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- Editorial Board appointments at the Journal of Contemporary Urban Affairs are made for a fixed term of three calendar years, after which each member will be contacted six months in advance to confirm their willingness to serve a further term; re-appointment is contingent on satisfactory performance, evidenced by timely peer-review activity, strategic engagement, and adherence to COPE principles. Editors who have been inactive—defined as failing to complete requested reviews or contribute to editorial duties over a twelve-month period without prior notice—will be deemed to have resigned and will be formally removed, with vacancies filled by new appointees who enhance the Board's disciplinary and geographic diversity.

- The Journal of Contemporary Urban Affairs does not retain honorary or inactive board positions—every member must remain actively engaged in editorial duties or relinquish their seat.

-All members of the Editorial Board serve in a voluntary (unpaid) capacity, with no financial compensation for their roles. Their participation reflects their academic commitment to the journal's mission.

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Aims and Scope

The Journal of Contemporary Urban Affairs is an international, peer-reviewed, open-access journal published biannually (June and December) by Alanya University. Responding to rapid urbanisation and widening socio-economic inequalities worldwide, the journal provides a platform for scholarly dialogue that transcends national and disciplinary boundaries. It prioritises innovative, interdisciplinary research that balances social and economic development with resilience in the built environment, critically examining how these forces shape today's urban landscapes.

The journal actively encourages internationally authored submissions and an equally international readership, welcoming robust empirical, theoretical, or mixed-method studies that explore urban transformations across diverse cultural, geographical, and socio-economic contexts. By fostering cross-regional academic exchange and comparative research, it aims to advance original scholarship, propose strategies to bridge global divides, and inform policy and practice. Ultimately, *The Journal of Contemporary Urban Affairs* strives to cultivate more inclusive, resilient, and sustainable cities worldwide.

Scope

The *Journal of Contemporary Urban Affairs* is dedicated to advancing interdisciplinary scholarship on the socio-economic factors shaping modern urban environments world-wide. We welcome contributions that explore, but are not limited to, the following core themes:

1. **Citizenship Rights and Responsibilities**

Investigating socio-economic impacts related to citizenship, including inequality, urban poverty, affordable housing, segregation, civic participation, social equity, welfare, health, accessibility, justice, and rights. *We particularly seek research highlighting economic vulnerabilities within urban communities and proposing actionable solutions to reduce inequality and enhance resilience.*

2. **Territorial Dynamics**

Examining the socio-economic implications of territorial changes, such as housing dynamics, urban migration, resource distribution, economic displacement, land speculation, economic clusters, heritage

preservation, and development constraints. *We encourage studies addressing economic disparities caused by shifting territorial patterns and offering strategies to strengthen local economies and mitigate inequities.*

3. **Urban Transformations**

Exploring the socio-economic consequences of urban change, encompassing development, planning, policy-making, transformation, resilience, regeneration, governance, investments, sustainable development, adaptive reuse, globalization impacts, smart cities, opportunities, and innovation. *We welcome inquiries that focus on economic resilience in evolving urban landscapes, presenting policies and frameworks that bolster economic stability and reduce socio-economic inequalities.*

Authorship Criteria

The *Journal of Contemporary Urban Affairs* adheres to the highest standards of publication ethics to ensure the integrity, originality, and scholarly value of all published work.

We do not accept:

- Simultaneous submissions
- Previously published material
- Redundant or duplicate publications

To safeguard academic integrity and relevance, manuscripts must:

- Be original and unpublished
- Demonstrate clear authorial contribution
- Employ rigorous and appropriate methods
- Align with the journal's scope and readership

In addition, all authors are expected to:

- Make a substantial contribution to the research
- Approve the submitted version of the manuscript
- Accept full accountability for every aspect of the work
- Disclose all potential conflicts of interest
- Acknowledge every source of funding and support
- Confirm that all required ethical approvals and participant consents have been obtained and reported
-Provide an accurate CRediT author-contribution statement detailing individual roles
-Make underlying data, code, and supplementary materials openly available (or justify any restrictions)
-Secure written permission for any copyrighted or third-party material reproduced in the manuscript
-Commit to post-publication responsibility, promptly informing the editors of any errors and cooperating with corrections or retractions when necessary.

Readership

JCUA is written for a global audience of:

- Academic researchers and graduate students in urban studies, architecture, planning, and cognate fields;
- Urban practitioners, policymakers, and non-governmental organisations seeking evidence-based guidance;
- Professionals in allied disciplines (engineering, public health, economics, cultural heritage) engaged with urban questions.

Editorial Vision

By embracing an international scope and positioning itself within established academic disciplines, the *Journal of Contemporary Urban Affairs* seeks to enhance global scholarly discourse on critical urban affairs. We encourage submissions employing quantitative, qualitative, or mixed methods, as well as interdisciplinary and comparative studies that shed light on best practices and challenges across different regions worldwide. Through this comprehensive approach, the journal aspires to be a leading outlet for

forward-thinking research that informs policy, guides practice on the socio-economic consequences of contemporary urbanization, and ultimately contributes to more equitable and sustainable urban environments. We invite contributions from the full range of disciplines within the social sciences and arts and humanities, including advanced empirical and theoretical work that addresses both positive and normative perspectives. Priority is given to research articles written for a multidisciplinary audience, demonstrating innovation, high quality, and significant impact. The journal also seeks articles that bridge theory and practice, offering insights relevant to policymakers, practitioners, and academics in urban planning, architecture, and related fields world-wide.

Scholarly Content Policy

Our journal is committed to publishing original scholarly material that contributes to the advancement of knowledge in its respective fields. We ensure that the research we publish meets the academic standards appropriate for a graduate, post-doctoral, and professional research audience. Submissions must present novel findings or insights, adhere to rigorous methodological standards, and be relevant to the interests of a global academic community.

for more information about publication policy please see Publication Policies , » Guidelines for Reviewers

Peer Review Statement

All research articles in this journal undergo a rigorous double-blind peer review process, starting with an initial evaluation by the editor, followed by double-blind reviews conducted by at least two expert referees. The purpose of peer review is to assist the editor in making editorial decisions, while also helping authors improve their manuscripts through feedback. In the double-blind process, neither reviewers nor authors are aware of each other's identities. The typical review period is 8 weeks.

- The selection of reviewers is at the discretion of the editor. Reviewers must be experts in the manuscript's subject matter, should not belong to the same institution as the authors, and must have no recent co-publications with them.
- Reviewers must disclose any conflicts of interest related to the research, authors, or funding sources to the editor without delay.
- Reviewers who feel unqualified to review a manuscript or cannot complete the review in a timely manner should notify the editor immediately.
- Reviews must be conducted objectively, avoiding personal criticism, and reviewers should clearly express their opinions with reasoned arguments.
- Manuscripts under review should be treated as confidential.

The Peer Review Process

Authors submit manuscripts via the online submission system, and they receive confirmation of receipt from the editorial office. The Chief Editor first reviews the manuscript, often with the help of Section Editors (or Co-/Associate Editors). A Section Editor oversees the manuscript through the entire review process and provides a recommendation or decision.

Initially, the manuscript is assessed for its alignment with the journal's scope and its adherence to formal requirements. If found unsuitable, it is directly rejected, and a rejection letter is sent to the author explaining the reasons. If the manuscript meets the journal's scope and guidelines, it is sent for peer review. Reviewers evaluate the manuscript and submit their reports to the Editor-in-Chief, who then makes one of the following decisions based on the feedback:

- Accept without revisions
- Accept with revisions
- Request a resubmission
- Reject

In case of acceptance, the final manuscript is sent to production. Authors may also be asked to revise their manuscript based on reviewers' comments and resubmit it for further evaluation. Review times vary between 4 to 8 weeks, depending on the discipline and additional information required. If rejected, the manuscript is archived, and a rejection letter is sent to the authors. Reviewers may be informed of the final decision.

Once the review process is completed, the manuscript is passed to the Copy Editor, who ensures that it adheres to the correct referencing style and journal formatting. The Layout Editor then prepares the manuscript, including figures and tables, for publication in formats such as PDF and HTML. Finally, the Proof Editor confirms that the manuscript is ready for publication after completing all the necessary stages. The reviewers of a manuscript remain anonymous to each other, and in cases where their decisions differ (accept/reject), the editor may assign additional reviewers. The editorial team ensures that reviews meet high standards of quality. If authors raise concerns about the objectivity of a review, the team takes special care to ensure the review's fairness and quality. When necessary, additional reviewers are assigned to maintain objectivity and academic rigor. The manuscript submission and the peer review process are broken down into the following steps:

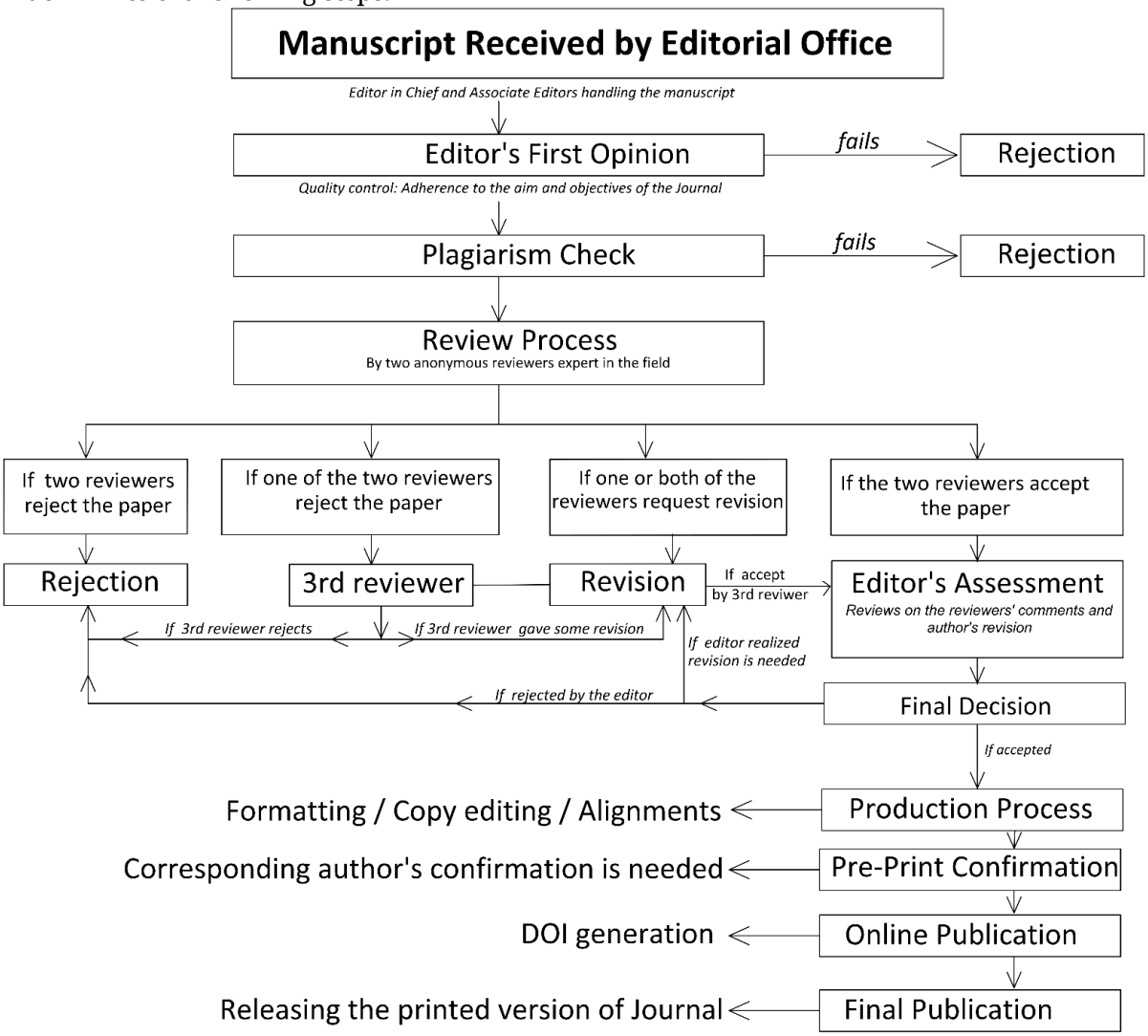

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Figure 1. Peer Review Process.

CrossCheck Plagiarism Screening System

All manuscripts submitted to the Journal of Contemporary Urban Affairs will undergo plagiarism screening using iThenticate's plagiarism detection tools. Any manuscripts found to contain instances of plagiarism or self-plagiarism will be promptly rejected.

What is plagiarism?

Plagiarism occurs when someone uses the ideas, words, or other intellectual property of others, whether published or unpublished, without appropriate credit or permission, and presents them as their own original work. This misleads readers about the true contributions of the plagiarist. Plagiarism can involve content from abstracts, research proposals, institutional submissions, or any other form of unpublished or published materials, and it is considered scientific misconduct.

Self-Plagiarism

Self-plagiarism involves an author reusing portions of their prior work in new publications without proper citation. While this practice, often unintentional, is common—particularly in sections such as the methods—it typically violates copyright agreements with publishers. Unlike plagiarism of others' work, self-plagiarism is not always regarded as scientific misconduct, and policies on this practice may vary among journals. If a journal has a policy on self-plagiarism, it should be clearly communicated to authors.

Types of Plagiarism

Direct plagiarism refers to the uncredited copying of text, while mosaic plagiarism involves borrowing ideas or opinions, along with some phrases or words, without giving proper attribution.

Reporting Plagiarism

In cases of suspected plagiarism, the following steps should be followed:

1. Notify the editor of the journal where the plagiarized article is published.
2. Submit both the original and plagiarized articles with the plagiarized sections clearly marked.
3. If the evidence is sufficient, the editor will arrange a disciplinary hearing.
4. The accused plagiarist will be asked for an explanation.
5. If no response is received within the specified time or the explanation is unsatisfactory, the article will be permanently retracted.
6. The author responsible will be banned from submitting to that journal for at least five years.
7. The head of the relevant institution will be informed.

Copyright and Permissions

Authors are responsible for ensuring that their submission does not violate copyright or ownership rights, such as for figures, tables, photographs, and other data. Authors must obtain and include permissions for any copyrighted material in their final submission and inform the editorial office and publisher when usage restrictions apply. Acknowledgements for such materials should be added in a dedicated section at the end of the paper, clearly crediting the source and copyright.

Adapted from: Bella H. Plagiarism. Saudi J Med Sci 2014; 2:127

Publication Ethics and Malpractice Statement

The Journal of Contemporary Urban Affairs is dedicated to maintaining the utmost standards of ethics in publishing and takes into consideration the guidelines for transparency and excellence in scholarly publishing established by the Committee on Publication Ethics (COPE), the Directory of Open Access Journals (DOAJ), and the Open Access Scholarly Publishers Association (OASPA).

Editorial Procedures

Fair play

At the *Journal of Contemporary Urban Affairs*, we are committed to ensuring that all manuscripts are assessed exclusively based on their intellectual merit, scholarly rigor, and overall contribution to the field. Submissions are reviewed through a fair and transparent process that emphasizes methodological soundness, clarity, and originality. We firmly uphold the principle that an author's age, gender, ethnicity, sexual orientation, nationality, or political beliefs must not influence editorial decisions, thereby promoting an inclusive and respectful academic community.

Submission and Acceptance Guidelines

We provide detailed submission guidelines that outline our requirements for manuscript preparation, formatting, referencing, and ethical considerations. Authors must adhere to these guidelines to facilitate a smooth review process. Our acceptance criteria are transparent and consistently applied, focusing on the quality, relevance, and integrity of the research. We enforce ethical standards uniformly, including policies on plagiarism, data fabrication, and conflicts of interest.

Content Relevance and Scope Alignment

The *Journal of Contemporary Urban Affairs* is committed to publishing high-quality, original research that significantly contributes to the field of urban studies. To maintain the journal's thematic integrity and ensure that readers receive relevant and focused content, all submitted manuscripts must align with the journal's stated aims and scope. Manuscripts that fall outside the journal's scope will not be considered for review. To see the Aims and Scope of the journal please click here.

To ensure alignment with the journal's scope, all submissions must meet the following criteria:

1. **Thematic Relevance**: The manuscript must address contemporary urban issues and align with the journal's focus areas.
2. **Originality**: The research must present original findings, insights, or theoretical contributions that advance the field of urban studies.
3. **Methodological Rigor**: The study should employ robust and appropriate research methods, with clear explanations of data collection, analysis, and interpretation.
4. **Practical or Theoretical Significance**: The manuscript should demonstrate how the research contributes to urban theory, policy, or practice.
5. **Clarity and Coherence**: The manuscript must be well-written, logically structured, and accessible to an interdisciplinary audience.

Submissions that do not meet the scope and relevance criteria will be desk-rejected without proceeding to peer review. Authors will be notified of the decision with an explanation. To ensure your manuscript meets the journal's formatting and submission requirements, please refer to the detailed Manuscript Preparation Guidelines available at the following link: Manuscript Preparation Guidelines

For further inquiries about scope alignment or submission suitability, please contact the Editorial Office at editor@ijcua.com.

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The Journal of Contemporary Urban Affairs upholds complete editorial independence, ensuring that all editorial decisions are made solely based on scholarly merit, methodological rigor, and relevance to the journal's scope. Although the journal is owned by Alanya University, the editorial process operates independently from institutional influence, financial considerations, or external pressures. The Editor-in-Chief and the Editorial Board have full authority over the selection, review, and publication of manuscripts, following COPE's guidelines on editorial integrity. Any attempts to interfere with editorial decisions will be formally addressed to maintain the transparency, credibility, and autonomy of the journal.

Editorial Decisions and Appeals

Our editorial decisions are made based on objective criteria and are communicated transparently to authors. Each decision—whether acceptance, revision, or rejection—is accompanied by constructive feedback from editors and reviewers.

Authors have the right to appeal editorial decisions if they believe a review contained factual errors, biased evaluations, or misinterpretations of their research. Appeals must be submitted in writing within 14 days of receiving the editorial decision and must include:

1. **A formal appeal letter** outlining the specific concerns regarding the decision.
2. **A point-by-point response** addressing the reviewers' comments, supported by evidence or references.
3. **Any additional clarifications** that may help the editorial board reassess the manuscript.

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- The outcome of the appeal may result in one of the following decisions:
    - **Uphold the original decision** (rejection remains final).
    - **Invite the authors to submit a revised version** for further review.
    - **Reassign the manuscript to new reviewers** for an additional evaluation.

The final decision on an appeal is made by the Editor-in-Chief in consultation with the Editorial Board and is binding. Authors will be notified of the final decision via email, and no further appeals will be considered after this point.

Editorial and Reviewer Accountability Policy

The Journal of Contemporary Urban Affairs is committed to maintaining transparency, fairness, and accountability in all editorial decisions. Editors and reviewers are expected to evaluate submissions based on scholarly merit, methodological soundness, and relevance to the journal's scope, avoiding subjective biases or personal preferences. To ensure accountability, all editorial decisions are regularly reviewed by the Editor-in-Chief and the Editorial Board. If concerns arise regarding an editor or reviewer's consistent rejection or acceptance of papers based on non-academic criteria, the matter will be formally investigated, and corrective actions—such as reassignment of manuscripts or removal from editorial duties—may be taken. This policy aligns with COPE's ethical guidelines to uphold the integrity and credibility of the peer review process.

Multiple Submissions

The Journal of Contemporary Urban Affairs upholds strict standards against multiple submissions and redundant publications. We do not consider manuscripts that are under review at another publication simultaneously, nor do we accept manuscripts that substantially duplicate content published or submitted

elsewhere. Authors must confirm that their submission is exclusive to this journal and is not being considered elsewhere, ensuring a fair and thorough peer-review process and contributing to the timely and ethical publication of research. Authors are required to ensure that their submitted work is original and has not been published previously in any other journal, book, or conference proceedings. This policy preserves the integrity of published research and provides readers with unique, original contributions to urban studies. By submitting to the journal, authors affirm that their work is original and not under consideration elsewhere.

Submissions that contravene this policy may be rejected immediately. Any instances of multiple submissions or redundancy will be addressed in accordance with the journal's ethical guidelines. Authors are encouraged to comply fully with this policy to uphold the high standards of academic publishing and to support the dissemination of unique, rigorously vetted research.

Policy on Rejecting Unethical or Low-Rigor Submissions: The *Journal of Contemporary Urban Affairs* reserves the right to decline or withdraw any manuscript—at initial screening, during peer review, or even after provisional acceptance—if it is found to breach ethical standards (e.g., plagiarism, fabricated data, undisclosed conflicts of interest) or to fall below the journal's methodological and scholarly thresholds. Editorial decisions to reject on these grounds are guided by COPE Core Practices, documented for transparency, and communicated promptly to authors with a clear rationale; if issues are discovered post-publication, the journal will issue a correction or retraction in line with its Retraction and Correction Policy.

Section Policies

Original Research:

Open Submissions Indexed Double-blind peer review

Review Articles:

Open Submissions Indexed Double-blind peer review

Studies and articles:

Open Submissions Indexed Double-blind peer review

Case Studies:

Open Submissions Indexed Double-blind peer review

Monographic studies:

Open Submissions Indexed Double-blind peer review

Book Reviews:

Open Submissions Indexed Double-blind peer review

Resolving Inconsistencies

In the case that an author has serious and reasonable objections to a review, the Editorial team makes an assessment of whether the said review is objective and whether it meets academic standards. If there is doubt about the objectivity or quality of the review, the Editor-in-Chief will assign an additional reviewer(s).

Additional reviewers may also be assigned when reviewers' decisions (accept or reject) are contrary to each other or are otherwise substantially incompatible.

Publishing Schedule

The *Journal of Contemporary Urban Affairs* publishes two issues each year, in **June** and **December**. Accepted papers are first published online as early-access articles before being compiled into the complete issue.

Manuscripts may be submitted at any time via our online portal. However, to be considered for rigorous peer review, editorial quality checks, and the production process for the upcoming issue, submissions must be received no later than three calendar months before the publication date (i.e. by 30 March for the June issue and 30 September for the December issue). This timeline ensures adequate time for a thorough evaluation and high-quality publication.

Ethical Standards and Research Integrity

Ethical Standards and Anti-Bias

We are committed to upholding the highest standards of **editorial integrity and fairness**. Our editorial team and reviewers are required to disclose any potential conflicts of interest and to treat all submissions impartially. Decisions are based solely on scholarly merit and relevance to the journal's scope, without discrimination based on authors' race, gender, sexual orientation, religious belief, ethnic origin, citizenship, or political philosophy. We enforce ethical practices consistently across all submissions.

Commitment to Diversity, Equity, and Inclusion (DEI)

Author Name-Change Policy

The *Journal of Contemporary Urban Affairs* is committed to fostering an inclusive and equitable publishing environment. We recognize that authors may need to change their name on previously published articles for various reasons, including gender affirmation, marriage, or divorce. To support author autonomy and comply with equality and diversity policies, we offer a discreet and straightforward process for updating author names on published works. Upon request, we will update the author's name on the article's PDF and HTML versions, as well as the associated metadata supplied to indexing services, without requiring documentation or publishing a public correction notice, unless explicitly requested by the author.

Authorship and Contributor Order

The *Journal of Contemporary Urban Affairs* adheres to the principle that authorship credit should be based on substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; or the creation of new software used in the work; or has drafted the work or revised it critically for important intellectual content; and has approved the final version to be published; and agrees to be accountable for all aspects of the work. While the first author is typically considered the primary contributor, author order is ultimately determined by mutual agreement among the co-authors, reflecting their respective intellectual contributions to the research. In cases where two or more authors have contributed equally to the work, this should be clearly stated in the acknowledgements or a dedicated "CRediT" section within the manuscript, and authors may, by mutual agreement, choose their presentation order, often indicated by a prominent footnote or symbol next to their names. All authors are expected to confirm their individual contributions in line with the CRediT (Contributor Roles Taxonomy) system if applicable to their submission type.

Geographical Diversity & Global South / Emerging Hubs Engagement Policy

The *Journal of Contemporary Urban Affairs* is committed to amplifying scholarly voices from the Global South and other **emerging research hubs**; accordingly, we run periodic themed calls for papers on region-specific urban challenges, offer targeted outreach webinars and manuscript-development workshops, and maintain a geographically balanced Editorial Board with representation from Africa, Asia, Latin America, and the Middle East to ensure culturally informed handling of submissions. Although the journal charges no publication fees, we additionally prioritise rapid, supportive peer review and, where needed, language-editing assistance for authors whose first language is not English. We monitor annual statistics on submissions, acceptances, and published content by world region to gauge progress and refine our initiatives, thereby fostering an inclusive, globally representative discourse aligned with the scope of the journal.

Gender Equity and Inclusion Policy

The *Journal of Contemporary Urban Affairs* is dedicated to promoting gender balance across all facets of its operations, including authorship, peer review, and its editorial board, as a fundamental component of its broader Diversity, Equity, and Inclusion (DEI) commitment. We actively strive to ensure fair representation and equitable opportunities for all genders, recognizing that diverse perspectives strengthen scholarship and contribute to a more comprehensive understanding of urban issues. Our ongoing efforts include monitoring the gender representation among our contributors and editorial teams, encouraging submissions from and inviting reviewers and editors of underrepresented genders in urban studies, and actively working to mitigate unconscious bias throughout the publication process.

Disclosure and conflicts of interest

Conflicts of interest, also known as competing interests, arise when external factors might influence the impartiality or objectivity of the research or its evaluation. Transparent disclosure of any potential conflicts allows others to make informed decisions regarding the research and its review process. Common types of conflicts of interest include:

- Financial
- Affiliations
- Intellectual Property
- Personal
- Ideological
- Academic

All authors must explicitly disclose any real or potential conflicts of interest related to the submitted work. This includes, but is not limited to, financial support, employment, consultancies, stock ownership, honoraria, paid expert testimony, patents, or relationships with organizations that may benefit or be harmed by the research findings. Authors are required to include a clearly stated "Conflict of Interest" section at the end of their manuscript, preceding the References section. This section should provide a concise summary of any relevant conflicts. If no conflicts exist, the statement should explicitly declare "The authors declare that there are no conflicts of interest."

Reviewers and editors must recuse themselves from handling or assessing manuscripts in which they have any conflicts of interest that could compromise their impartiality.

Data Fabrication and Falsification

At our journal, we uphold the highest standards of academic integrity and research ethics. We strictly adhere to the **Committee on Publication Ethics (COPE) guidelines** regarding data fabrication and falsification. Any instance of misconduct will be thoroughly investigated, and appropriate actions will be taken to maintain the integrity of the scholarly record.

Data Fabrication refers to the intentional creation of non-existent data or research results without having conducted any actual experiments, observations, or data collection. Data Falsification involves manipulating research materials, equipment, processes, or altering, omitting, or modifying data to misrepresent research findings. This includes selective reporting and deceptive image or figure manipulation.

Prohibited Practices: We reserve the right to **reject, retract, or report** any manuscript found to involve:

- Fabrication or falsification of research data, images, figures, or experimental outcomes.
- Plagiarism, including self-plagiarism (text recycling) and unauthorized use of others' work.
- Submission of the same manuscript to multiple journals simultaneously (redundant publication).
- Salami slicing, where a single study is fragmented into multiple papers to increase publication count.
- Citation manipulation, including excessive self-citation, coercive citation practices, or citation stacking to inflate metrics.

- Improper authorship practices, such as ghost authorship, gift authorship, or denial of rightful authorship.

If data fabrication, falsification, or any form of misconduct is confirmed, the journal may:

- Reject or retract the paper (if already published).
- Notify the author's institution and relevant funding bodies about the misconduct.
- Place a submission ban on the authors for a defined period.
- Report the violation to COPE and other indexing databases to uphold academic integrity.

Policy of Screening for Plagiarism

All papers submitted to the *Journal of Contemporary Urban Affairs* will undergo a plagiarism check using the iThenticate software, part of the CrossCheck Plagiarism Screening System. Any papers found to contain plagiarism or self-plagiarism will be immediately rejected. The journal is committed to upholding the highest standards of academic integrity and expects all submissions to be original works of the authors. Proper citation and acknowledgment of sources are mandatory. Authors are responsible for ensuring that their manuscripts are free from any form of plagiarism, including duplicate publication of their own previous work without proper citation. The journal reserves the right to report any instances of plagiarism to the authors' institutions and relevant authorities. By submitting a manuscript, authors agree to these terms and acknowledge that failure to comply may result in sanctions.

Policy on Academic–Practitioner Co-authorship

The *Journal of Contemporary Urban Affairs* actively encourages manuscripts co-authored by researchers and practising professionals (e.g., planners, architects, policymakers, community organisers, industry consultants) to enhance the practical relevance and societal impact of published work. Submissions that demonstrate genuine collaboration—evidenced through shared conception, data collection, analysis, and joint authorship contributions—are prioritised, provided they meet the journal's rigorous scholarly standards. Authors should indicate practitioner affiliations clearly and outline, in the CRediT Author Contribution Statement, how academic and practitioner insights were integrated to address real-world urban challenges or inform policy and design practice.

Policy on Ethical Committee Approval

Our journal adheres to COPE's ethical guidelines, including policies on consent for publication, protection of vulnerable populations, ethical treatment of animals and human subjects, handling confidential information, and responsible business practices. For studies requiring ethical committee approval, authors must provide detailed information about the approval, including the name of the ethical committee, the date of approval, and the approval number. This information must be explicitly stated in:

1. **The Methodology Section**: Include the ethical approval details as part of the description of the study's methods.
2. **The First and Last Page of the Manuscript**: Clearly mention the ethical approval details for transparency.

This statement must appear at the end of the manuscript—under the heading "Institutional Review Board Statement" and **before** the references section. Authors may choose one of the following scenarios relevant to your study (and adjust the details as needed):

-This study received ethical approval from [**Committee Name**], approval number [**Number**], dated [**Date**].

-This study did not require ethical approval as it does not involve human or animal subjects.

-Ethical approval was not applicable to this study in accordance with [**specific guideline or reason**].

-All procedures followed ethical standards and were conducted in compliance with institutional and national regulations.

Data Sharing and Reproducibility

We follow the FAIR Principles (Findability, Accessibility, Interoperability, and Reusability) for data sharing. If authors do not provide access to raw data without a valid reason, their article may be rejected. All submissions must include a Data Availability statement, even if there is no data included.

Retrospective Ethical Review Policy

The Journal of Contemporary Urban Affairs follows the Committee on Publication Ethics (COPE) guidelines regarding retrospective ethical approval. Retrospective ethical approval refers to cases where a study was conducted without prior ethics committee approval, and authors seek approval after the research has been completed. As a general policy, the journal does not accept retrospective ethical approvals, as ethical oversight should be obtained before research begins to ensure compliance with ethical standards, particularly in studies involving human or animal subjects. However, in exceptional cases where authors can demonstrate that ethical standards were followed despite the lack of prior approval, the Editor-in-Chief and the Editorial Board will assess the study on a case-by-case basis. Authors must provide a formal statement from their institution's ethics committee acknowledging that the study aligns with ethical principles and would have been approved under current guidelines. The journal reserves the right to reject submissions that fail to meet these requirements, ensuring that all published research upholds the highest ethical standards.

Policies on the Use of AI

The Journal of Contemporary Urban Affairs follows COPE guidelines in these matters, and authors are encouraged to consult the Committee on Publication Ethics (COPE) resources for further guidance. As stated by COPE, authors remain fully responsible for all content in their manuscripts, including any portions influenced by AI tools, and are accountable for any breaches of publication ethics.

For Authors:

AI or AI-driven large language models (e.g., NovelAI, Jasper AI, DALL-E, ChatGPT, Rytr AI) cannot be credited as authors or co-authors under any circumstances, as they lack the capacity for responsibility and accountability required of human contributors. All intellectual content, including that refined or developed with AI assistance, must be validated and overseen by the human authors, ensuring the manuscript's integrity and ethical compliance.

AI may be employed to improve the clarity, fluency, and readability of the manuscript's text, helping to refine language, resolve grammatical errors, and enhance overall presentation.

Any use of AI—whether for language editing, conceptual refinement, or other non-authorial support—must be transparently acknowledged in the Acknowledgements section. Authors must clearly state how AI was utilized and confirm that final content has been verified by the authors themselves in accordance with COPE guidelines.

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The Journal does not accept images produced solely by AI due to unsettled legal, ethical, and copyright concerns. AI-based enhancements to pre-existing images or visuals must be fully disclosed so that editors and readers can assess the nature of the modifications. In rare cases, when AI-generated imagery is integral to the research itself (e.g., studies examining AI image generation methods), such content may be considered, provided it is clearly labeled as AI-generated and ethically sourced, and that it meets all applicable legal and copyright standards.

AI Use by Reviewers:

Peer reviewers must not share or upload any part of a manuscript to generative AI platforms, thus maintaining strict confidentiality and data protection.

Manuscript Withdrawal by the Authors

Authors have the right to withdraw their manuscript from the Journal of Contemporary Urban Affairs at any stage before final publication. To request withdrawal, the corresponding author must submit a formal

written request to the editorial office, stating the manuscript title, submission ID, and reason for withdrawal. The request will be processed within seven working days, and once approved, the manuscript will be removed from the editorial system. Withdrawal after peer review or acceptance is discouraged unless there are compelling reasons, such as ethical concerns or significant errors. Authors should note that once a manuscript is published online, it cannot be withdrawn, and any necessary corrections or retractions will follow the journal's Retraction & Correction Policy, in line with COPE guidelines.s.

Peer Review Process

Peer Review Statement

At the *Journal of Contemporary Urban Affairs*, every submitted manuscript undergoes a rigorous double-blind peer review process. We apply consistent review criteria to all submissions, evaluating them based on originality, relevance to contemporary urban issues, methodological rigor, clarity of presentation, and contribution to the field. Our reviewers follow standardized guidelines to ensure each manuscript is assessed fairly and thoroughly, without bias or favoritism. For details on the journal's Peer Review Statement, please visit the following link: https://www.ijcua.com/ijcua/reviewing-procedure

Author and Reviewer Communication

We ensure consistent and professional communication with authors, reviewers, and editorial board members. Our correspondence follows standardized templates that provide clear instructions, expectations, and updates throughout the submission and review process. Feedback to authors is constructive and detailed, aiming to assist in improving their work. We are committed to prompt responses and transparent communication to foster a collaborative and respectful publishing environment.

Publication and Post-Publication Policies

Citation Policies

The *Journal of Contemporary Urban Affairs* adheres to the best practices outlined by the Committee on Publication Ethics (COPE) regarding citation manipulation. We define citation manipulation as the inclusion of references that do not contribute to the scholarly content of the article and are added solely to increase citation counts for personal gain. This includes excessive self-citation, excessive citation to the journal publishing the article, and coordinated excessive citation between journals. Such practices violate publication ethics and are strictly prohibited.

Authors must ensure that all citations are relevant and contribute meaningfully to their work. Legitimate self-citations that address valid academic needs are acceptable. However, any form of manipulative citation will result in immediate rejection of the manuscript and may lead to further penalties, such as reporting to the authors' institutions or relevant authorities. The journal reserves the right to take appropriate action to uphold the integrity of the academic record. For more details, you can check their recommendations here: https://doi.org/10.24318/cope.2019.3.1

Retraction and Correction Policy

Our journal is committed to maintaining the highest standards of scholarly integrity. We recognize that errors, oversights, or misconduct can compromise the accuracy of the academic record. This policy outlines the procedures for addressing flawed, fraudulent, or otherwise compromised publications, ensuring transparency and trust in the scientific record. An article may be considered for retraction if:

1. **Evidence of Fraud or Misconduct**: Data fabrication, data falsification, plagiarism, unethical research practices, or other forms of misconduct are discovered.
2. **Serious Errors**: Errors in methodology or results that significantly undermine the reliability or validity of the research findings.
3. **Duplicate Publication**: If the article has been published elsewhere without proper authorization or disclosure.

4. **Breach of Ethical Standards**: Violation of ethical guidelines, including issues related to consent, confidentiality, or conflicts of interest that invalidate the research.

Retraction Process:

1. **Investigation Initiation**
    - Investigations may be triggered by authors, readers, reviewers, editorial board members, or other concerned parties who provide credible evidence of misconduct or major errors.
    - The Editor-in-Chief (or an appointed committee) will perform an initial review of the complaint or evidence.
2. **Inquiry and Evaluation**
    - The Editorial Office requests any necessary documentation from the authors, reviewers, or relevant institutions.
    - The Editor-in-Chief consults with subject matter experts or members of the Editorial Board for an unbiased evaluation of the evidence.
3. **Decision and Communication**
    - If the investigation confirms misconduct or major flaws, the Editor-in-Chief will decide to retract the article, possibly in consultation with the Editorial Board.
    - A written notice outlining the findings and the decision is sent to all involved authors, giving them an opportunity to respond or appeal within 14 days.

Retraction Notice:

The retraction notice will clearly state the reason for the retraction (e.g., data falsification, major errors) and reference the original article. It will be written to avoid defamatory or accusatory language, focusing on factual statements. The retraction notice will:

- Appear in the next available issue and on the journal's website.
- Be prominently linked to the retracted article (PDF and HTML versions).
- Clearly mark the article as "Retracted" in all publicly accessible places where the article metadata is displayed.

Corrections and Errata:

1. **Minor Corrections (Errata)**
    - If an error does not compromise the overall findings or interpretations (e.g., minor typographical errors, mislabeled figures), the journal will publish a **Correction** or **Erratum**.
    - The Correction will be linked to the original article and be clearly labeled.
2. **Major Corrections**
    - If errors significantly affect specific parts of the article but do not invalidate the entire research, a **Corrigendum** may be issued. This corrigendum will include a detailed explanation of the corrections and how they affect the research conclusions.

Expression of Concern:

If a significant allegation of research misconduct or a major error comes to light but conclusive evidence is not yet available (e.g., ongoing institutional investigation), the journal may publish an Expression of Concern. This serves to:

- Alert readers of a potential issue with the article.
- Indicate that an official investigation is underway.

Once the investigation concludes, the Expression of Concern may be replaced with a Retraction Notice or a Correction, depending on the outcome.

Article Removal:

In rare instances (e.g., legal infringement, defamation, extremely high risk of harm if the information remains accessible), the journal may remove the article's text from the online platform. A statement will be published in its place explaining the reason for the removal, in line with best ethical practices and applicable legal requirements.

Follow-up and Indexing

-We will promptly communicate retractions or corrections to indexing databases so that all records accurately reflect the article's status.

-Retractions, corrections, or expressions of concern remain part of the permanent publication record to maintain transparency.

-Any editorial board member with a conflict of interest regarding a suspected article will recuse themselves from the investigation. Authors have the right to appeal retraction decisions. Appeals must be submitted in writing, detailing specific reasons and additional evidence. The Editorial Office will re-evaluate the case with impartial advisors.

Note: Our retraction policy follows the Committee on Publication Ethics (COPE) recommendations and guidelines.

Post-publication Discussions

The Journal of Contemporary Urban Affairs encourages discussion and debates regarding its published articles through letters to the editor or on an external moderated platform such as PubPeer. PubPeer is a platform that facilitates the evaluation and discussion of scientific research after it has been published. The journal follows the guidelines set by the Committee on Publication Ethics (COPE) regarding post-publication discussions and corrections.

CrossMark Policy

For details on the journal's CrossMark Policy, please visit the following link: https://doi.org/10.25034/crossmarkpolicy

Access, Licensing, and Archiving

Open Access Policy

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For details on the journal's Repository Policy, please visit the following link: https://ijcua.com/ijcua/repository-policy

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The Journal of Contemporary Urban Affairs allows authors to self-archive their submitted, accepted, and published versions of their articles without embargo. Authors may deposit their work in institutional repositories, personal websites, academic social networks (e.g., ResearchGate, Academia.edu), and departmental websites at any time. The final published version (Version of Record) must include a full citation and a link to the original article on the journal's website. This policy is registered in SHERPA/RoMEO and ensures compliance with open-access standards, enabling wider dissemination of

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-There are no membership fees in the Journal of Contemporary Urban Affairs.
-There are no language editing fees in the Journal of Contemporary Urban Affairs.
-The authors are not charged for including coloured photos or extra pages in their papers.

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The Journal of Contemporary Urban Affairs assigns a unique Digital Object Identifier (DOI) to each article that successfully passes the initial screening and reaches the production stage. DOIs ensure permanent accessibility, citation tracking, and seamless integration into academic databases, enhancing the visibility and credibility of published research. All assigned DOIs are registered with CrossRef, allowing authors, researchers, and institutions to reference and retrieve published articles reliably. This policy aligns with international best practices for academic publishing, ensuring long-term digital preservation and accurate citation indexing.

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Policies on Intellectual Property

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Administration and Transparency

Investigations and Complaints Policy

The *Journal of Contemporary Urban Affairs* is committed to maintaining research integrity and adheres to COPE guidelines for addressing ethical concerns, research misconduct, and formal complaints.

1. **Reporting Ethical Concerns and Allegations**

Any concerns regarding ethical violations, research misconduct, or breaches of publication ethics should be reported to the editorial office of the journal. Reports can be submitted anonymously through secure services like ProtonMail or TorGuard. The journal may request raw data, images, or supporting documentation from authors, seek expert editorial advice, or contact relevant institutions to conduct investigations.

2. **Complaint Handling Process**

The journal takes all complaints seriously and follows a structured process to investigate and resolve issues fairly and transparently. We maintain records of the following types of complaints:

- Authorship disputes
- Plagiarism and duplicate publication
- Misappropriation of research results
- Research errors and fraudulent data
- Violations of research ethics and standards
- Undisclosed conflicts of interest

Complaints should be submitted via email to **editor@ijcua.com** with full details. The journal will investigate each case thoroughly and notify the complainant of the **final decision**. If necessary, further actions—such as retraction, correction, or institutional reporting—will be taken to uphold academic integrity. For more information, see Allegations of Misconduct.

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The Journal of Contemporary Urban Affairs is committed to protecting your personal information and respecting your privacy. Any personal details you provide to us, such as your name and email address, will be kept confidential and used solely for the intended purposes of this journal. We assure you that any information collected will be handled in accordance with this privacy statement.

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General Repositories

If subject-specific or institutional/funder repositories are unavailable, authors can use general repositories to share their data such as:

Repository Name	Information on costs	URL
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- Figshare	Fees apply	Visit the website
-Harvard Dataverse	Contact repository for datasets over 1 TB	Visit the website
Open Science Framework	Free of charge	Visit the website
Science Data Bank	Free of charge	Visit the website
Zenodo	Donations towards sustainability encouraged	Visit the website

Our journal follows COPE's guidelines on "data sharing and reproducibility". For more information in this regard please see: https://publicationethics.org/topic-discussions/data-sharing

ORCID Number

The journal strongly suggests that all authors submitting a paper obtain an Open Researcher and Contributor Identifier (ORCID) account. ORCID registration provides a unique and permanent digital identifier for the author, which enhances the discoverability of their published work and ensures that proper credit is given to the correct author. The ORCID remains unchanged, even if the author's name, affiliation, or research field changes, ensuring that their past work remains easily discoverable and making it easier to correspond with colleagues. The journal strongly encourages the corresponding authors to include their ORCID in their submission information and suggests that co-authors do the same. The ORCID should be included in the author's information at the time of submission, and if the paper is accepted, it will be published along with the submission.

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Note: The Journal of Contemporary Urban Affairs and its publisher and editorial board follow the guidelines set by COPE in handling any accusations.

Duties

Duties of Editors

The Journal of Contemporary Urban Affairs recognizes and takes into consideration the following potential sources of conflict when evaluating and publishing articles: personal conflicts, financial conflicts, non-financial conflicts, submission by an editor, submission from the same institution, personal relationships, political or religious beliefs, submission by a family member of the editor(s), or by an author whose relationship with the editor(s) may give rise to the appearance of bias. Our publisher and editors are committed to publishing corrections, clarifications, retractions, and apologies as necessary. Our journal follows COPE's guidelines on the "Code of conduct for journal editors". For more information in this regard please see: https://publicationethics.org/media/609/download?attachment

Below are the detailed responsibilities of our editorial team:

Editorial Role	Key Responsibilities	COPE Compliance Highlights
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	blind review process. • Investigates plagiarism, authorship disputes, data fabrication, and conflicts of interest. • Leads and appraises the editorial team.	declarations from editors, reviewers, and authors.
Managing Editors	• Screens submissions for scope fit, plagiarism, and formatting. • Coordinates reviewers via Section Editors / Coordinators and tracks deadlines. • Communicates editorial decisions and reviewer comments to authors. • Oversees the entire submission-to-production workflow.	• Implements and enforces double-blind review. • Detects duplicate submissions and ethical breaches. • Maintains strict confidentiality throughout peer review.
Academic Editors	• Provide in-depth scholarly evaluations or select subject experts for review. • Assess methodological rigour and contribution to urban studies. • Recommend acceptance, revision, or rejection to the EIC. • Flag citation manipulation or other unethical research practices.	• Declare any COIs before reviewing. • Report suspected misconduct (e.g., data falsification) directly to the EIC.
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Editorial Advisory Board	• Advise on international best practice in urban-studies publishing and journal strategy. • Identify emerging research trends. • Occasionally review submissions or recommend reviewers. • Champion JCUA within academic networks. • Assist the EIC with complex ethical dilemmas.	• Uphold ethical standards and support resolution of serious ethical cases alongside the EIC.
Production & Support Team	• **Copy / Layout Editors:** ensure manuscripts follow journal style and layout. • **Proof Editors:** check final proofs for accuracy and consistency. • **Site Administrators:** maintain submission platform uptime and accessibility.	• Preserve authors' voice while editing. • Monitor for text recycling or undisclosed overlap and alert the EIC.

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The term "authorship" can refer to either the originator of an idea, such as the person who created the theory of relativity, or the individuals responsible for executing and disseminating intellectual or creative works. To address this, the Committee on Publication Ethics (COPE) offers crucial resources for authors, policy guidance for editors, clarification on the scope of submission guidelines, tools for resolving pre- and post-publication authorship disputes, and guidance for institutions to maintain and support the integrity of authorship. Our journal follows COPE's guidelines on authorship. For additional information, please refer to COPE's Discussion Document on Authorship.

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- Offer unbiased feedback supported by clear arguments and evidence.
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Aims and Scope

The Journal of Contemporary Urban Affairs is an international, peer-reviewed, open-access journal published biannually (June and December) by Alanya University. Responding to rapid urbanisation and widening socio-economic inequalities worldwide, the journal provides a platform for scholarly dialogue that transcends national and disciplinary boundaries. It prioritises innovative, interdisciplinary research that balances social and economic development with resilience in the built environment, critically examining how these forces shape today's urban landscapes. The journal actively encourages internationally authored submissions and an equally international readership, welcoming robust empirical, theoretical, or mixed-method studies that explore urban transformations across diverse cultural, geographical, and socio-economic contexts.

By fostering cross-regional academic exchange and comparative research, it aims to advance original scholarship, propose strategies to bridge global divides, and inform policy and practice. Ultimately, The Journal of Contemporary Urban Affairs strives to cultivate more inclusive, resilient, and sustainable cities worldwide.

***Important Note**: Submitted articles must be consistent with the title and stated scope of this journal. Any submitted article outside the focus of the journal will receive a desk rejection.*

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Original scientific paper

Comprehensive Evaluation of Urban Renewal Based on Entropy and TOPSIS Method: A Case of Shandong Province

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ABSTRACT

This study offers a comprehensive evaluation of urban renewal efforts in Shandong Province, China, by employing the entropy method combined with the Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS). An evaluation index system was constructed to assess the weights of key factors influencing urban renewal, including the renovation of old residential areas, improvement in sewage treatment quality, development of sponge cities, adoption of clean heating, and enhancement of air quality. Analysis of 16 prefecture-level cities in 2019 reveals significant disparities in performance, with Jinan achieving the highest ranking due to notable improvements in infrastructure and environmental management. Meanwhile, other cities displayed varying levels of success, reflecting different developmental stages and capacities. The findings underscore the necessity for tailored strategies to optimize urban renewal outcomes, focusing on high-weight factors such as sewage treatment, clean heating, and residential renovation. This study provides actionable insights for policymakers, advocating adaptive renewal strategies that align with local contexts and encourage continuous innovation. The results highlight the importance of targeted policy interventions to enhance urban renewal quality across Shandong Province, promoting sustainable urban development and better living standards.

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Highlights:	Contribution to the field statement:
- The study introduces a new evaluation method for urban renewal using Entropy and TOPSIS. - Key focus areas include residential renovation, sewage treatment, sponge city construction, heating, and air quality. - Results show significant differences in renewal performance across 16 cities, with Jinan performing best. - Emphasizes locally tailored strategies and continuous innovation in urban renewal. - Provides actionable insights for policymakers to enhance urban renewal efforts.	-Constructed a comprehensive and scientific evaluation index system for urban renewal. -Introduced a new method that combines objective data weighting (entropy) with multi-criteria decision-making (TOPSIS) for comprehensive evaluation of urban renewal work.

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1. Introduction

As of 2023, China's urbanization rate has reached 66.16%. With the rapid advancement of urbanization in China, urban development issues are increasingly prominent. Urban renewal aims to comprehensively improve the urban living environment, optimize industrial structure, and promote sustainable urban development（Dan Wang, 2022). Urban renewal has gradually become a hot topic for governments and scholars recently. The concept of urban renewal was first proposed in the government work report at the Central Economic Work Conference in Dec. 2019. In Nov. 2020, the implementation of urban renewal actions was proposed in the Proposal on Formulating the 14th Five-Year Plan for National Economic and Social Development and the Long-Range Objectives for 2035 (from now on referred to as Proposal) drafted by the Central Committee of the Chinese Communist Party (Dong, 2022). Promoting urban renewal and achieving high-quality development is put forward.

Shandong Province, a vital economic hub in eastern China, has experienced rapid urban expansion and significant demographic shifts. This rapid development has resulted in outdated urban infrastructure, inadequate public facilities, and environmental degradation. Urban renewal in this context is not just about physical infrastructure but also about aligning urban environments with contemporary economic and social needs.

The views held by foreign scholars on urban renewal can be roughly divided into four categories. Firstly, urban renewal can bring environmental and economic benefits (Adedeji & Arayela, 2018). (Ekemode Benjamin Gbolahan, 2019) evaluated the rental value of commercial property after urban renewal from 2008 to 2017 in Osobo, the capital of Osobo state in Nigeria. Tangible urban infrastructure such as roads, drainage, water supply, and waste disposal in the region has been improved, and the investment performance of commercial properties in the area was significantly enhanced. Secondly, historical buildings should be preserved and repaired in urban renewal. Walaa Abou El Haggag Mehanna et al. (2019) believe that the traditional commercial streets in the city's historical center should be protected to the maximum extent, as they represent a city. Appropriate principles and standards are recommended to maintain continuity and interests. Promote local culture by preserving the historical characteristics and developing these streets. Thirdly, sustainable development in urban renewal strategies should be integrated. V I Sarchenko et al. (2020) analyzed concepts such as integrated real estate and sustainable development and how they are applied in urban renewal actions. The article explores the essential land and resource planning and sustainable development elements. Research shows that applying comprehensive and sustainable development tools can help attract more investment, change the urban structure, and improve the urban environment. Fourthly, people-oriented should be promoted in urban renewal. Boros Judit et al. (2021) analyzed the design driving and enabling factors that affect the park's human-centred and nature-based performance while investigating the design and implementation process of Biblioteca degli Alberti Park in Milan. They consider that it is necessary to integrate the urban ecological perspective into the overall design process to successfully re-examine urban design and planning practices and instil humanism in nature first.

Currently, the research hotspots of urban renewal in China mainly focus on three aspects. Firstly, study foreign urban renewal projects and get inspiration from them (Dai et al., 2023). Secondly, the urban renewal projects that are being implemented or have been completed in China should be studied (Cao et al., 2023). Then, the defects during implementation will be found, and recommendations will be made. Thirdly, the game among the public, government, and enterprise (Wang et al., 2022). Zheng Weihan (2021) combined the city backgrounds of the United Kingdom and the U.S.A. and analyzed the urban renewal models of the two countries. He proposes that urban renewal should aim at sustainable development, adhere to the market-leading, government-guiding policy, strengthen public participation, and adjust measures to local conditions. Taking the urban renewal project in the Yulin area of Chengdu as an example, Chen Guangqiong (2021) analyzed the problems existing in this area,

such as the existing low-end industrial level, unreasonable distribution of public support facilities, insufficient public space resources, and prominent contradiction between parking supply and demand, and put forward new models such as gathering high-end industries and people-oriented. Through the text analysis and comparison of the renewal methods of Shanghai, Guangzhou, and Shenzhen, Yang Xuan (2020) proposed combining top-level design and grassroots innovation, actively integrating the public into governance, and gradually improving the long-term urban renewal mechanism. Recent studies have explored various methods for evaluating urban renewal projects, with a focus on both qualitative and quantitative approaches. For instance, Zhao et al. (2023) integrated GIS, fuzzy theory, and the Decision-Making Trial and Evaluation Laboratory to develop a pre-assessment model for evaluating the sustainability potential of urban renewal projects. Wang &Yang (2022) used the developed framework to construct a demand potential constraint model that includes three dimensions of evaluation indicators.

These studies, published in high-impact Web of Science (WOS)-indexed journals underscore the critical role of comprehensive evaluation methods in urban renewal. Foreign and domestic scholars have slightly different focuses on urban renewal. Foreign scholars such as Shih-Yuan Liu et al.(2020), Mehmet Faruk Kocak(2023), and Beibei Zhang (2023) mainly focus on research on urban renewal work methods. Domestic scholars such as Yan Tang et al.(2019), Jingxian Tang(2016), Qing Zhang(2022), Kexin Cao et al.(2023), Liu H. et al. (2023) focus on studying successful project cases at home and abroad and analyzing work methods. However, the foreign experience should only be applied indirectly due to the influence of political, market, cultural, and other factors. It is necessary to improve methods to meet China's national conditions. In recent years, research on urban renewal evaluation has been relatively scarce, although China has vigorously promoted urban renewal measures. Urban renewal evaluation aims to check and provide feedback on the current urban renewal work, correct the existing problems in time, and promote the smooth implementation of urban renewal work.

Taking Shandong Province as an example, an evaluation system with four first-level indexes and ten second-level indexes is established. The entropy method and TOPSIS are used to comprehensively evaluate the urban renewal work of 16 prefecture-level cities in Shandong Province in 2019. This study introduces a novel approach that combines objective data weighting (Entropy) with multi-criteria decision-making (TOPSIS), offering a more nuanced and accurate evaluation of urban renewal projects. Moreover, this study not only evaluates urban renewal comprehensively but also aims to offer actionable insights and recommendations for policymakers and urban planners in Shandong Province, bridging the gap between theoretical evaluation and practical implementation.

2. Current status of urban renewal in Shandong Province

People's Government of Shandong Province passed the Three-Year Action Plan for Improving Urban Quality in Shandong Province (from now on, referred to as Plan) in 2019. Eight particular tasks are made in the Plan: actions on style and characteristics enhancement, blue and green space improvement, air cleanliness improvement, road traffic improvement, life service improvement, governance capacity improvement, safe operation improvement, and civilized quality improvement.

Actions on style and characteristics refer to protecting and utilizing historical buildings and cultural blocks, preserving their historical charm, and fully showcasing the city's characteristics and heritage. Up to now, most historic and cultural city districts have set up protection signs, and historical buildings that can be well protected and utilized have been listed. Cities such as Jinan, Qingdao, Zibo, Zaozhuang, Yantai, Weifang, Jining, Tai'an, Linyi, and Liaocheng have formulated plans to protect historical and cultural cities.

The blue-green space promotion action refers to building a blue-green intertwined space for citizens by promoting sponge city construction, improving sewage and black and odorous water treatment, carrying out urban greenway construction, three-dimensional greening, and other projects. Housing

and Urban-Rural Development Department, Ecology and Environment Department, and Development and Reform Commission of Shandong Province jointly issued a Notice on the 3-year Action for Improving Quality and Efficiency of Urban Sewage Treatment put forward that the black and odorous water bodies in the urban built-up areas should be eliminated. The black and odorous water bodies in the county (city) built-up areas should be eliminated by 70% in 3 years. The annual target requirements for the weighted BOD concentration of the influent of each urban sewage treatment plant were put forward.

Air cleanliness improvement action refers to actively promoting clean heating, expanding the coverage of central heating, increasing the proportion of clean heating, strengthening the prevention and control of air pollution sources such as industry, strengthening the construction of dust control, and improving the level of road cleaning. Under the joint guidance of the Housing and Urban-Rural Development Department Energy Administration of Shandong Province, 16 cities comprehensively manage the open-air barbecue in the built-up areas, strengthen the control of mobile source exhaust pipes, actively promote clean heating work, and establish multi-energy complementary heating systems.

Road traffic improvement refers to improving the level of public transport infrastructure and comprehensive pipe gallery construction, increasing the intensity of road construction in urban built-up areas, increasing the density of road networks, reducing the difficulty of citizens ' travel, and promoting economic development. General Office of the People's Government of Shandong Province promulgated Opinions on Implementing No.61 Document issued by the State Council in 2005 to Promote the Construction of Urban Underground Comprehensive Pipe Gallery, which put forward the target for each city's underground comprehensive pipe gallery. Regarding public transportation, cities keep improving the public transportation infrastructure and vigorously developing low-energy and efficient public transportation systems.

Life service promotion action refers to the overall layout of the three-level public service facilities, including city, group, and community, focusing on promoting the full coverage of community services such as education, medical care, and old-age care in 15-minute activity circle and actively promoting the transformation of old communities, accessibility, and other basic livelihood projects (Shanghai Urban Planning, 2020). Cities improve the planning of education facilities construction, increase community hospitals and daycare centers, and make up for the shortcomings of education, community medical care, community pensions, and other services. At the same time, the General Office of the People's Government of Shandong Province also issued an Implementation Plan for Further Promoting the Transformation of Old Urban Communities in Shandong Province, which aims to complete the transformation of old communities built before 2005 by the end of 14th Five-Year.

Governance capacity improvement action refers to the construction of a better environment and life in an all-round way, which can improve the urban grass-roots governance mechanism, upgrade the digital urban management system, build an innovative urban management platform, implement municipal solid waste classification activities, and improve system and mechanism of municipal solid waste classification. The Housing and Urban-Rural Development Department of Shandong Province issued the Implementation Plan for the Classification System of Municipal Solid Waste in Shandong Province, which requires five types of classification for municipal solid waste in each city. Key cities should build a waste classification and treatment system. In terms of intelligent city management platforms, digital urban management systems of 16 cities have been completed and implemented. They were upgraded to intelligent urban management platforms according to the relevant guidelines and standards, which passed the acceptance of provincial departments.

Safe operation improvement refers to the risk investigation and hidden danger management of the construction quality, operation, and maintenance support ability of various infrastructures, effectively preventing various urban disasters such as floods and fires, and building and improving various emergency shelters, ensuring the city's safe operation. General Office of the People's Government of

Shandong Province issued Implementation Opinions on Promoting the Safe Development of Cities in the Province, proposing that cities must improve urban safety regulations and standards, strengthen infrastructure safety management, and accelerate urban emergency management and rescue capacity building. Civilized quality improvement refers to the extensive education of citizens, the introduction of virtue and etiquette into the classroom, the severe punishment of social morality, the active development of social public welfare activities, the promotion of the construction of the credit system, which contributes to the continuous improvement of civilization quality and the level of urban culture. With the efforts of the Propaganda Department of Shandong Provincial Party Committee and other organizations, nine cities, including Jinan, Qingdao, Zibo, Dongying, Yantai, Weifang, Weihai, Rizhao and Linyi, have created national civilized cities. Qingdao, Weifang, and Weihai have been rated demonstration cities for constructing the national social credit system.

3. Entropy and TOPSIS methods

The entropy method is an objective weighting method that is determined according to the degree of dispersion of the data of each index. As the data is more dispersed, the entropy value is smaller. The data contains more information, so the weight is more significant, and vice versa. TOPSIS was first proposed in 1981. It constructs positive and negative ideal solutions to the multi-index problem. The ranking is based on the degree of proximity between the index and the perfect solution (Notice of the General Office of the People's Government of Shandong Province on Issuing the Three-Year Action Plan for Improving Urban Quality in Shandong Province, 2019). The entropy method and TOPSIS are comprehensive evaluation methods (Rao,R.V.,2012) that combine the entropy method and TOPSIS. After solving the weight of each evaluation index by the entropy method, the multi-objective is sorted based on the weight. It can avoid the subjectivity of data and has no strict limit on the number of indexes. It is suitable for both small samples and multi-evaluation units. Therefore, this paper uses this method to comprehensively evaluate the urban renewal work of 16 prefecture-level cities in Shandong Province in 2019. The methodological process is shown in Figure 1 and the specific steps are as follows.

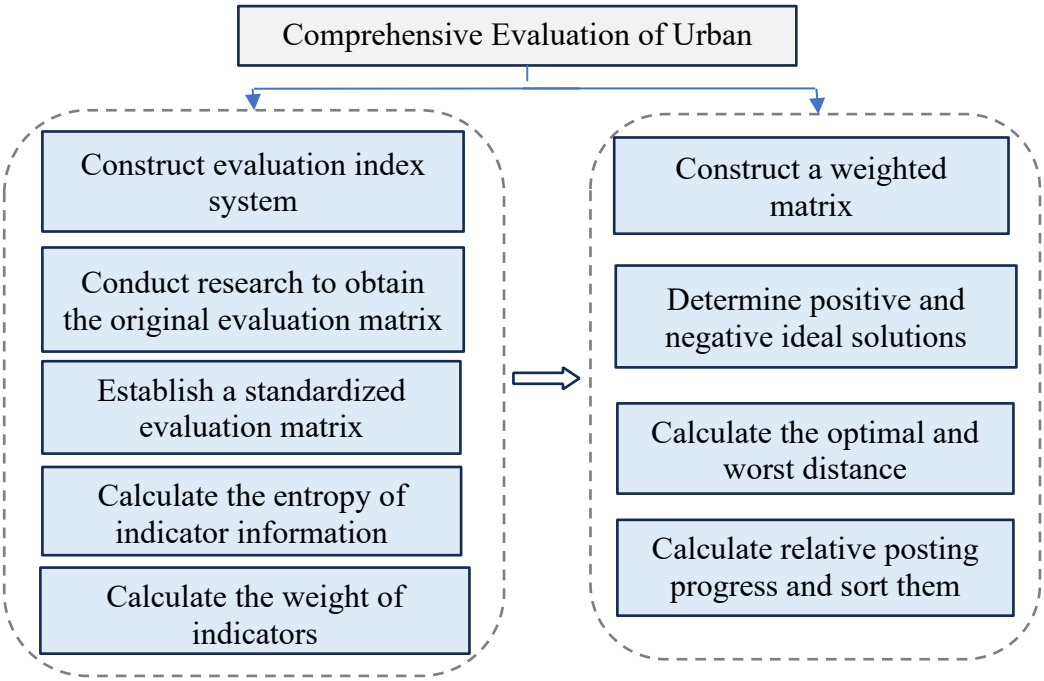

Figure 1. Methodological process of the research.

3.1. Constructing evaluation index system

A total of 4 first-level indexes and 10 second-level indexes are selected based on reviewing implementation policies and literature, measuring the quantifiable nature of indexes, and following the basic principles of establishing the index system. The index system is shown in Table 1. In the entropy method, the index types are divided into four categories. The more extensive positive index is the better one. The smaller negative indexes are the better ones. For the intermediate index, the best index is the one that tends to a specific value. The last index type is an interval index, which falls best in a particular interval. Implementing urban renewal work can reduce the number of black and odorous water, so the index is negative. And the other indexes are positive.

Table 1: Evaluation index system.

Contents	First-level indexes	Second-level indexes	Index explanation	Type of index
effect of urban renewal A	blue-green spaces B	black and odorous water treatment B_1	the number of existing black and odorous water	negative
		quality and efficiency improvement of sewage treatment B_2	influent weighted BOD concentration of sewage treatment plant（mg/L）	positive
		sponge City construction B_3	the proportion of built-up area to area of built-up district（%）	positive
	air cleaning C	urban clean heating C_1	new clean heating area (10,000 m2)	positive
		urban air quality C_2	excellent air duration (days)	positive
	road traffic D	the road network in urban built-up areas D_1	road network density of urban built-up area (km / km2)	positive
		public traffic D_2	number of public transport vehicles owned by 10,000 people in the city	positive
		comprehensive pipe gallery construction D_3	Length of new comprehensive pipe gallery construction (km)	positive
	life service E	15-minute life circle E_1	convenience（%）	positive
		renovation of old residential areas E_2	number of renovation households (households)	positive

3.2 Weight calculation-entropy method

3.2.1 Standardization

We find the required data through China's economic and social big data research platform and government bulletin and use the above database to ensure the authenticity of the data, making the calculation results more scientific.

There are 16(m) cities and 10(n) evaluation indexes. Table 2 defines the original data matrix Xij, which is the original data value of the ith evaluation object under the jth evaluation index.

Table 2: Original data matrix.

City	B_1	B_2	B_3	C_1	C_2	D_1	D_2	D_3	E_1	E_2
Jinan	103	100.23	11.96%	650	212.00	7.83	21.1	58	100.00%	95087
Qingdao	82	255.61	21.50%	639	287.00	8.20	14.12	66	100.00%	11510
Zibo	33	102.77	18.88%	912.07	186.00	7.94	15	27	100.00%	15253
Zaozhuang	50	70.87	22.63%	396	245.00	6.90	15.2	38	100.00%	31118
Dongying	118	103.76	21.67%	811.38	276.00	5.86	19.2	21	100.00%	597
Yantai	10	168.81	16.73%	345.8	286.00	8.22	15.2	28	100.00%	2844
Weifang	24	100.39	38.99%	893	218.00	8.19	12.27	36	66.67%	3738
Jining	317	79.56	15.43%	396	256.00	8.01	15.07	34	100.00%	8903
Taian	24	97.6	32.72%	354.77	189.00	8.72	13.29	34.2	100.00%	2560
Weihai	4	172.95	18.81%	650	295.00	6.79	14.7	40	100.00%	4921
Rizhao	25	159.75	16.02%	467.98	253.00	8.17	14.1	59	100.00%	5869
Linyi	94	118.83	33.96%	400	197.00	8.11	11	75	100.00%	12247
Dezhou	103	81.06	18.19%	597	188.00	6.51	12.36	22	100.00%	9409
Liaocheng	35	62.61	23.27%	350	177.00	5.35	14.4	20	100.00%	4819
Binzhou	138	80.59	29.56%	231	206.00	7.53	9	8.27	75.00%	7267
Heze	238	61.02	12.85%	586	254.00	3.25	12.08	18.23	100.00%	5214

To eliminate the influence of different dimensions on the evaluation results, the standardized matrix V is obtained by processing each index, and the calculation results are shown in Appendix A.

For the positive index, the v_{ij} Calculation method is as follows:

$$v_{ij} = \frac{x_{ij} - \min(x_j)}{\max(x_j) - \min(x_j)} \quad (1)$$

The $\max(x_j)$ 、 $\min(x_j)$ represent all evaluation objects' maximum and minimum values under j evaluation indexes, respectively. In particular, when the maximum value is equal to the minimum, there will be uncertain situations, such as 0/0, and v_{ij} can be taken as 1.

For the negative index, the v_{ij} Calculation method is as follows:

$$v_{ij} = \frac{\max(x_j) - x_{ij}}{\max(x_j) - \min(x_j)} \quad (2)$$

3.2.2 Normalization

The characteristic proportion matrix P can be obtained by further processing the standardized matrix. Let p_{ij} be the characteristic proportion of the ith evaluation object under the jth evaluation index. The calculation method is as follows, and the calculation results are shown in Appendix B.

$$p_{ij} = \frac{v_{ij}}{\sum_{i=1}^{m} v_{ij}} \quad (3)$$

3.2.3 Define weight

The entropy matrix E is calculated, e_j is the entropy value of the jth evaluation index. The calculation method is shown in Formula (4), and the calculation results are shown in Appendix C. To avoid the case of $ln(0)$, the whole data of P can be shifted, and a smaller number (0) can be added.

$$e_j = -\frac{1}{ln(m)} \sum_{i=1}^{m} p_{ij} \cdot ln\, p_{ij} \quad (4)$$

Calculate the weight matrix W, $w_{(e)j}$ is the weight of the jth evaluation index, the calculation method is as follows, and the calculation results are shown in Table 3.

$$w_{(e)j} = \frac{(1-e_j)}{\sum_{j=1}^{n}(1-e_j)} \quad (5)$$

Table 3: Weight matrix.

Index	$w_{(e)j}$
B_1	3.75%
B_2	15.58%
B_3	11.02%
C_1	8.51%
C_2	10.90%
D_1	3.44%
D_2	5.94%
D_3	8.30%
E_1	3.42%
E_2	29.14%

3.3 Comprehensive evaluation-TOPSIS method

3.3.1 Constructing a weighted matrix

Before constructing the weighting matrix, the original data is first positively processed. Positive processing converts all types of indexes into positive indexes. For the negative indexes appearing in this chapter, the formula (6) is used.

$$x'_{ij} = \frac{1}{x_{ij}} \qquad (6)$$

After normalizing the original matrix, the standardized method is processed. The standardized matrix is calculated, and the weighted matrix C is constructed. The formula is shown in (7), and the calculation result is shown in Appendix D.

$$c_{ij} = v'_{ij} * w_j \qquad (7)$$

3.3.2 Determining positive and negative ideal solution

The positive ideal solution is the best solution of an idea (denoted by C^+), for which various index values reach the best value of each candidate scheme. The negative ideal solution is the worst solution of another idea (denoted by C^-), for which various index values reach the worst value of each candidate scheme.

The method of determining the positive ideal solution is different for different indexes. The formula is as follows.

$$c_j^+ = \begin{cases} max\ c_{ij}, \text{j is a positive index} \\ min\ c_{ij}, \text{ j is a negative index} \end{cases} \text{j=1, 2, ···, n} \qquad (8)$$

Similarly, the determination method of negative ideal solution is different for different types of indexes. The formula is as follows.

$$c_j^- = \begin{cases} min\ c_{ij}, \text{ j is a positive index} \\ max\ c_{ij}, \text{j is negative index} \end{cases} \text{j=1, 2, ···, n} \qquad (9)$$

Positive and negative ideal solutions are shown in Appendix E.

3.3.3 Optimal and worst distance

The distance between the evaluation object and the positive ideal solution is denoted by d_i^+, and the distance between the evaluation object and the negative ideal solution is denoted by d_i^-. They are calculated respectively. The distance information between them is used as the standard to rank the 16 cities.

The distance from each evaluation object to the positive ideal solution is called the optimal distance, and the calculation formula is as follows.

$$d_i^+ = \sqrt{\sum_{j=1}^{n} (c_{ij} - c_j^+)^2}, \ i = 1, 2, \cdots, m \qquad (10)$$

The distance from each evaluation object to the negative ideal solution is called the worst distance d_i^-, and the calculation formula is as follows.

$$d_i^- = \sqrt{\sum_{j=1}^{n} (c_{ij} - c_j^-)^2}, \ i = 1, 2, \cdots, m \qquad (11)$$

The results of the optimal distance and the worst distance are shown in Appendix F.

3.3.4 Establish relative closeness

Finally, the relative closeness Z between the evaluation object and the positive ideal solution is calculated, and the formula is as follows:

$$Z_i = \frac{d_i^+}{d_i^+ + d_i^-} \ (i = 1, 2, \cdots, m) \qquad (12)$$

According to Formula (12), Z_i ranges from 0 to 1. Project schedule management can be sorted according to relative proximity. The smaller Z_i is, the closer to the positive ideal solution, which means the comprehensive evaluation's result is better. The relative closeness and ranking are shown in Table 4.

Table 4: Relative closeness and ranking.

City	Relative closeness	Ranking
Jinan	0.3774	1
Qingdao	0.5567	2
Zibo	0.7207	10
Zaozhuang	0.6654	4
Dongying	0.6996	9
Yantai	0.6843	7
Weifang	0.6781	6
Jining	0.7615	12
Taian	0.7557	11
Weihai	0.6411	3
Rizhao	0.6918	8
Linyi	0.6769	5
Dezhou	0.8146	15
Liaocheng	0.8388	16
Binzhou	0.8025	14
Heze	0.7905	13

4. Results

The results show that Jinan ranks highest in evaluating urban renewal work. Qingdao, Weihai, Zaozhuang, Linyi, Weifang, Yantai, Rizhao, Dongying, Zibo, Tai 'an and Jining follow closely behind. The urban renewal work of Heze, Binzhou, Dezhou, and Liaocheng needs to be further improved.

Among the ten evaluation indexes, the weight of blue-green space (first-level index) is 30.35%, of which the weight of black and odorous water treatment (second-level index) is 3.75%, the quality and efficiency of sewage treatment (second-level index) is 15.58%, and the sponge city construction (second-level index) is 11.02%. The weight of air cleanliness (first-level index) is 19.4%, of which the weight of urban clean heating (second-level index) is 8.51%, and the urban air quality (second-level index) is 10.9%. The weight of road traffic (first-level index) is 17.68 %, of which the weight of urban built-up area road networks (second-level index) is 3.44%, public transportation is 5.94 %, and

utility tunnel construction is 8.3 %. The weight of life service (first-level index) is 32.56%, of which the weight of the 15-minute circle (second-level index) is 3.42%, and the old community transformation accounts for 29.14 %.

Among the evaluation indexes, the weight of old community renovation, sewage treatment quality and efficiency improvement, sponge city construction, urban clean heating, and urban air quality is relatively high. The remaining indexes are all less than 10%. Therefore, the high-weight indexes mentioned above are the focus of urban renewal. The number of renovated households in old residential areas in Jinan is 95087, which is far higher than that in other cities. That explains why urban renewal work in Jinan gets the best results in a comprehensive evaluation.

Cities with low ranking in comprehensive evaluation, including Dezhou, Liaocheng, Binzhou, and Heze, should focus more on improving the quality and efficiency of sewage treatment, sponge city construction, and comprehensive pipe gallery construction. In addition, urban air quality, urban built-up area road network, and public transportation indexes in Dezhou are relatively weak. Relevant policies should be formulated to improve the weak aspects of the above. Air quality, road network in urban built-up areas, and renovation of old residential areas in Liaocheng City are relatively weak. The urban air quality ranks the lowest among 16 prefecture-level cities. Public transportation in Binzhou City should be improved because its public transportation level does not reach the same level as other cities. The density of the road network in the built-up area of Heze City is far lower than that of Shandong Province. So, road network construction should be strengthened.

5. Discussions

Some cities failed to complete the annual goal of urban renewal in government gazettes and provincial statistics. The main problems are as follows. Regarding promoting blue-green space, treating influent-weighted BOD concentration in urban sewage treatment plants in Dezhou and Heze is close to the annual target requirements. The related work in Jinan, Zaozhuang, Jining, Tai 'an, Linyi, and Liaocheng is far from the annual target. The proportion of sponge city-built area to urban-built area is less than 20% in half of the 16 prefecture-level cities. The ratio in several cities is less than 13%, which is far lower than the target. Regarding air cleanliness improvement actions, the number of days with good air quality in most cities failed to meet the annual assessment targets, and nearly half of the cities had a large gap with the annual targets.

Regarding road traffic improvement actions, the number of public transport vehicles per 10,000 people in Qingdao, Weifang, Dezhou, Binzhou, and Linyi cities failed to meet the relevant standards. More than half of the cities failed to complete the construction of a comprehensive pipe gallery. The percentage of built comprehensive pipe galleries in Zibo, Liaocheng, Binzhou, and Heze completed is less than 70%.

The following are the existing problems and corresponding promotion strategies.

1. As the main responsible body for urban renewal work, governments should build a smooth and perfect mechanism to coordinate and promote related work. 16 prefecture-level cities should take precise measures based on the local situation and economy. At the same time, a corresponding supervision department should be established to carry out dynamic monitoring, tracking analysis, and regular work checks. Besides, fund support, including financial support and social capital investment, is vital.

2. Multimedia platforms should be fully used to carry out various urban renewal publicity and education activities. Public participation should be enhanced through bulletin boards, science brochures, etc. Urban renewal work plans should be made with high satisfaction by public opinion solicitation on public communication service platforms. So potential interest conflicts can be eliminated in advance. Public satisfaction with completed and ongoing urban renewal projects should be online or offline to provide ideas for follow-up work. Open question options can be added to fully obtain public appeals as well.

3. As the connotation of urban renewal differs in different periods and city levels, cities must formulate urban renewal strategies according to local conditions based on full investigation. One size fits all must be avoided. The urban renewal model needs to be continuously innovated with the continuous development of the urban economy. Cities should study successful cases of urban renewal at home and abroad, innovate urban renewal strategies based on local conditions, and monitor and adjust related measures in time to achieve urban renewal goals.

6. Conclusions

The main problems with urban renewal in Shandong Province are 1) Inefficient blue-green space promotion, particularly in Jinan, Zaozhuang, Jining, Tai'an, Linyi, & Liaocheng; low sponge city-built area ratio (<20% in half, <13% in several cities). 2) Poor air quality improvement, with most cities failing to meet good air quality days targets. 3) Inadequate road traffic improvements, such as insufficient public transport vehicles in Qingdao, Weifang, Dezhou, Binzhou, & Linyi, and unfinished comprehensive pipe gallery construction in >50% of cities, with Zibo, Liaocheng, Binzhou, & Heze <70% complete. It can be seen that although urban renewal work has been actively promoted in various cities, the quality of urban renewal work varies greatly due to the different development levels of each city. Existing urban construction and management systems in China have been established to support rapid urbanization, but they are no longer suitable for urban development and transformation. They even conflict with urban renewal. The findings are specific to urban renewal projects in Shandong Province. Future research will explore how the research results can be applied or adapted to other regions facing similar urban renewal challenges, considering how cultural factors affect the outcomes of urban renewal projects.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data availability statement

Data is not available due to commercial restrictions.

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Ziqi Qiao: Conceptualization, Investigation, Formal analysis, Resources, Data curation, Writing – original draft; Xiang Xu: Conceptualization, Methodology, Formal analysis, Resources, Data curation, Writing – review & editing; Xinran Wang: Investigation, Methodology, Resources, Data curation, Writing – editing; Yifei Zhang: Investigation, Resources, Data curation, Writing – editing. All authors have read and approved the published version of the article.

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Appendices

Appendix A: Standardized matrix.

City	B_1	B_2	B_3	C_1	C_2	D_1	D_2	D_3	E_1	E_2
Jinan	0.6837	0.2015	0.0000	0.6152	0.2966	0.8373	1.0000	0.7452	1.0000	1.0000
Qingdao	0.7508	1.0000	0.3529	0.5991	0.9322	0.9049	0.4231	0.8651	1.0000	0.1155
Zibo	0.9073	0.2146	0.2560	1.0000	0.0763	0.8574	0.4959	0.2807	1.0000	0.1551
Zaozhuang	0.8530	0.0506	0.3947	0.2423	0.5763	0.6673	0.5124	0.4455	1.0000	0.3230
Dongying	0.6358	0.2196	0.3592	0.8522	0.8390	0.4771	0.8430	0.1908	1.0000	0.0000
Yantai	0.9808	0.5539	0.1765	0.1686	0.9237	0.9086	0.5124	0.2957	1.0000	0.0238
Weifang	0.9361	0.2023	1.0000	0.9720	0.3475	0.9031	0.2702	0.4156	0.0000	0.0332
Jining	0.0000	0.0953	0.1284	0.2423	0.6695	0.8702	0.5017	0.3856	1.0000	0.0879
Taian	0.9361	0.1880	0.7680	0.1817	0.1017	1.0000	0.3545	0.3886	1.0000	0.0208
Weihai	1.0000	0.5752	0.2534	0.6152	1.0000	0.6472	0.4711	0.4755	1.0000	0.0458
Rizhao	0.9329	0.5074	0.1502	0.3480	0.6441	0.8995	0.4215	0.7602	1.0000	0.0558
Linyi	0.7125	0.2971	0.8139	0.2481	0.1695	0.8885	0.1653	1.0000	1.0000	0.1233
Dezhou	0.6837	0.1030	0.2305	0.5374	0.0932	0.5960	0.2777	0.2058	1.0000	0.0933
Liaocheng	0.9010	0.0082	0.4184	0.1747	0.0000	0.3839	0.4463	0.1758	1.0000	0.0447
Binzhou	0.5719	0.1006	0.6511	0.0000	0.2458	0.7824	0.0000	0.0000	0.2500	0.0706
Heze	0.2524	0.0000	0.0329	0.5212	0.6525	0.0000	0.2545	0.1493	1.0000	0.0489

Appendix B: Characteristic proportion matrix.

City	B_1	B_2	B_3	C_1	C_2	D_1	D_2	D_3	E_1	E_2
Jinan	0.0582	0.0467	0.0000	0.0841	0.0392	0.0720	0.1439	0.1099	0.0702	0.4458
Qingdao	0.0640	0.2316	0.0590	0.0819	0.1232	0.0779	0.0609	0.1276	0.0702	0.0515
Zibo	0.0773	0.0497	0.0428	0.1366	0.0101	0.0738	0.0714	0.0414	0.0702	0.0692
Zaozhuang	0.0727	0.0117	0.0659	0.0331	0.0761	0.0574	0.0737	0.0657	0.0702	0.1440
Dongying	0.0542	0.0509	0.0600	0.1164	0.1109	0.0411	0.1213	0.0281	0.0702	0.0000
Yantai	0.0836	0.1283	0.0295	0.0230	0.1220	0.0782	0.0737	0.0436	0.0702	0.0106
Weifang	0.0797	0.0469	0.1670	0.1328	0.0459	0.0777	0.0389	0.0613	0.0000	0.0149
Jining	0.0000	0.0221	0.0215	0.0331	0.0885	0.0749	0.0722	0.0569	0.0702	0.0392
Taian	0.0797	0.0435	0.1283	0.0248	0.0134	0.0860	0.0510	0.0573	0.0702	0.0093
Weihai	0.0852	0.1332	0.0423	0.0841	0.1321	0.0557	0.0678	0.0701	0.0702	0.0204
Rizhao	0.0795	0.1175	0.0251	0.0476	0.0851	0.0774	0.0606	0.1121	0.0702	0.0249
Linyi	0.0607	0.0688	0.1359	0.0339	0.0224	0.0764	0.0238	0.1475	0.0702	0.0550
Dezhou	0.0582	0.0239	0.0385	0.0734	0.0123	0.0513	0.0400	0.0304	0.0702	0.0416
Liaocheng	0.0768	0.0019	0.0699	0.0239	0.0000	0.0330	0.0642	0.0259	0.0702	0.0200
Binzhou	0.0487	0.0233	0.1088	0.0000	0.0325	0.0673	0.0000	0.0000	0.0175	0.0315
Heze	0.0215	0.0000	0.0055	0.0712	0.0862	0.0000	0.0366	0.0220	0.0702	0.0218

Appendix C: Entropy value matrix.

Index	e_j
B_1	0.9638
B_2	0.8496
B_3	0.8936
C_1	0.9179
C_2	0.8948
D_1	0.9668
D_2	0.9426
D_3	0.9199
E_1	0.9670
E_2	0.7187

Appendix D: Weighted matrix.

City	B_1	B_2	B_3	C_1	C_2	D_1	D_2	D_3	E_1	E_2
Jinan	0.0365	0.0314	0.0000	0.0523	0.0323	0.0288	0.0594	0.0619	0.0342	0.2914
Qingdao	0.0361	0.1558	0.0389	0.0510	0.1016	0.0311	0.0252	0.0718	0.0342	0.0337
Zibo	0.0334	0.0334	0.0282	0.0851	0.0083	0.0295	0.0295	0.0233	0.0342	0.0452
Zaozhuang	0.0349	0.0079	0.0435	0.0206	0.0628	0.0229	0.0305	0.0370	0.0342	0.0941
Dongying	0.0367	0.0342	0.0396	0.0725	0.0914	0.0164	0.0501	0.0158	0.0342	0.0000
Yantai	0.0228	0.0863	0.0194	0.0143	0.1006	0.0312	0.0305	0.0245	0.0342	0.0069
Weifang	0.0317	0.0315	0.1102	0.0827	0.0379	0.0310	0.0161	0.0345	0.0000	0.0097
Jining	0.0375	0.0148	0.0141	0.0206	0.0729	0.0299	0.0298	0.0320	0.0342	0.0256
Taian	0.0317	0.0293	0.0846	0.0155	0.0111	0.0344	0.0211	0.0323	0.0342	0.0061
Weihai	0.0000	0.0896	0.0279	0.0523	0.1090	0.0222	0.0280	0.0395	0.0342	0.0133
Rizhao	0.0319	0.0791	0.0166	0.0296	0.0702	0.0309	0.0251	0.0631	0.0342	0.0163
Linyi	0.0364	0.0463	0.0897	0.0211	0.0185	0.0305	0.0098	0.0830	0.0342	0.0359
Dezhou	0.0365	0.0160	0.0254	0.0457	0.0102	0.0205	0.0165	0.0171	0.0342	0.0272
Liaocheng	0.0336	0.0013	0.0461	0.0149	0.0000	0.0132	0.0265	0.0146	0.0342	0.0130
Binzhou	0.0369	0.0157	0.0718	0.0000	0.0268	0.0269	0.0000	0.0000	0.0085	0.0206
Heze	0.0373	0.0000	0.0036	0.0443	0.0711	0.0000	0.0151	0.0124	0.0342	0.0142

Appendix E: Positive and negative ideal solution.

Type	B_1	B_2	B_3	C_1	C_2	D_1	D_2	D_3	E_1	E_2
Positive ideal solution	0.0000	0.1558	0.1102	0.0851	0.1090	0.0344	0.0594	0.0830	0.0342	0.2914
Negative ideal solution	0.0375	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix F: Optimal distance and the worst distance.

City	Optimal distanced_i^+	Worst distanced_i^-
Jinan	0.1907	0.3147
Qingdao	0.2745	0.2186
Zibo	0.3131	0.1214
Zaozhuang	0.2754	0.1385
Dongying	0.3338	0.1434
Yantai	0.3223	0.1487
Weifang	0.3260	0.1548
Jining	0.3318	0.1039
Taian	0.3429	0.1109
Weihai	0.3043	0.1703
Rizhao	0.3124	0.1391
Linyi	0.3062	0.1461
Dezhou	0.3400	0.0774
Liaocheng	0.3601	0.0692
Binzhou	0.3478	0.0856
Heze	0.3537	0.0937

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Shaping Tourism Strategies through Local Perceptions: A Case Study of Muharraq

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ABSTRACT

Bahrain, a longstanding tourist destination in the Gulf region, has seen its economy benefit significantly from tourism. However, the improper development of tourism has led to negative impacts on urban tourism in historic areas, risking the loss of authenticity. This study aims to explore factors influencing the development of tourism strategies in Muharraq city, focusing on residents' perceptions. A qualitative approach was used, including a comprehensive literature review, interviews with residents to capture their views on tourism-related issues, and a self-administered questionnaire with key officials and stakeholders. The study identifies critical factors affecting tourism development and offers recommendations for enhancing cultural tourism in Muharraq. The findings provide valuable insights for policymakers to create sustainable strategies that balance economic growth with cultural preservation, ensuring that Muharraq remains a culturally vibrant city while promoting sustainable urban tourism. This research contributes to the broader field of urban tourism studies by highlighting the importance of local perceptions and participatory approaches in shaping effective tourism policies. By addressing key elements that influence tourism development, the study supports the creation of strategies that safeguard heritage while fostering sustainable growth in one of Bahrain's most culturally significant cities.

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Highlights:

- Proposing a strategic plan to improve the tourism industry as a strong supporter of the country's economy
- Understanding local's perception of tourism-related issues contributes to identifying important aspects that impact the growth of cultural tourism in Muharraq City.
- A fishbone diagram is a useful analysis tool to highlight the crucial factors towards successful and sustainable cultural tourism in the city.
- The significance of public participation in tourism development is discussed in this research.
- Policymakers can use the findings of the study to build a strong basis for the success of strategic planning to make Muharraq city a destination for cultural tourism.

Contribution to the field statement:

According to this study, Bahrain's economic status might be enhanced by strategically boosting the tourism industry. It seeks to determine, via the perspectives of its citizens, the variables that might influence Muharraq City's tourism development initiatives. In one of Bahrain's most culturally vibrant cities, this research adds to the body of knowledge on urban tourist studies by addressing important elements that would assist policymakers in developing sustainable cultural tourism.

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1. Introduction

The global tourism industry attracts hundreds of millions of domestic and international travelers each year, making it a significant contributor to local economies worldwide (UNWTO, 2023b). According to the World Tourism Barometer, the global economy is projected to grow by 2.9% in 2024, highlighting tourism's potential role in this expansion (UNWTO, 2023a). However, while tourism development can positively impact local economies, it can also bring about various negative consequences for communities, particularly in historic urban areas (Vidal Rua, 2020). The perceptions of host communities regarding the impacts of tourism are critical to understanding these effects and to fostering sustainable tourism strategies.

Recent studies have extensively examined how host communities perceive the impacts of tourism development on their well-being and community life (Ko & Stewart, 2002). These studies have identified both positive and negative community perceptions of tourism. For instance, some research suggests that unfavorable perceptions are often linked to specific aspects of community life, such as public services and opportunities for civic engagement (Ko & Stewart, 2002). Conversely, other studies indicate that many residents believe tourism can improve their community's quality of life. Understanding these perceptions is essential for developing initiatives that foster local support for sustainable tourism development and reduce potential conflicts between visitors and residents (Lee, Li, & Kim, 2007).

Local perceptions of tourism can vary significantly, influenced by factors such as the extent of tourism development, the interaction between locals and visitors, and changes within the tourism sector itself. Allen et al. (1988) emphasized that the perceived impacts of tourism on community life are closely related to the scale of tourism development. Hence, understanding how local communities perceive tourism is crucial for planning and implementing sustainable tourism strategies that align with community expectations and needs.

Bahrain is a compelling case study for examining these dynamics, given its unique blend of archaeological heritage spanning 5,000 years and contemporary Arab culture. The nation draws tourists from neighboring Gulf Cooperation Council (GCC) countries and beyond, thanks to its rich historical legacy, which includes artifacts dating back over 9,000 years. Despite its limited physical and human resources, Bahrain's tourism sector is experiencing rapid growth, supported by the National Action Charter and Vision 2030, which emphasize economic diversification away from oil dependency (Sadiq Husain et al., 2022). The strategic importance of the tourism industry as a driver of economic growth was underscored in Bahrain's Vision 2030 (Oxford Business Group, 2022).

The economic impact of tourism in Bahrain is significant. For example, a 2022 survey by the Bahrain Tourist and Exhibitions Authority and the Information and e-Government Authority reported that revenues from inbound tourism increased by 175%, reaching approximately BHD 1.5 billion (MOFNE, 2022). Moreover, research indicates a correlation between tourism and economic growth in Bahrain, with findings suggesting a causal relationship between the two (Fuad, 2015; Kreishan, 2015). To maximize the potential of heritage tourism, numerous conservation and preservation projects have been launched, leveraging these as attractions for tourists (El-Ghonaimy & Al-Haddad, 2019).

While substantial research exists on local perceptions of tourism in underdeveloped countries, there is a notable gap in the literature concerning historic towns in more developed destinations, such as Bahrain. This study aims to address this gap by examining local perceptions of tourism in Muharraq, a historic city in Bahrain. It seeks to understand how residents' views on tourism-related issues, shaped by their demographic and socioeconomic backgrounds, impact the development of effective tourism strategies for these areas.

To achieve these objectives, the study focuses on the following research questions:

1. What are the perceptions of local residents regarding the impact of tourism on their city?
2. How can residents' perceptions and insights influence the development of sustainable urban tourism strategies in Muharraq?

By answering these questions, the research will provide valuable insights into the role of local perceptions in shaping tourism development strategies that balance economic growth with cultural preservation, thereby contributing to the broader field of urban tourism studies.
Figure 1 explains the main lines structuring the research.

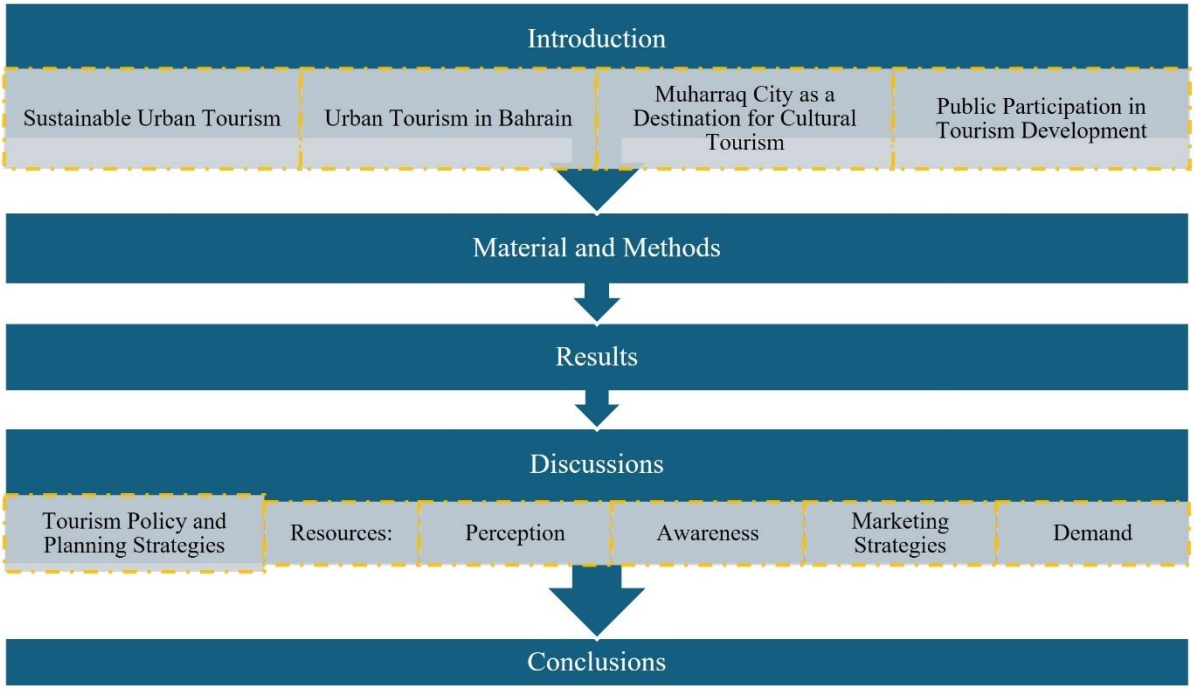


Figure 1. The Research Structure.

1.1. Sustainable Urban Tourism

As per UNWTO (2023a), urban tourism is known as *"a type of tourism activity which takes place in an urban space with its inherent attributes characterized by non-agricultural based economy such as administration, manufacturing, trade and services and by being nodal points of transport. Urban/city destinations offer a broad and heterogeneous range of cultural, architectural, technological, social and natural experiences and products for leisure and business"*. Since cities serve multiple purposes, there might be a wide range of reasons why visitors choose to visit them. Its multifunctionality allows for the simultaneous of multiple experiences, which complicates the link between (urbanity, mobility, sustainability, and tourism) (Aall & Koens, 2019). Many advantages come from urban tourism for urban communities: more local goods and services are produced, population growth and living standards are raised, arguments are made for building or upgrading basic infrastructure (roads, waterworks, parks, power plants, and electricity), the environment is improved, and the reputation that is needed to attract businesses is formed (Moulay, 2019). When the needs and desires of residents and visitors collide, cities face differing demands for services and amenities (LUU et al., 2021). Even if cities are more resilient and active than rural locations, increasing numbers of tourists may disrupt the harmony between various user groups and lower cities' living standards (Nia & Suleiman, 2017). These "tourist difficulties" are simultaneously connected to more significant societal problems and city stakeholders. Engaging all critical stakeholders in governance is especially difficult because many parties are engaged (Rahbarianyazd, 2017). One may even argue that the problems with sustainable urban tourism are so significant that they cannot be resolved within the confines of the existing (*political, social, and economic structures)*, necessitating a drastic change or revolution (Seyfi et al., 2019).
A significant contribution to the New Urban Agenda and the 17 Sustainable Development Goals—among which Goal 11 is to "*make cities and human settlements inclusive, safe, resilient, and sustainable*"—can come from urban tourism. A city's ability to grow and offer its citizens and visitors enhanced and improved living circumstances is fundamentally linked to its tourism industry

(UNWTO, 2020). The United Nations World Tourism Organization (UNWTO) first presented its viewpoints on the topic in 1993, marking the beginning of the conversation on sustainable tourism. Prior changes in the industry that resulted in social, economic, and ecological issues, prompted the inclusion of sustainable development on the agenda for tourist policy. Accordingly, the type of tourism that promotes actions that further the cause of universal and generational justice might be referred to as sustainable urban tourism (Aall and Koens, 2019).

1.2. Urban Tourism in Bahrain

With a total area of 771 square kilometres, Bahrain is composed of 51 islands. Blessed with a multitude of unique geographical features, the region boasts an astounding quantity of natural springs. Traditional customs and historical landmarks coexist with contemporary advancements and cosmopolitan life, and the nation presents an intriguing fusion of Eastern and Western cultures as tall structures compete for space with traditional buildings. With over 1850 persons per square kilometre, Bahrain's population—estimated at 1.42 million in 2017—is extremely densely inhabited. Foreigners from various nations and backgrounds make up 54% of Bahrain's population (Bahrain National Portal, 2024). Historical and traditional places in Bahrain serve as reminders of the country's rich past and robust cultural identity.

In Bahrain, the industry most impacted by the pandemic was tourism. Before the pandemic, Bahrain welcomed one million tourists on average each month, and the Bahrain Economic Board (EDB) reports that between 2015 and 2019, total inbound tourism spending grew at a compound annual growth rate of 9.9%. 12 million tourists visited Bahrain in 2018, and 11.1 million did so in 2019 (Figure 2). International arrivals fell to 1.9 million in 2020, an 83 percent decrease as a result of closed borders. This steep decline in foreign arrivals was accompanied by a corresponding decline in incoming tourism spending. According to the Oxford Business Group (2022) on tourism in Bahrain, total inbound tourism expenditure reached BD1.6 billion in 2019, however, this fell to BD692.5 million in 2020.

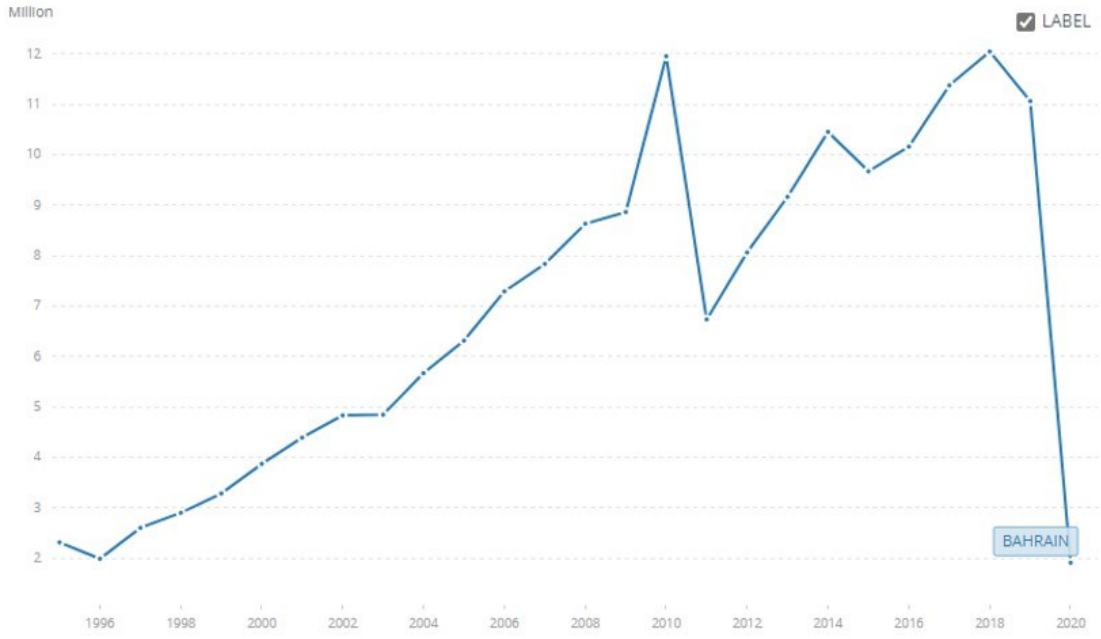


Figure 2. Arrivals tourists to Bahrain. Source: World Bank (www. data.worldbank.org)

Bahrain's Minister of Industry, Commerce, and Tourists, Zayed bin Rashid Al Zayani, unveiled the country's new 2022–2026 tourism plan in 2021. As indicated by the Minister, the plan's primary goals are to promote Bahrain as a major international tourism destination and to enhance the industry's GDP contribution. Among other initiatives, the goal is to establish cultural tourism as a primary draw for travellers to accomplish this (The Daily Tribune, 2021). The most recent figures for the period of January to June 2023 were released by the Bahrain Tourism and Exhibition Authority (BTEA) in

2023, and they showed impressive growth in the country's tourism industry. The most recent BTEA data shows that during the first half of 2023, Bahrain received an incredible 5.9 million tourists, a phenomenal 51 percent rise over the same period the previous year, when the Kingdom received 3.9 million visitors. This notable increase in visitors highlights Bahrain's increasing appeal as a top travel destination.

Bahrain is a desirable destination for both business and pleasure travel because of its geographical location, easy access, and wide array of services that suit a variety of tourists' tastes. According to M. Toorani, Director of Marketing & Promotion at BETA, the increase in tourists made Bahrain a top travel destination. She emphasized the goal of creating experiences that highlight Bahrain's rich past and culture (The Daily Tribune, 2021).

1.3. Muharraq City as a Destination for Cultural Tourism

Muharraq has been taken as this paper's case study due to its significant past and present impact on identity, comprising numerous historical elements in the Kingdom such as historical fortresses and magnificent traditional buildings, and is endowed with cultural importance. Muharraq was initiated by Al Khalifa in 1810, and its economy was Initially organized around a tribal, feudal system (El-Ghonaimy, 2020). In the past ten years, the city has witnessed a very active process of reviving its heritage, regenerating economic areas, implementing comprehensive infrastructure, and safeguarding communities. Muharraq, the third-largest city of Bahrain is located in the southwest part of the northern island (Figure 3). Muharraq is 1.5 miles away from the main island and linked to Manama city, the capital, by a causeway (Figure 4). In 2020, around 263,373 people were living in Muharraq (www.ceicdata.com). The city has maintained its historic charm despite numerous alterations over the years. The compact and organic urban fabric, which has developed over time, connects the various areas of the city and is in line with the prevailing natural and cultural conditions (Shubbar & Boussaa, 2022). Muharraq has gained recognition for its cultural contributions, exemplified by the numerous restored traditional Bahraini homes scattered throughout its winding streets and alleys (Figure 4). The Sheikh Isa bin Ali House, the Bin Matar House, the Abdullah al Zayed House, and other traditional homes that highlight various facets of Bahrain's rich legacy are among the remnants of these ancient homes that were once held by local pearl traders (BACA, n.d.). As the principal hub for the once-significant pearl-diving business in Bahrain, its harbour served as it expanded into a commercial hub. It met a complex web of interrelated cultural, social, religious, economic, and physical needs by utilizing local resources which created a link between the built environment and culture. Like all other Arab cities, Muharraq's urbanization was influenced by customary tribal laws, which is why it has many of the physical traits of Islamic Arab cities. Considered one of the finest examples of traditional Gulf urbanization, the city's distinctive organic form and architecture are evident in its network of homes, mosques, and trading facilities (Alraouf, 2014).

Figure 3. Al Muharraq city location in the map of Bahrain. **Source:**www.ontheworldmap.com

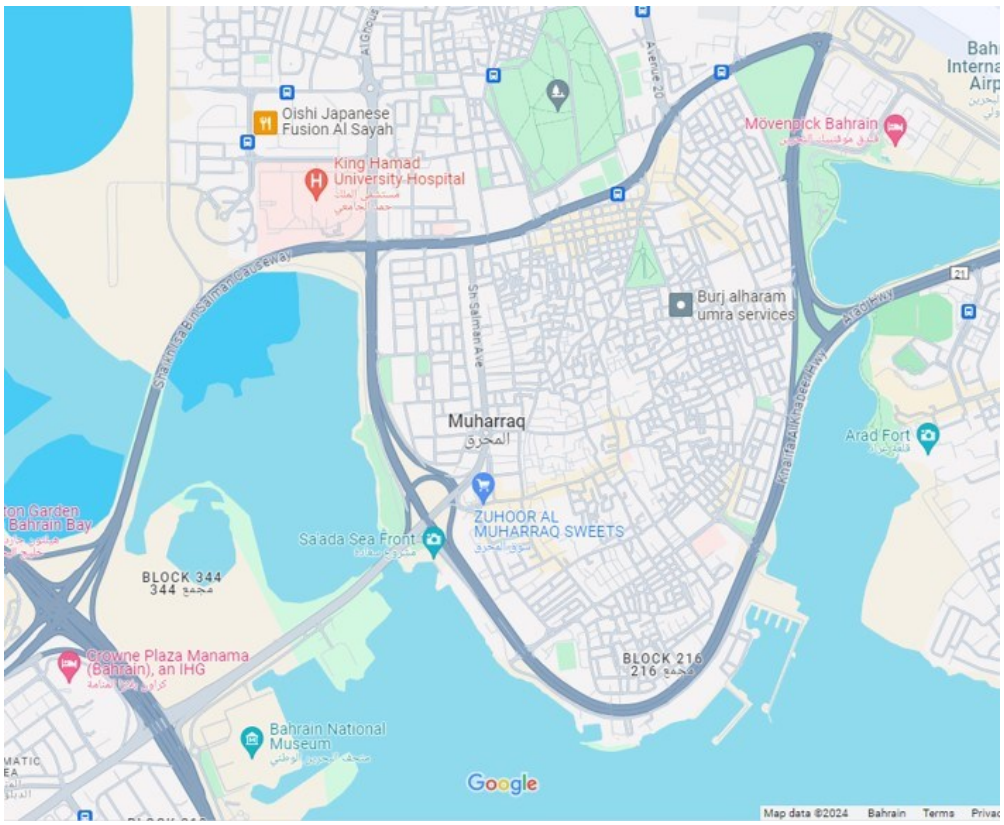
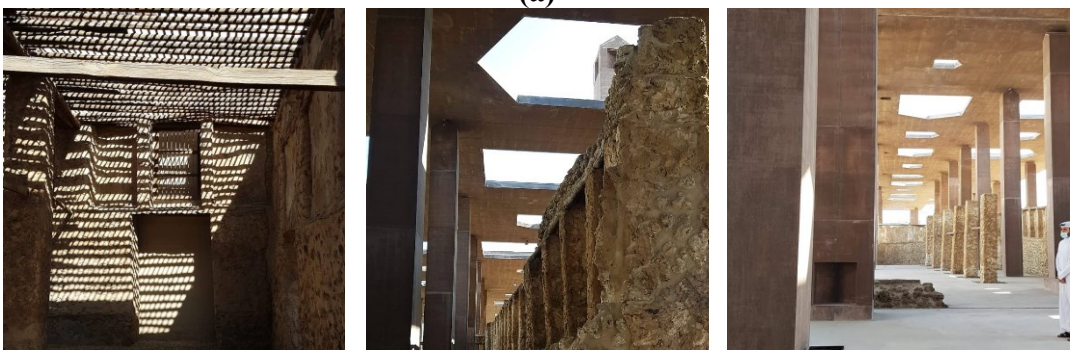


Figure 4. Map of Muharraq City, Bahrain. **Source:** www.google.com/maps

Nonetheless, the government moved to preserve and modernize the region's architectural legacy. A UN World Heritage site, the Pearling Path includes historic homes with their distinctive character (Figure 5a & 5b). His Majesty King Hamad Bin Isa Al Khalifa gave the orders to revive Isa Al Kabeer Palace and develop Muharraq in a way that maintains and protects its historical and cultural identity. An essential part of the country's character is its cultural heritage, developed, protected, and promoted

by the Bahrain Authority for Culture and Antiquities (BACA). The Authority aims to solidify culture's position as a social and economic advancement pillar and enhance Bahrain's standing as a nation that respects all cultures abroad. (BACA) as a government authority is working with all relevant official entities to highlight the historical and cultural significance of the city's rich tangible and intangible urban and cultural heritage through various urban renewal initiatives, like the Pearling Path project, that was implemented throughout the city of Muharraq (Sadiq Husain et al., 2022). The project is a representation of Muharraq's pearling era, which was recognized for many centuries as the most prominent pearling civilization and industry in the world (www.pearlingpath.bh). The project's goals are to provide community and cultural venues, enhance the town's environment, and draw local Bahraini families back to the area in order to balance the town's demographics. It also aims to highlight the town's heritage with the pearling business. The Pearling Path was successfully added to the UNESCO World Human Heritage List as part of the authority's efforts to promote the city's cultural and tourism status, and it is still working on cultural sites that highlight the city's historical relevance (BACA, n.d.).

(a)



(b)

Figure 5. (a) Traditional Buildings, and Al Qaisarya Souq in AL Muharraq. (b) The Pearl Path Project, AL Muharraq.

1.4. Public Participation in Tourism Development

According to Geddes et al. (2019), participatory design is predicated on five essential ideas. “Politics” in the sense that those who are impacted by a decision should have a chance to influence it; “people” in the sense that they are subject matter experts and can have a significant influence on design; “context” in the sense of circumstances; “methods” in the sense that they are a way for users to have an impact; and “product” in the sense of the ultimate objective of participatory design. Three major

themes with differing approaches can be used to organize participatory planning throughout the literature:

a. Reasons for choosing to participate in participatory design.
b. Potential levels of engagement; and
c. kinds of participants in terms of networks and scale.

Geddes et al. (2019) believe that the Design Participation development should shift its attention from asking "why people should engage" to asking "how" to apply the concept of participation. The impacts of tourism, which explain changes or repercussions on tourist development, have received more attention as tourism grows globally. Understanding locals' perspectives on tourism's consequences can help policymakers and other tourism sector players create more sustainable tourism policies and foster support from residents (Long & Kayat, 2011). The success of the tourism sector depends on the cooperation of locals, who must be amicable and welcoming to visitors and refrain from opposing tourism-related initiatives in their neighbourhoods. In the same way that they concentrate on drawing visitors, tourism planners should also take the time to comprehend locals' worries and perspectives regarding the effects of tourism. Numerous studies have looked into how locals perceive tourism's effects on their communities in recent years. At the positive end of the spectrum, Hammad et al. (2017) contend in their study about tourism in Abu Dhabi that the growth of tourism enhances the standard of living for locals, fosters cultural interactions with visitors, upgrades infrastructure, expands leisure options, fortifies cultural identity, and provides communities with economic advantages and job opportunities. Conversely, adverse consequences encompass low-wage tourism jobs, particularly in service sectors such as cleaning, security, and hospitality, which devalue locals in comparison to other employment prospects; loss of local resource access; development of tourism-related coping mechanisms; avoidance of tourist destinations that contradict local customs; and problems with crowding and security (Hammad et al., 2017).

According to a recent analysis, the most popular paradigm for looking at local viewpoints on tourism is the social exchange theory (Hadinejad et al., 2019). The aim of social exchange theory (SET) is to comprehend the resource exchange between people and groups in an interaction environment. According to the theory, the probability of an individual having a positive evaluation of a trade is higher when they believe the exchange holds benefits. One community feature that affects resident sentiments, according to Algassim et al. (2022) is the ability to control how tourism resources are used or how development is directed.

2. Material and Methods

This research utilizes a case study approach, focusing on Muharraq City, to explore the relationship between Bahraini residents' support for the expansion of the tourism industry and their perceptions of its negative consequences. The study aims to investigate urban tourism perceptions in historic areas and to understand how residents of Muharraq City perceive tourism-related issues, including how socioeconomic and demographic factors shape these perspectives. A qualitative research methodology was selected to provide comprehensive, descriptive data that would generate insights and perceptions regarding urban tourism (Hassan, 2024). Furthermore, this approach helps contextualize quantitative data, enhancing the understanding of public perceptions and offering explanations for quantitative findings.

The research methodology was structured into two main stages:

Stage One: A comprehensive literature review was conducted, focusing on the concept of sustainable urban tourism, the characteristics of urban tourism in Bahrain, and the specific appeal of Muharraq City as a cultural tourism destination. This stage also explored the role of citizen engagement in tourism development, drawing on insights and information from previous studies to establish a foundational knowledge base.

Stage Two: A survey was conducted using a qualitative methodology targeting a sample of Bahraini permanent residents over the age of 18, residing either in Muharraq or other Bahraini cities. The survey instrument consisted of three sections: the first section collected demographic data, including age, gender, and place of residence; the second section asked participants to rate their agreement or

disagreement with fourteen statements regarding urban tourism; and the third section solicited participants' recommendations for improving tourism planning in Muharraq. The survey was distributed online in both Arabic and English, and participants were encouraged to share the survey link with their acquaintances. Due to time constraints, the survey was conducted over one week, resulting in 83 responses from a diverse range of participants in terms of age, gender, education level, and background. Further details are provided in Table 3.

Additionally, open-ended interviews were conducted with Muharraq residents to document their opinions and analyze local perspectives on tourism-related issues in this historical heritage city. These one-to-one interviews aimed to capture a comprehensive understanding of participants' experiences, attitudes, and views. Depending on availability, interviews were conducted via video conference or in person, using open-ended questions to encourage in-depth responses.

To complement the questionnaire, several stakeholders and industry professionals were interviewed to gain insights into the tourism sector in Bahrain. These semi-structured interviews included ten open-ended questions focused on opinions about Muharraq City and its cultural tourism potential (Table 2).

Ethical considerations were carefully observed throughout the study. The purpose of the questionnaire and interviews was clearly communicated, and no personal information was collected from participants, ensuring anonymity and confidentiality.

Table 2: Experts Interview – Open-ended Questions on Cultural Tourism in Muharraq and the Authorities' Role in the Development of Tourism in Bahrain.

No.	Questions	Categories
1	Please give us insight into the status of tourism in Bahrain and what is targeted in the new tourism plan for the Kingdom of Bahrain.	Perception
2	What types of Tourism in Bahrain are more successful? Cultural, sports, medical, ecological, leisure,..etc?	
3	Why tourism is important for Bahrain?	
4	Do you think Bahrain's cultural tourism can be successful compared to the other types?	Demand
5	What are the stakeholders that need to collaborate to make Muharraq a successful cultural tourism destination?	Resources
6	Has any survey been conducted considering the social impact of tourism in Bahrain? (i.e. is tourism encouraging social interaction between residents and visitors? Is the satisfaction of the residents taken into account?	Awareness
7	What are the challenges that might face cultural tourism in Bahrain?	
8	In case of resistance from the residents towards tourist attractions in their area, what could be the solution to reach public satisfaction? Can public participation in the planning process and taking their concerns into consideration work?	Planning Strategies
9	From your experience, what are the recommendations to be considered in targeting Muharraq as a cultural tourism destination without causing any negative impact of overcrowding in the area (cultural differences, congestions in traffic, disturbance to quiet neighbourhoods, safety and security,..etc)	
10	What is the role of the BCCI Committee in making this type of tourism a successful one?	

Three parts make up the survey: the first recorded demographics, which were evaluated as follows: age (three age groups: 18–29, 30-49, and 50 and above), gender (male and female), and city of residence (Muharraq, or other cities).

The second component comprised 14 statements that assessed citizens' opinions of the four domains of tourist impacts on a scale from strongly disagree to highly agree. The characteristics were drawn from past research on locals' impressions of the cultural, social, economic, and environmental effects

of tourism carried out in areas with comparable cultural and environmental features, like Saudi Arabia and the United Arab Emirates (Algassim et al., 2022; Hammad et al., 2017). In the third section, there were measures of public support for tourism growth. The participants were given a checklist with seven recommendations that they believed would enhance cultural tourism in the city and benefit the community. The participants were free to contribute suggestions beyond those that were provided.

3. Results

Following the collection of information from the questionnaires and interviews, the demographics of the respondents were examined. Figures 6a, 6b and 6c display the respondents' age, gender, and place of residence. Most respondents were female (78.3%), and 21.7% were male. The majority of the respondents were in the younger age group of 18-29 (38.6%), 30-49 (37.3%), and the older age group above 50 years old were the least (24.1%). 51.8% of respondents live in Muharraq city while the rest were from different cities in Bahrain. The diverse demographics of the respondents demonstrated an increased interest in the research issue, particularly among the younger respondents who expressed concerns about the direction of their community development.

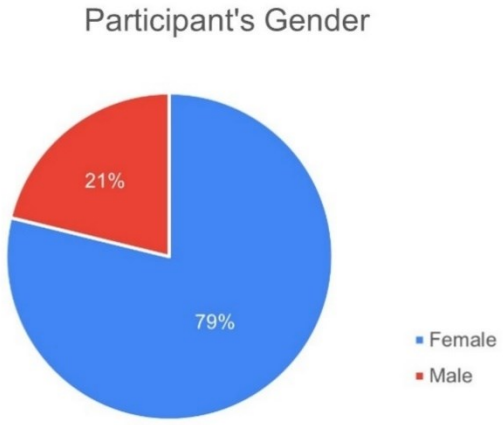


Figure 6a. Results of Participants' Gender.

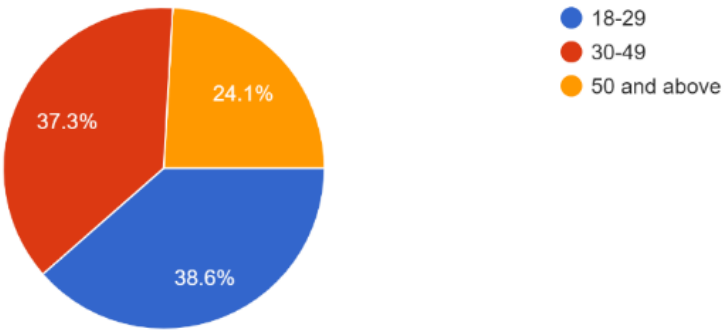


Figure 6b. Results of Participants' Age Group.

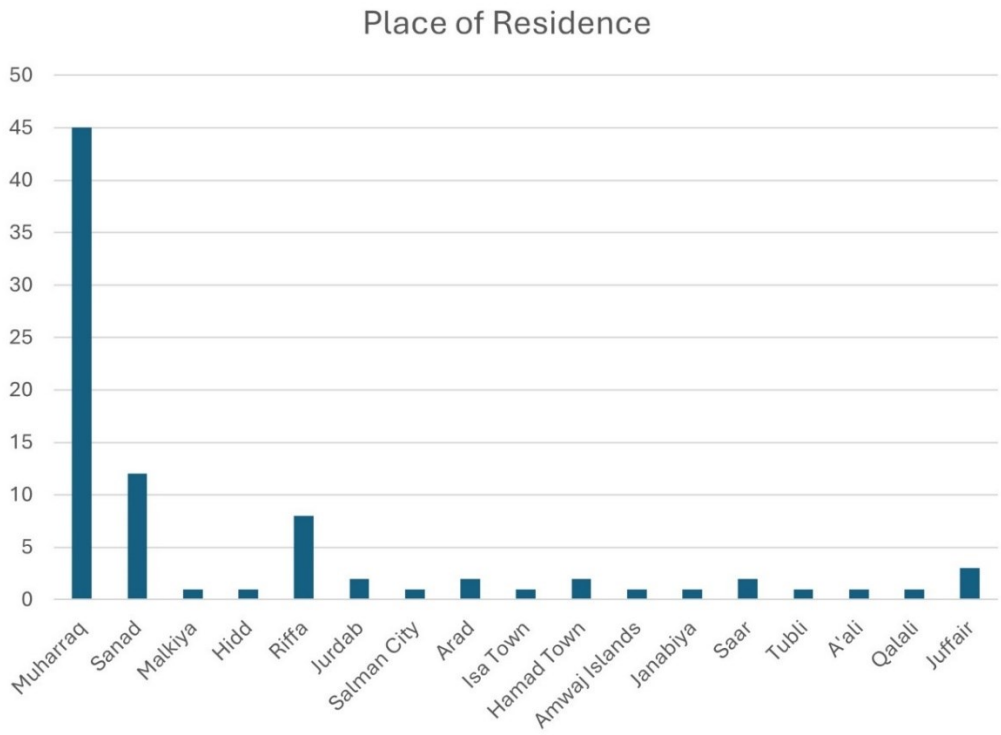


Figure 6c. Results of Participants' Place of Residence.

Statements measuring locals' impressions of the four dimensions of tourist impacts—cultural, economic, environmental, and social—were included in the second section of the questionnaire. The vast majority of respondents firmly concur that locals' perspectives are essential when it comes to Muharraq's tourism strategy. 57 of the respondents strongly agree that tourism can lead to protecting the historic buildings in the city. Table 3 displays the statements and the respondents' opinions that measure the residents' contribution to the future of tourism development in Muharraq.

Table 3: Respondents' Opinions on given Statements related to the Cultural Tourism in Muharraq City.

No.	Statement	Respondents' Opinions			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	Muharraq City can be an attractive cultural tourism destination.	57	24	1	0
2	I support Muharraq's continued development of cultural tourism.	52	27	3	0
3	The Bahrain Tourism & Exhibition Authority should consider residents' opinions and concerns in the planning of tourism in Muharraq.	61	18	3	0
4	Cultural Tourism supports the local business environment in Muharraq	46	32	4	0
5	Tourism increases real estate property prices in the area.	42	33	7	0
6	Tourism increases pride in cultural identity and preserves it.	56	22	4	0
7	Tourism increases parking problems due to overcrowding.	49	28	5	0

8	Interest in protecting the region's historic buildings rises as a result of tourism.	57	21	4	0
9	Tourists cause inconvenience to residents and disturb the tranquillity of the residential area in Muharraq.	15	38	26	3
10	Misbehaviour of tourists creates problems and dissatisfaction among residents due to cultural differences.	18	38	27	2
11	Tourism improves police service and security in the area.	24	41	15	2
12	Tourism causes pollution due to increasing traffic.	14	35	31	2
13	Tourism improves the appearance of Muharraq by improving services in the area.	43	33	6	0
14	Tourism can cause damage to cultural/historical venues.	9	20	45	8

Figure 7 illustrates the questionnaire's third portion. The vast majority of participants (85.5%) strongly concur that, in order to improve the area, the parking lots and pedestrian pathways should be kept apart. Conversely, 79.5 percent support the inclusion of outdoor seating areas and open spaces in the neighbourhood. Other approaches to boosting tourism in the city were suggested by a few individuals. In addition to improving the city's infrastructure and services, some recommendations called for increasing the number of family-friendly events.

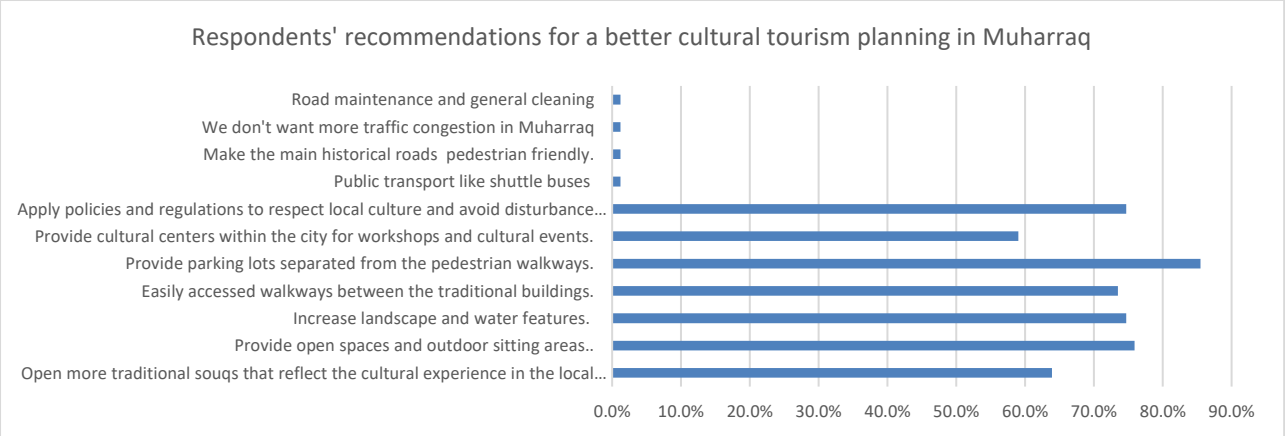


Figure 7. Results of Participants' Recommendations for Better Cultural Tourism Planning in Muharraq City.

The experts' interviews added another depth to the perception of tourism in the city and gave professional guidance towards proper planning for the tourism future without creating any conflicts with the residents and the environment. Two well-experienced individuals in the tourism sector were interviewed individually and asked open-ended questions that would clarify the policies and the authorities' strategies in the planning of tourism in the city. The interviews were transcribed, and themes were derived from the interviewees' responses that can influence tourism planning strategies in the area. Mr. J. A., the head of the Tourism and Hospitality Committee at BCCI, believes that taking into consideration the residents' concerns and recommendations is one of the key elements for the success of tourism development. Mr J. A. stated that the biggest challenge that faces cultural tourism in Muharraq is the rehabilitation of the historic and traditional areas due to being a sensitive procedure and extra care to be taken in the

conservation process to maintain the historic assets in the best way possible. Mr. J. A. and Mr. H. H., owners and CEOs of multiple hospitality projects in Bahrain, agree that enhanced communication between government agencies like Tamkeen, BTEA, and BCCI is necessary to create a more robust and healthy tourism development plan for Bahrain. This is vital to ensure the sustainability of cultural tourism in the nation.

4. Discussions

The overall qualitative research demonstrates a positive correlation between locals' favourable assessments of tourism's benefits and their support for its growth. The replies from stakeholders and locals to the questionnaires and interviews show several factors that may influence how cultural tourism is planned for sustainability. The findings emphasized challenges that could impede the development of sustainable cultural tourism in Muharraq City if they are not successfully addressed. To determine the origins of these difficulties, a fishbone diagram (Figure 8) is utilized to highlight these six aspects that were obtained from the data. Each factor is explained in the following section in relation to previous research findings.

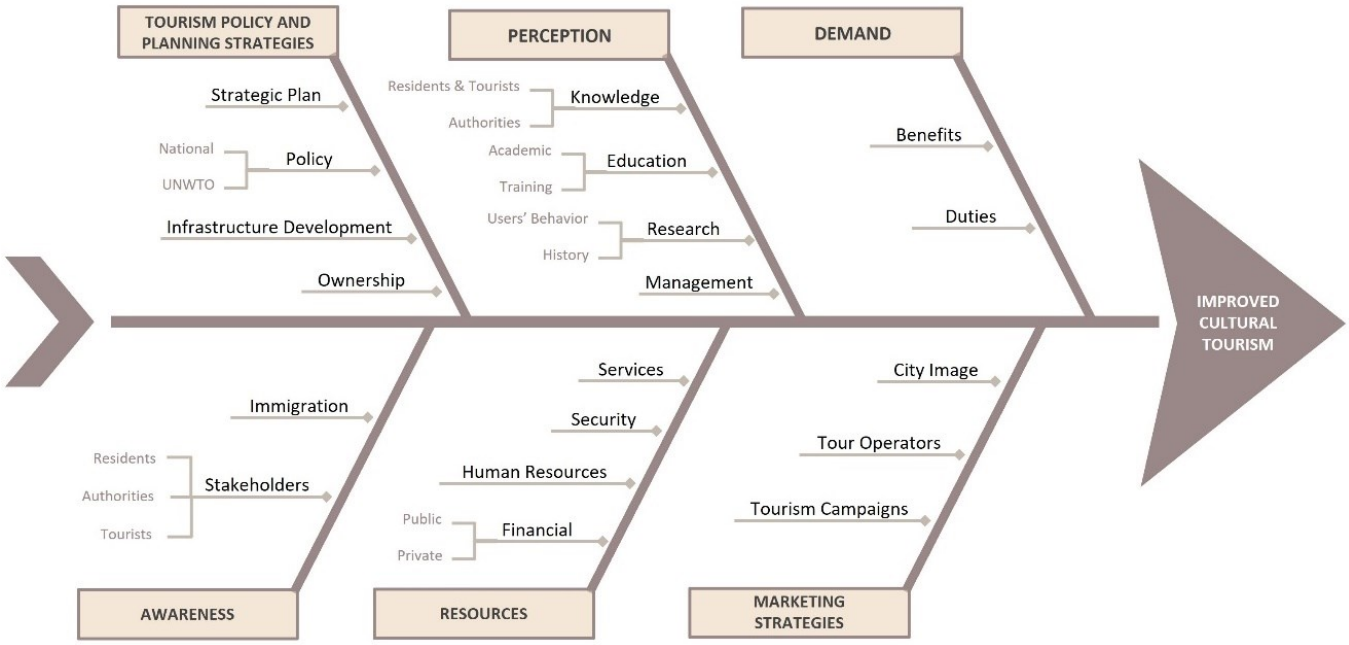


Figure 8. Fishbone diagram of factors affecting the development of cultural tourism in Muharraq City.

4.1 Tourism Policy and Planning Strategies

According to the data analysis, the main obstacle to tourism development was the lack of cooperation among stakeholders, which resulted in differing opinions about how to promote the business (Seyfi et al., 2019). These involve several aspects to consider which include well-studied strategic planning for cultural tourism, Policy, Infrastructure development, and standards to follow. The owners and the government's lack of collaboration may result in a disrespect for customs and standards, which can pose a number of challenges to the sustainable growth of tourism in these locations. According to Kapera (2018) research, a number of stakeholders must work together, exhibit effective management, and have the backing of the local government in order for sustainable development concepts to be successfully implemented. Representatives from the tourism sector expressed concerns during the interviews on the maintenance of assets other than the area's tourist attractions. They emphasized the need for a policy to be formed about this issue to maintain consistency in the development of the city's infrastructure.

MacKenzie & Gannon (2019) assert that a prerequisite for long-term growth is the merging of the government and private sectors.

4.2 Resources

This component covers every obstacle pertaining to resources, finances, and site conditions—these being the primary concerns of the locals. The majority of the respondents agree that a successful tourism strategy is to improve the services in the area. Wayfinding, basic amenities, paths, sewage and trash collection systems, and other weak infrastructure services are included in the code of services. One of the most crucial components of tourism growth is the provision of infrastructure and facilities (Seyfi et al., 2019). Activities in the city related to tourism may be impacted by the organizations' personnel and financial resources. The region's historical sites may not be sufficiently preserved if there is insufficient financing and a lack of skilled workers to maintain and restore the area's numerous historical landmarks and features. In addition, concerns about safety and security in Muharraq City's tourist zones were expressed in the majority of the comments. The way that safety is managed and how tourists behave both have a significant impact on these aspects (Hall et al., 2012). Visitor safety is an important matter that warrants special attention, as Woo et al. (2015) point out. This is especially true for locations deep within residential neighbourhoods, narrow walkways and pathways designated for pedestrian use.

4.3 Perception

The conclusions are heavily influenced by the opinions of numerous stakeholders. The main causes of this problem are a lack of research and a poorly designed knowledge management system. The tourism authorities' ignorance of cultural tourism and the challenges it might face, and the growth of urban tourism may be severely hindered (Kapera, 2018). Cooper (2018) believes that the management of knowledge has not been applied extensively in the tourism field, defining it as "*a sequential process of recording, creating, sharing, and leveraging from organizational knowledge*". The academic and professional training can greatly enhance the knowledge to be received in the tourism sector, as noted by one of the interviewed experts in the field. A further important obstacle to sustainable development is found to be the dearth of research on the architecture, history, and behaviour of visitors and locals at these sites. By providing locals with a stronger historical and cultural grounding, can increase their understanding of the key concerns surrounding the heritage assets' worth (Vargas, 2018).

4.4 Awareness

The data analysis revealed that authorities, migrants, stakeholders, and residents acknowledge Muharraq City's potential spiritual worth, its importance as a destination for cultural tourism, and the significance of developing sustainable management strategies for these cultural heritage assets. However, Muharraq City has a migratory population, which has a significant impact on how different populations engage with the city's historical sites (El-Kholei et al., 2019). Immigrants generally lack knowledge of the local culture and history, particularly those who were economically and socially disadvantaged when they immigrated. They don't seem motivated to find out this kind of information either. This ignorance opens the door to disregarding and even harming the destination's cultural legacy. Dutt et al. (2018) found a direct link between the degree of social attachment to tourism expansion and the length of time that individuals spend in a community. Nonetheless, the government authorities began to take steps to preserve and restore the region's architectural legacy in an attempt to spread awareness of the legacy's worth. The Bahrain Authority for Culture and Antiquities (BACA) wants to strengthen culture's role as a cornerstone of social and economic development and strengthen Bahrain's reputation as a country that values different cultures around the world. By raising awareness of this, industries like the arts, cultural tourism, and businesses associated with culture may have a significant impact on the economy by generating a lot of jobs and high-income streams, in addition to aiding in the recycling of local wealth. To achieve this goal, the collaboration between (BACA) and other pertinent official entities should be maintained closely and efficiently as part of the planning strategy for cultural tourism.

4.5 Marketing Strategies

According to the research findings, effective marketing strategies are one of the recommendations received. They are found to be critical to the development of cultural tourism (Hughes & Carlsen, 2010). To attract tourists, it is essential to create a picture of the location that mobilizes both cognitive and affective components. Travelers' knowledge and opinions about a place are tied to its cognitive dimension, while their sentiments toward the location are related to its affective dimension (Pezeshki et al., 2019). Inadequate operations by tour operators combined with poor marketing and promotional strategies might lead to a negative image of Muharraq City as a destination for cultural tourism.

4.6 Demand

The results show that the perceptions of negative effects on the environment and economy have an impact on locals' support for the growth of the tourism industry. The results indicate that Bahrainis are worried about the harm that tourism does to the environment. As per the recommendations received by the participants in the study, policies promoting tourism should promote eco-friendly travel and incorporate sustainable practices. A person's attitude toward a certain component of their environment is defined as "an enduring organization of motivational, emotional, perceptual, and cognitive processes" (Mothersbaugh et al., 2020). Understanding locals' demands and concerns can help policymakers and other tourism sector players create more sustainable tourism policies and foster support from residents (Long & Kayat, 2011). Perceptions, both good and bad, influence the growth of tourism. An analysis conducted recently by Hadinejad et al. (2019) revealed that empowered locals are more inclined to take advantage of tourism's potential economic, psychological, social, or political benefits as well as to engage in it. This also supports the notion that social cohesiveness can assist locals in creating unique identities and products, as well as in establishing themselves in the market (Parga Dans & Alonso González, 2019). The research successfully identified the factors that are found to be crucial in the strategic planning towards developing sustainable and efficient cultural tourism in Muharraq city.

5. Conclusions

This study explored the development of tourism strategies in Muharraq, focusing on local residents' perceptions and their impact on shaping sustainable urban tourism policies. The findings emphasize the importance of incorporating local insights into tourism planning to ensure that economic growth does not compromise cultural preservation. Bahrain's recent strategic focus on diversifying its economic resources includes a robust plan to enhance the tourism sector as a significant economic contributor. Heritage tourism, identified by the Bahrain Authority for Culture and Antiquities (BACA) as a key area, aims to attract both domestic and international tourists, thus strengthening the tourism industry and delivering social and economic benefits. To align with national goals for sustainable tourism, it is crucial to incorporate residents' perspectives into strategic planning, ensuring a balance between economic development and cultural preservation.

In line with BACA's vision of fostering a supportive tourism environment, this research centred on improving cultural tourism in Muharraq by integrating local residents' views. The study highlighted that valuing community input helps shield Bahraini communities from potential social, cultural, environmental, and financial harm. The data gathered revealed several key factors influencing the growth of cultural tourism in Muharraq City, including policy and planning strategies, area resources, decision-makers, users' perceptions, residents' awareness, marketing strategies, and demand. The use of a fishbone diagram effectively identified these crucial aspects, illustrating their importance in strategic planning for sustainable urban tourism in historic areas.

The findings underscore the need to enhance infrastructure for both residents and tourists while preserving the social fabric and economic vitality of cultural sites. The study emphasizes the utility of using tools like the fishbone diagram in future research, given its effectiveness in analyzing the factors affecting perceptions of urban tourism in historic areas like Muharraq City. Moreover, this research discusses the importance of public participation in tourism development. The qualitative analysis provides comprehensive insights into perceptions of urban tourism, demonstrating a positive correlation

between residents' support for tourism growth and their perception of its impact on their community. Expert interviews further clarified key issues affecting the development of cultural tourism and identified challenges that must be addressed to ensure sustainability.

The study's limitations stem from the small sample size due to time constraints, making it exploratory in nature. To enhance the generalizability of the findings, future research should include a larger and more diverse group of participants and additional interviews with other officials to gain a deeper understanding of the strategies and regulations required for sustainable cultural tourism. This expanded scope could help mitigate the influence of individual opinions and provide more comprehensive guidance for fostering public participation in tourism development.

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Conflict of Interests

The Author(s) declares(s) that there is no conflict of interest.

Data availability statement

The research data is available within the article or its supplementary materials.

CRediT author statement:

Conceptualization: A.E.M. and I.H.E. Data curation: A.E.M. and I.H.E. Formal analysis: A.E.M. and I.H.E. Investigation: A.E.M. and I.H.E. Methodology: A.E.M. and I.H.E. Project administration: A.E.M. and I.H.E. Writing—original draft: A.E.M. and I.H.E Writing—review and editing: A.E.M. and I.H.E. All authors have read and agreed to the published version of the manuscript.

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Factors Affecting Urban Housing Development in Lusaka, Zambia

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ABSTRACT

This study investigates the factors affecting urban housing development in Lusaka, Zambia, a city facing significant challenges due to rapid urbanization and a high prevalence of inadequate housing. Utilizing the Delphi method, data was collected through two iterative rounds from a panel of 10 experts to identify and evaluate 15 factors contributing to poor housing outcomes. The findings reveal that political influence, poor linkage between infrastructure investment and service delivery, lack of access to affordable housing finance, weak urban governance, and high mortgage interest rates are the key factors impeding urban housing development in Lusaka. The study recommends developing an integrated housing planning framework, tailored housing finance products for low-income earners, and promoting governance principles to enhance transparency and accountability in housing development. This research provides valuable insights for policymakers and stakeholders in Sub-Saharan Africa, highlighting socio-economic areas requiring intervention to achieve sustainable urban housing development.

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Highlights:	Contribution to the field statement:
- The study identifies key factors affecting urban housing development in Lusaka, Zambia, including political influence and high mortgage interest rates. - The research employs the Delphi method, engaging a panel of experts to achieve consensus on the factors contributing to poor housing.	This study uniquely contributes to urban housing literature by identifying the primary socio-economic and political factors impeding housing development in Lusaka, Zambia, using the Delphi method. It provides valuable insights for policymakers and stakeholders in addressing housing shortages and improving urban planning in the Global South.

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1. Introduction

The rapid rate of urbanization poses significant challenges to housing and other key infrastructure, particularly in cities of the Global South. In contrast to other parts of the world, where urbanization is driven by industrialization and economic development, urbanization in Africa is primarily characterized by rural-urban migration of low-income earners without corresponding investment in housing infrastructure (Songsore, 2020). This trend has led to substantial difficulties in accommodating the growing urban population.

Africa's urban infrastructure deficit must be viewed within the context of resource scarcity (Okeke et al., 2020). Many African cities face a persistent lack of adequate housing, with approximately 80% of urban dwellers living in substandard conditions (Collier and Venables, 2016). These informal settlements, often composed of single-story shacks, lack access to basic amenities such as water, sanitation, and electricity, and are frequently constructed in violation of planning or building regulations. In contrast, modern residences catering to wealthier populations coexist within the same urban fabric, highlighting the disparity in housing provision (Zehra et al., 2019).

In this context, the current research focuses on identifying the key factors contributing to poor urban housing development in Lusaka, Zambia. Although the challenges associated with urban housing development in Zambia are well-documented (Tipple, 2015; Munshifwa, 2015; Mwamba, 2020), there remains a gap in understanding the specific factors that contribute to poor housing outcomes. Addressing this gap is essential for developing targeted solutions to improve urban housing conditions. This study employs the Delphi method, involving expert consensus to identify and evaluate these factors. The methodological approach is illustrated in Figure 1.

The primary objective of this research is to identify the key factors leading to poor urban housing development in Lusaka.

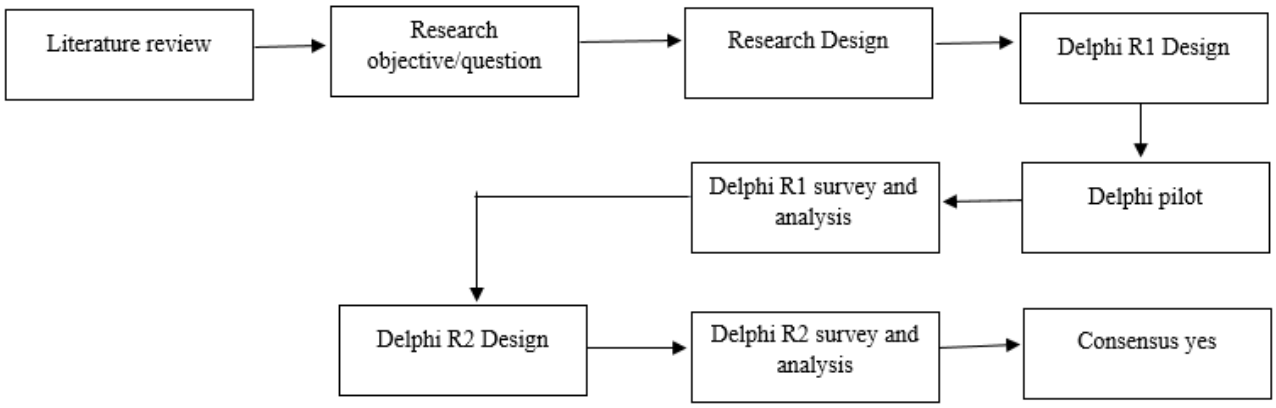

Figure 1. Methodological approach.

1.1 Selection of Variables/Factors militating against Housing Development

The factors contributing to poor urban housing in the Global South differ significantly from those experienced in developed countries. Lopes et al. (2020) argue that, in many developing countries, investment in infrastructure and service delivery is not effectively linked with land-use planning. Richmond et al. (2018) also noted the lack of synchronization between town planning and investment in critical infrastructure, such as roads, industrial parks, energy networks, water supply systems, and waste treatment facilities, which are essential for slum upgrading programs. In Africa, investment in housing and other vital infrastructure has been inadequate; for instance, by 2014, housing investment lagged behind urbanization by nine years across the continent (Grekou and Owoundi, 2020).

Funding for housing development, like many other development challenges in the Global South, remains a complex issue due to inadequate conditions or infrastructure that would typically attract such investment. High urban land costs (Oladehinde et al., 2023; Nkubito, 2022), insecure tenure, increasing housing construction costs, and the prevalence of slums are additional critical issues that

exacerbate the urban housing crisis in developing countries (Chileshe et al., 2022). A summary of other factors identified from the literature is presented in Table 1.

Table 1: Factors contributing to poor urban housing in developing countries (Source: Researchers' literature survey).

Factors	**Author (s)**
Political influence	Cartwright et al. 2018; Jarah et al. 2019; Rodríguez-Pose & Storper, 2020
Ineffective planning	Bah et al. 2018; Auwalu & Bello, 2023
Weak regulatory framework	Changula, 2015; Bah et al. 2018
Low institutional capacity	Changula, 2015; Mutale et al., 2020; Tembo et al., 2020
Poor coordination	Changula, 2015; Yazdani et al., 2015; Jankauskaitė-Jurevičienė & Mlinkauskienė, 2021
Inadequate policies and legislation	Munshifwa, 2015; Chisumbe et al, 2022
Lack of Budgets for disciplinary work	Sette Whitaker et al., 2020; Chisumbe et al. 2024
Lack of skills and incentives for working together	Sette Whitaker et al., 2020
Weak urban planning institutions	Güneralp et al. 2017; Jarah et al. 2019
Insufficient public and private investments in housing.	Bolay, 2015; Watcher, 2018; Mwanaumo et al., 2020
Governance capacities are notably weak or absent in many African Cities.	Cartwright et al. 2018; Hantalo et al. 2023
Non-availability of low-cost serviced land	Oladehinde et al. 2023
Non-availability of institutional credit at low interest rates to developers	Oladehinde et al. 2023

1.2 Contextualizing the Problem of Urban Housing Development in Zambia

The housing deficit in Zambia is estimated to exceed 2.8 million units and could surpass 3 million by 2030 if no significant action is taken (Phiri, 2016; Chisumbe et al., 2024). Similar to many African countries, cities in Zambia are expanding through two parallel systems: formal and informal. The formal system offers adequate housing with basic services, while the informal system consists of substandard housing in unplanned areas, lacking essential services and prone to flooding (Baye et al., 2020). Strikingly, most urban growth in Zambia has occurred within informal settlements characterized by poor housing conditions. This urban expansion is driven primarily by rural-urban migration. However, the increase in urban population has not been matched by corresponding investments in housing infrastructure and services (Munshifwa, 2015).

In Lusaka, the focus area of this study, nearly 70% of the housing stock is considered substandard and informal (Phiri, 2016). The majority of residents live in unplanned settlements characterized by inadequate waste management, unreliable water supply, and frequent electricity outages. Flash floods are common during the rainy season due to poor drainage infrastructure, and inadequate sanitation often leads to groundwater contamination, posing significant public health risks such as cholera and diarrhea. The government lacks a clear strategy to address the issue of unplanned settlements, and inadequate community sensitization on housing development issues has led to resistance against improvement programs.

Poor stakeholder coordination further hinders housing development in these areas. The high cost of housing is another significant barrier; an analysis of the relationship between income levels and house prices across Sub-Saharan African countries revealed that formal housing remains unaffordable for most people in Zambia (Tipple, 2015). This study seeks to provide insights into these challenges by identifying the key factors affecting urban housing development in Lusaka, Zambia.

2. Materials and Methods

2.1 Study Design

This study utilized the Delphi method to identify factors affecting urban housing development in Lusaka. The Delphi method is a systematic approach that emphasizes the importance of aligning research with real-world practices and decision-making (Ogunbayo et al., 2023). This technique relies on the principle that expert judgment on a specific issue becomes more reliable when a collective consensus is achieved. The Delphi method involves gathering input from a group of experts who anonymously express their views on a given topic until a consensus is reached (Shariff, 2015). McPherson et al. (2018) also note that this method allows researchers to leverage the experiential insights of participants regarding the topic under investigation.

The use of the Delphi technique in this study is supported by its recognized strengths. Aghimien et al. (2021) argue that the Delphi method equips researchers to better predict future trends compared to theoretical approaches or simple trend extrapolation. The Delphi method is particularly beneficial for policy and decision-makers because it generates actionable information (Aliu et al., 2021).

2.2 Selection of Delphi Panelists

The selection of Delphi panelists was based on several established criteria to ensure the reliability and validity of the findings. Various scholars have proposed different strategies for selecting Delphi experts. For instance, Aliu et al. (2021) suggest that criteria should include extensive work experience, a high level of involvement in jobs related to the topic, and sound knowledge and understanding of the study area. Similarly, McCarthy et al. (2023) emphasize the importance of selecting experts with direct involvement in the area of inquiry, significant knowledge of the subject, and relevant work experience.

Other Delphi studies, such as those by Shariff (2015) and Gunduz and Elsherbeny (2019), have considered additional factors for selecting experts, including broad work experience in the relevant field, a minimum of a bachelor’s degree, recent or ongoing involvement in similar projects, professional registration, willingness to participate in multiple rounds of surveys, and substantial understanding of the topic.

Studies by Gad and Shane (2017) and Kermanshachi et al. (2020) used selection criteria similar to those proposed by Hallowell and Gambatese (2010). These criteria include the experts' experience in delivering presentations or lectures, publishing books or articles on related topics, their education level, and professional experience in fields related to the study area. Given the comprehensive nature of these guidelines, this study adopted Hallowell and Gambatese's (2010) criteria for selecting experts to participate in the Delphi survey. This approach ensured a robust basis for generalization, as detailed in Table 2.

Table 2: Expert Panelists Composition: Legend: **SIZ**: Surveyors institute of Zambia, **ZIA**: Zambia institute of Architects, **ZIP**: Zambia institute of planners, **EIZ**: Engineering institute of Zambia: **R**#: Respondent.

Id	Institution	Highest degree	Peer Reviewed Journal articles	Presented at conference	Member or chair of a committee	Years of industry experience	Professional Affiliation	Job related to Housing
R#1	Academia	PhD	10	4	1	26	SIZ, VSRB	Yes
R#2	Academia	PhD	8	2	3	30	SIZ, EIZ	Yes
R#3	Local Authority	Masters	0	0	1	10	ZIP	Yes
R#4	Government Ministry	Master	0	0	1	20	ZIA	Yes
R#5	Government Ministry	PhD	4	1.5	1	22	ZIP	Yes
R#6	NGO	Masters	0	0	1	9	ZICA	Yes
R#7	Mortgage lender	BSc	0	0	1	13	SIZ	Yes
R#8	Quasi Gov. Housing Institution	Masters	2	0	1	10	ZIA	Yes
R#9	Private consultant	Masters	8	1.5	1	20	ZIP	Yes
R#10	Private developer	BSc	0	0	1	14	ZIA	Yes

The composition of the panel of experts consisted of 3 architects (Resp 4, Resp 8, and Resp 10), 1 Quantity Surveyor (Construction Economics and Management) (Resp 2), 3 urban and regional planners (Resp 3, Resp 5 and Resp 9), 2 real estate/property professionals (Resp 1 and Resp 7), and 1 economic development professional representing the non-governmental organisations (Resp 6) as shown in table 3.

Table 3: Expert Panellists Qualification types.

Item no.	Type of Qualification	Number of Experts
1	Architects	3
2	Construction Economics & Management	1
3	Urban and Regional Planners	3
4	Real Estate or Property studies	2
5	Economics and Development	1
6	Total	10

An important aspect of the panel was the vast amount of cumulative experience that they had in housing development and planning. The cumulative experience was 174 years translating to an average of 17 years. More so, the panels consisted of experts from various sectors of housing

development. All the panellists satisfied the conditions as set in Hallowell and Gambatese's (2010) guidelines.

The rationale behind the panel composition is that most of the sampled experts had academic qualifications in built environment or allied programmes, hence, they had the required level of understanding of housing development.

2.3 Number of Expert Panelists

There is no consensus in the literature on the minimum number of experts required for a Delphi study. However, several guidelines are available for consideration in scholarly research. For instance, Hallowell and Gambatese (2010) suggest that a panel of 8 to 12 experts is sufficient, while Alarabiat and Ramos (2019) propose a minimum of 10 experts. Similarly, Alomari et al. (2018) recommend a minimum of 7 experts, and Gunduz and Elsherbeny (2019) suggest selecting between 8 to 20 experts. Based on these varied recommendations, this study opted for a panel of 10 experts, which aligns with the guidance provided in prior Delphi studies. It is important to note that the sample size in Delphi studies is determined not by statistical power but by the expertise of the panelists and the quality of the consensus reached.

2.4 Iterative Rounds and Consensus Determination

The study began by compiling a list of factors from the literature, which were then used to develop a questionnaire for the expert panelists. The experts were asked to rate their level of agreement on whether each identified factor contributed to poor urban housing development in Lusaka using a scale of 1 to 10:

- 1–2: Strongly disagree
- 3–4: Disagree
- 5–6: Fairly agree
- 7–8: Agree
- 9–10: Strongly agree

The Delphi method was employed to achieve consensus among the experts through iterative rounds of questionnaires and controlled feedback. Different scholars have adopted various measures for determining consensus. While some assert that a 100% agreement among participants constitutes consensus, others believe that a two-thirds majority is sufficient (Somiah, 2019; Aghimien et al., 2021). In this study, a consensus was defined as 60% agreement among the experts on each statement. The survey was conducted over two iterative rounds. After each round, the median, mean, standard deviation, percentages, and interquartile deviation (IQD) scores for each question were calculated. Following the first round, the questionnaire with the calculated group medians was sent back to the panelists. If any score was more than one unit above or below the group median, the experts were asked to provide detailed explanations for their responses. The survey proceeded to a second round, after which consensus was achieved on most factors influencing urban housing development in Lusaka.

The scale adopted for consensus determination, informed by Mambwe et al. (2021) and Yankah (2019), was as follows:

- A group median of 9 to 10, with a mean of 8 to 10 and an IQD of ≤1, indicated a strong consensus.
- A group median of 7 to 8.99, with a mean of 6 to 7.99 and an IQD between 1.1 and 2, indicated good consensus.
- A group median of ≤6.99, with a mean of ≤5.99 and an IQD between 2.1 and 3, indicated weak consensus.

In Delphi studies, such as this one, the IQD obtained after iterative rounds serves as a robust indicator of expert agreement (consensus). Although reaching a consensus often involves up to three rounds, the actual number of rounds is less important than the level of agreement achieved at the conclusion of each round.

2.5 Ethical Considerations

Several ethical considerations were addressed in this study, including anonymity, iterations, statistical aggregation of group responses, and controlled feedback. Anonymity was ensured by preventing face-to-face interactions among the expert panelists to minimize groupthink and bias. The iterative rounds allowed the experts to review and, if necessary, revise their responses, thereby enhancing the reliability of the findings.

3. Results

3.1 Assessment of Key Factors Affecting Urban Housing Development in Lusaka

An assessment was conducted to identify the key factors affecting urban housing development in Lusaka. A list of factors compiled from the literature was presented to the expert panelists, who were asked to rate their level of agreement on whether each factor contributed to poor urban housing development in Lusaka. After the first round, all factors achieved group medians of at least 7, except for "inadequate housing legislations and policies," which scored a median of 5, as shown in Table 4. However, since the interquartile deviation (IQD) indicated a lack of consensus for all but two factors, a second round was conducted to reach a consensus.

Table 4: Key Factors Affecting Urban Housing Development in Lusaka. (Round 1).

Factors	Median	Mean	Std.	IQD
Low institutional capacity	8	6.90	2.64	3.25
Inadequate housing legislation and policies	5	4.40	1.84	1.75
Ineffective urban planning	8	7.50	2.12	3.00
Weak urban governance	9	8.40	1.43	2.50
Weak housing regulatory framework	7	6.70	2.79	4.50
Stakeholders disembodied approach	7	6.70	1.64	1.00
Political influence	10	8.10	2.64	2.75
Lack of budgets for cross-disciplinary works	8	7.30	2.41	4.75
Limited skills & incentives for planning institutions to work together	7	6.40	3.53	5.50
Poor linkage between infrastructure investment and service delivery	9	8.00	2.49	2.50
Low private sector and community involvement	7	6.50	2.72	3.25
Lack of access to affordable housing finance	9	8.30	2.16	2.00
Limited access to land	10	8.50	1.78	3.00
Corruption	8	8.00	1.76	3.50
High mortgage interest rates	10	9.10	1.20	1.00

Legend: **Std**: Standard deviation, **IQD**: Interquartile deviation.

After the second round, the findings revealed strong agreement on political influence, poor linkage between infrastructure investment and service delivery, lack of provision of housing finance, limited access to land, weak urban governance, Corruption, and high mortgage interest rates as key factors leading to poor housing development with the group medians in the range of 9 to 10. The IQD values were less or equal to one, except for weak urban governance and corruption which had IQD values of 1.50 and 2.00 respectively, further, their std values showed consistency.

Similarly, there was agreement on low institutional capacity, ineffective urban planning, weak housing regulatory framework, stakeholders' disembodied approach, lack of budgets for cross-disciplinary works, and low private sector and community involvement. These were factors identified as causes of urban housing development in Lusaka as denoted by the group medians of 7 to 8 with most of the IQD values indicating common consensus. However, attributes such as limited skills and incentives for planning institutions to work together had some far outliers, with (panellists) insisting that there are sufficient skills and incentives for planning institutions to work together as indicated with the IQD value of 3. Lastly, there was only 1 factor (inadequate housing legislations and policies) which was considered to have a fair contribution to poor urban housing development in Lusaka with a group median of 5 and IQD value of 1 as shown in Table 5.

Table 5: Key Factors Affecting Urban Housing Development in Lusaka. (Round 2).

Factors	Median	Mean	Std.	IQD	Rk
Political influence	10	9.80	0.42	0.00	1
High mortgage interest rates	10	9.80	0.42	0.00	2
Lack of access to affordable housing finance	9	9.30	0.67	1.00	3
Limited access to land	9	9.10	0.99	1.00	4
Weak urban governance	9	8.90	0.99	1.50	5
Poor linkage between infrastructure investment and service delivery	9	8.30	2.31	0.75	6
Corruption	9	8.60	1.58	2.00	7
Ineffective urban planning	8	7.90	1.79	0.75	8
Low institutional capacity	8	7.80	2.49	1.00	9
Lack of budgets for cross-disciplinary works	8	8.30	1.57	1.75	10
Low private sector and community involvement	8	7.70	1.77	1.75	11
Stakeholders disembodied approach	7	7.30	1.06	0.00	12
Weak housing regulatory framework	7	7.50	2.37	2.5	13
Limited skills & incentives for planning institutions to work together	7	7.00	2.75	3.00	14
Inadequate housing legislations and policies	5	4.50	1.27	1.00	15

Legend: **Std**: Standard deviation, **IQD**: Interquartile deviation, **Rk**: Ranking.

3.2 Reliability Statistics

In determining the internal reliability of the scores, Cronbach alpha was computed and the results yielded a value greater than 0.7 at 0.860, an indication of internal reliability (Aigbavboa, 2014) as shown in Table 6.

Table 6: Reliability Statistics.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.860	.923	15

4. Discussion

The study aimed to identify the key factors affecting urban housing development in Lusaka. The findings reveal several critical challenges, including low institutional capacity, ineffective urban planning, weak urban governance, an inadequate housing regulatory framework, a disjointed approach among stakeholders, political influence, insufficient budgets for cross-disciplinary initiatives, limited skills and incentives for planning institutions to collaborate, poor linkage between infrastructure investment and service delivery, low private sector and community involvement, limited access to affordable housing finance, restricted access to land, corruption, and high mortgage interest rates.

These findings are consistent with previous studies. For example, Lopes et al. (2020) and Grekou and Owoundi (2020) have highlighted the lack of a clear linkage between infrastructure investment and service delivery in many African countries and cities. Doebele (2022) and Nkubito (2022) further emphasize that poor and low-income households face significant challenges in accessing land due to the market regulation of well-located, registered land, which creates affordability issues. Additionally, other scholars have identified issues such as ineffective urban planning (Güneralp et al., 2017), political influence, weak urban governance, and a disjointed stakeholder approach (Hantalo et al., 2023; Jankauskaitė-Jurevičienė & Mlinkauskienė, 2021; Cartwright et al., 2018).

4.1 High Mortgage Interest Rates

The findings align with the literature that identifies high mortgage interest rates and the lack of affordable housing finance as significant challenges in housing development. Nakiwala et al. (2022) and Dafeamekpor et al. (2022) emphasize that access to cheaper, long-term funds is crucial for housing delivery. Scholars such as Asabere et al. (2016) and Udoka Kpataene (2017) argue that credit

finance and mortgage loans positively impact housing development. Blackwell et al. (2017) support this view, noting that easy access to finance enhances housing supply. Bah et al. (2018) further highlight that the availability of housing finance facilitates decisions to acquire, build, or rent a house. Glaeser and Gyourko (2018) underscore that housing units are the most valuable assets for most families, reinforcing the need for accessible finance for both housing demand and supply. Edwin et al. (2023) suggests that measures facilitating access to housing finance can significantly improve housing development.

4.2 Legislation and Policies

The study's results are consistent with Munshifwa (2015), who highlights inadequacies in legislation and policies as barriers to housing development. Various scholars stress the importance of a legal framework in urban housing growth. Olonde et al. (2022) argue that integrated management of several elements, including legal aspects, is crucial for sustainable urban growth in housing. Mhlongo et al. (2022) emphasize that the legal framework should encompass all areas that determine the production and availability of affordable housing, including legislation affecting housing inputs like land and finance. McCawley (2019) notes that improving the legal and regulatory environment is vital for enhancing living conditions for the urban poor. Furthermore, Galster and Lee (2021) and Wetzstein (2022) reaffirm that a conducive policy environment is essential for housing development. Tiwari et al. (2016) underscore the need for laws related to land titles, tenure forms, and housing transactions to ensure efficient housing markets.

4.3 Stakeholder Disembodied Approach

The study confirms Yazdani et al. (2015) and Changula (2015)'s assertion that poor coordination among stakeholders contributes to inadequate housing development. Urban housing development requires input from government, civil society, and the private sector, necessitating both 'top-down' and 'bottom-up' feedback (Connective Cities, 2020). Effective implementation of the 2030 Agenda relies on coordinated planning and cross-sectoral cooperation (Horan, 2022). Torvinen and Haukipuro (2018) stress the importance of coordinating public and private stakeholders during and after construction projects. Raynor and Whitzman (2021) similarly advocate for intersectoral coordination among government institutions, private sectors, and NGOs. Successful urban development requires collaboration across various sectors (Ravetz, 2016; Chisumbe et al., 2024). Eweje et al. (2021) emphasize that the successful participation of all actors is crucial for achieving desired developmental targets.

4.4 Low Institutional Capacity

The findings also support Changula's (2015) and Emiru et al. (2023)'s assertion that low institutional capacity hinders urban housing development. According to Medeiros and Van Der Zwet (2020), effective urban growth requires strengthening capacities at all levels among all stakeholders, integrating individual, institutional, and policy dimensions. Satterthwaite (2016) highlights the importance of enhancing the capacity of national and local governments to meet urban sustainability commitments. Medina et al. (2015) suggest capacity-building measures, including interdisciplinary training and knowledge-sharing, to address urban challenges effectively.

4.5 Low Private Sector and Community Involvement

The results are consistent with Ramovha (2017), who argues that low private sector and community involvement negatively affects housing development. The private sector plays a crucial role in developing housing policies and programs, implementing projects, and providing affordable housing and finance (Ramovha, 2017; Tiwari et al., 2016; Okoro et al., 2023; Morakinyo et al., 2015; Kacaribu et al., 2022). Joseph et al. (2023) emphasize the importance of community participation in designing and delivering effective interventions. Chisumbe et al. (2022) and Fulcher et al. (2022) argue that

community involvement is critical for sustainable housing growth, especially in decision-making processes regarding housing design and allocation.

4.6 Limited Access to Land

The findings on limited access to land are supported by Oladehinde et al. (2023), who assert that the lack of low-cost serviced land hinders urban housing development. Satterthwaite (2020) identifies land as a critical component in housing development, with delays in titling and land documentation discouraging investment. De la O Campos (2023) highlights that increased tenure security positively affects housing investment. Simwanda and Murayama (2018) note that the limited availability of land forces many urban residents to settle in unplanned areas, raising costs for low to middle-income earners.

4.7 Political Influence

The results indicate that political influence contributes to poor urban housing development, aligning with the literature (Cartwright et al., 2018; Jarah et al., 2019; Rodríguez-Pose & Storper, 2020). Political actors often exert influence on local authorities regarding land allocation, with decision-makers sometimes failing to adhere to plans due to job security concerns. Political resistance also poses challenges to slum upgrading and prevention efforts.

4.8 Weak Urban Governance

Weak governance is identified as a significant challenge, consistent with Cartwright et al. (2018) who noted the lack of governance capacities in many African cities. Scholars such as Olanrewaju et al. (2016), Zafarullah and Huque (2017), and Calder (2017) confirm a positive correlation between governance and housing supply. Effective governance is essential for communicative planning, transparency, and equitable development (Newman et al., 2020; Saidu and Yeom, 2020; Syed and Ying, 2019).

4.9 Implications and Future Directions

The findings suggest that improving urban housing requires efforts to prevent political interference in planning and development. Given that a large portion of the population consists of low to middle-income earners, inclusive financial models tailored to their needs are necessary. The study also emphasizes the need for an intersectoral approach in housing planning and the provision of basic utilities, such as water, electricity, sewer networks, and roads.

5. Conclusion

This study aimed to identify the key factors contributing to poor urban housing development in Lusaka, Zambia. The findings reveal that political influence, poor linkage between infrastructure investment and service delivery, lack of affordable housing finance, weak urban governance, and high mortgage interest rates are critical challenges affecting housing conditions in the city. These factors highlight systemic issues within urban planning and governance that require comprehensive and coordinated intervention by multiple stakeholders, including governmental authorities, private sector entities, and local communities.

To address these challenges, the study recommends that institutional stakeholders, including local authorities, housing ministries, and utility service providers, develop an integrated housing planning and development framework to improve the linkage between infrastructure development and service delivery. This involves capacity building through adequate staffing, professional development, and technology adoption. Additionally, the private sector should be encouraged to develop housing finance products tailored for low-income earners and those in the informal sector, recognizing the potential market within the informal economy as a significant opportunity for improvement. Governance principles should also be promoted by institutions such as anti-corruption bodies and

audit offices to ensure accountability, transparency, and equality in housing planning and development.

The study underscores the importance of aligning infrastructure investments with effective service delivery to improve housing conditions. This alignment requires a coordinated approach among various stakeholders to foster collaboration and enhance urban planning processes. Improving access to affordable housing finance is also crucial, particularly for low-income earners and those working in the informal sector, to expand housing opportunities and meet the needs of the city's growing population.

The practical value of this study lies in its guidance for both state and non-state stakeholders on areas requiring intervention to enhance urban housing development in Lusaka. While the research provides valuable insights, its focus on a single city presents a limitation. Future research should explore housing finance models for low-income earners in other cities to provide a broader understanding of the challenges and potential solutions for urban housing development across different contexts.

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Conflicts of Interest

The authors declare that they have no competing or conflicting interests.

Data availability statement

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy and ethical issues.

Institutional Review Board Statement

The study was done in accordance with the Declaration of Helsinki principles and authorized by the University of Johannesburg's Institutional Ethics and Plagiarism Committee (FEPC) (protocol code UJ_FEBE_FEPC_00059).

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Critical Success Barriers (CSB) to Rental Housing Policy Implementation in Urban India

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ABSTRACT

Barriers to rental housing (RH) pose significant challenges to urban development in India. This study examines critical success barriers (CSBs) to implementing RH policies, offering novel insights into this underexplored area. Despite rising demand for RH, significant obstacles hinder effective policy execution. Through expert surveys with 36 respondents and RIDIT analysis, the research identifies and prioritizes 16 CSBs, categorized into Regulatory and Institutional, Economic and Market, and Infrastructure and Development groups. Key findings reveal that the most critical barriers are inflexible rental agreements, negative social attitudes, and the absence of government incentives. These interdependent barriers impact the feasibility, attractiveness, and sustainability of RH projects. Inflexible agreements limit participation, negative social attitudes hinder inclusive development, and lack of incentives reduces private investment. The study recommends revising rental agreements, providing substantial incentives to private investors, and promoting high-density development through modified zoning regulations. Emphasizing multi-level governance, stakeholder engagement, and regular policy evaluations is crucial for effective implementation. Addressing these barriers can enhance the RH sector's sustainability and scalability. This research contributes to the existing literature by providing a quantitative framework for identifying and prioritizing CSBs in the RH, offering valuable insights for policymakers, developers, and stakeholders in urban housing.

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Highlights:

- This analysis identifies and prioritizes 16 critical success barriers (CSBs) to implementing rental housing policy in urban India through RIDIT analysis.
- It provides evidence for the significant impact of regulatory, economic, and infrastructural barriers on rental housing initiatives in developing countries.
- The research employs a mixed-methods approach, integrating qualitative interviews and quantitative surveys with housing experts.
- Key recommendations include flexible rental agreements, government incentives for private investors, and promotion of high-density development.

Contribution to the field statement:

- This study advances the understanding of rental housing (RH) policy implementation in urban India by addressing a critical knowledge gap. It identifies and ranks key barriers to effective RH policies, providing valuable insights for academia, policymakers, and housing sector stakeholders. The research offers evidence-based recommendations for overcoming these barriers, contributing to more effective policy formulation. By exploring this understudied area, the study lays a foundation for future research in urban housing policy. The comprehensive framework presented aims to balance RH supply with demand, potentially alleviating the housing shortage crisis. This work enhances housing accessibility and affordability in urban India, benefiting various stakeholders and advancing urban housing policy.

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1. Introduction

1.1 Background and Context

The rapid pace of urbanization globally has significantly influenced housing markets, presenting both challenges and opportunities for urban development (Akande, 2021; Bangura & Lee, 2023). In developing countries, this phenomenon has intensified the demand for affordable rental housing (RH) (Agayi & Karakayacı, 2020; Gupta & Gupta, 2017). The high costs associated with housing construction and purchase often exclude low-income groups from the opportunity for homeownership (Welters et al., 2024). Consequently, renting has emerged as a practical and flexible housing solution, particularly for those unable to afford homeownership. It offers a vital alternative for individuals in transitional stages or those not prepared for the financial commitment of homeownership (Gilbert, 2016). In urban areas of developing countries, a significant portion of the population resides as tenants under residential tenancy agreements (Naik, 2019). Furthermore, RH provides additional benefits beyond mere accommodation. It often offers proximity to workplaces, thereby enhancing productivity and fostering entrepreneurship (Gupta & Gupta, 2017; Harish et al., 2023). This particularly benefits low-income families, students, migrant workers, young households, and other urban residents, ultimately promoting economic mobility (Government of India, 2015).

Despite the rising need for RH in developing countries like India, a substantial unmet demand still needs to be met. The Technical Group on Urban Housing Shortage, established by the Ministry of Housing and Urban Affairs, estimates a shortfall of approximately seven million rental homes across urban India (Government of India, 2015). This shortage is further reported by Census data, which reports a significant decline in RH's share from 58% in 1961 to 28% in 2011 (Census of India, 2011). This decline highlights several factors impeding the growth of India’s RH market and pushing it towards informality. The imbalance in India's housing markets is particularly apparent in urban slums, where about 37.5% of slum households reside in rented accommodations. This situation reflects a high demand for RH and low affordability (Harish et al., 2023).

Further exacerbating the problem are low rental yields, which have deterred landlords from investing in rental properties. Despite some residential real estate sector recovery, gross rental yields have stagnated at 3-4.5%. After accounting for expenses such as property taxes, maintenance charges, agent fees, and non-occupancy costs, net rental yields in most Indian cities hover around 2-3%—among the lowest rates globally (Frank & Khaitan Co., 2019). This stagnant trend in rental yields, combined with the lack of capital value appreciation for residential properties, has significantly limited investor participation in India's housing market. The resulting shortage of formal rental options has pushed many urban residents towards informal and often substandard housing solutions, further complicating the urban housing landscape in India.

In response to the growing need for RH, the Indian government has introduced several policy interventions. However, these efforts have primarily remained in the planning stages or faced challenges in implementation. The Draft National Urban Rental Housing Policy of 2015, aimed at addressing urban RH issues, has proven ineffective in its implementation (Government of India, 2015). Similarly, the Affordable Rental Housing Complexes (ARHC) scheme, launched in 2020 to support urban migrants and the poor, has faced complex market dynamics and implementation challenges (Government of India, 2020). Despite its potential to offer better quality-to-rent ratios, the scheme's effectiveness has been limited by factors such as locational disadvantages, management issues, and reduced tenure security, leading to a lack of demand and suboptimal outcomes in addressing urban India's RH needs (Harish, 2021). These shortcomings have resulted in a near absence of formal government-sponsored RH, leading to the proliferation of unregulated, sub-standard housing in urban areas.

Compounding these issues are the existing Rent Control Acts (RCA), which form the main regulatory framework for rental markets. These heavily pro-tenant laws restrict rent increases to marginal levels and impose severe limitations on evictions, significantly stifling the rental market's vitality (Ambrosius et al., 2015; Tandel et al., 2016). Consequently, landlords are often reluctant to offer their properties for rent, further exacerbating the housing shortage (Frank & Khaitan Co., 2019).

Additionally, the challenges of implementing effective RH policies are compounded by bureaucratic hurdles, financial constraints, and complex regulatory barriers (Airgood-Obrycki et al., 2023; Seo et al., 2023). This combination of restrictive regulations and implementation challenges continues to hinder the development of a robust and sustainable RH sector in India, leaving a significant gap between housing needs and available solutions in urban areas.

1.2 Research Gap and Objectives

While extensive literature explored critical barriers to sustainable housing, there is a notable dearth of research specifically addressing the challenges in implementing RH policies in developing countries like India. Existing studies have predominantly focused on housing barriers or the needs of high-income groups, overlooking the unique challenges the RH market faces in developing regions. For example, Williams & Dair (2007) and Karji et al. (2020) have highlighted challenges such as a scarcity of skilled professionals, insufficient knowledge, and high expenses in sustainable housing. Similarly, Alam et al. (2019) and Winston (2010) identified delays in planning and approval processes, lack of housing guidelines, and scarcity of experts as significant obstacles in Australia and Ireland, respectively. Research by Adabre et al. (2020) and El Touny et al. (2021) pointed out infrastructural deficiencies and a shortage of information on sustainable principles in New Zealand and Sub-Saharan Africa. Further challenges highlighted in the literature include inequality and neglect of low-income residents' needs (Sulemana et al., 2019; Muhammad et al., 2015), insufficient professional expertise and policy contradictions (Akinshipe et al., 2019; Agyemang & Morrison, 2017). Economic barriers, such as high rental charges, transportation, and operational costs (Chan & Adabre, 2019), often force households to choose between shelter and other basic needs. Zhang et al. (2016) discussed inadequate public funding and stringent credit conditions as significant hindrances to RH development, while other studies pointed to community opposition (Trudeau, 2018) and income segregation (Roy et al., 2018) as additional complicating factors.

However, these studies need to specifically address the unique challenges and barriers to successful RH projects in urban India. This research aims to bridge this gap by identifying and analyzing the critical success barriers (CSBs)—key obstacles impeding the effective implementation of RH policies in the Indian context (Adabre & Chan, 2021; Oluleye et al., 2021). The study has three primary objectives: first, to identify the critical success barriers (CSBs) in RH policies in urban India; second, to perform a priority ranking of the most critical barriers using RIDIT analysis; and third, to propose strategies to overcome these barriers. The study employs a mixed-methods approach to achieve these objectives, combining qualitative interviews with key stakeholders and quantitative surveys. This methodology ensures a comprehensive analysis of the barriers and the development of evidence-based strategies, providing a well-rounded understanding of the issues and actionable recommendations for improvement.

1.3 Contribution and Structure of the Paper

The study makes significant contributions to the field of RH policy in urban India, benefiting various stakeholders, including academia, policymakers, and housing sector participants. For the academic community, it expands the existing knowledge base by exploring the understudied area of RH policy barriers in urban India, providing detailed analysis and valuable data for further research and theoretical advancements. The comprehensive examination of these barriers in the study fills a crucial gap in the literature and lays the groundwork for future investigations in this field. This research offers evidence-based insights for policymakers by identifying and ranking the most critical barriers to RH policy implementation. These findings are invaluable for informing policy decisions and formulating effective RH strategies. Moreover, the study proposes practical approaches to overcome these barriers, potentially enhancing the efficacy of future housing policies. Other stakeholders in the housing sector, such as developers, landlords, and community organizations, will benefit from the actionable intelligence on the pressing barriers to RH projects, enabling them to take proactive measures to address these challenges. Ultimately, this research presents a comprehensive framework

for enhancing RH initiatives in urban India, aiming to address the housing shortage crisis by balancing the supply of RH with the demand. By providing an in-depth assessment of the challenges and potential solutions, this study improves housing accessibility and affordability in urban India.

The subsequent sections of this paper are organized as follows: Section 2 details the research methodology, including the systematic literature review conducted to identify barriers hindering effective RH implementation. Section 3 presents the results of the statistical analysis of survey responses. Section 4 discusses the findings and their implications. Finally, Section 5 concludes the paper by summarizing key insights and suggesting directions for future research and policy development.

2. Materials and Methods

2.1 Study Design and Setting

This research employs a mixed-methods design, integrating qualitative and quantitative approaches to comprehensively identify and analyze the CSBs for RH policy implementation in urban India (Sohaimi & Shuid, 2023). The study adopts an observational, cross-sectional approach, aiming to capture data from a diverse group of housing experts at a single point in time. This design facilitates the collection of both in-depth insights and broad statistical data, enabling a nuanced understanding of the multifaceted barriers affecting RH development.

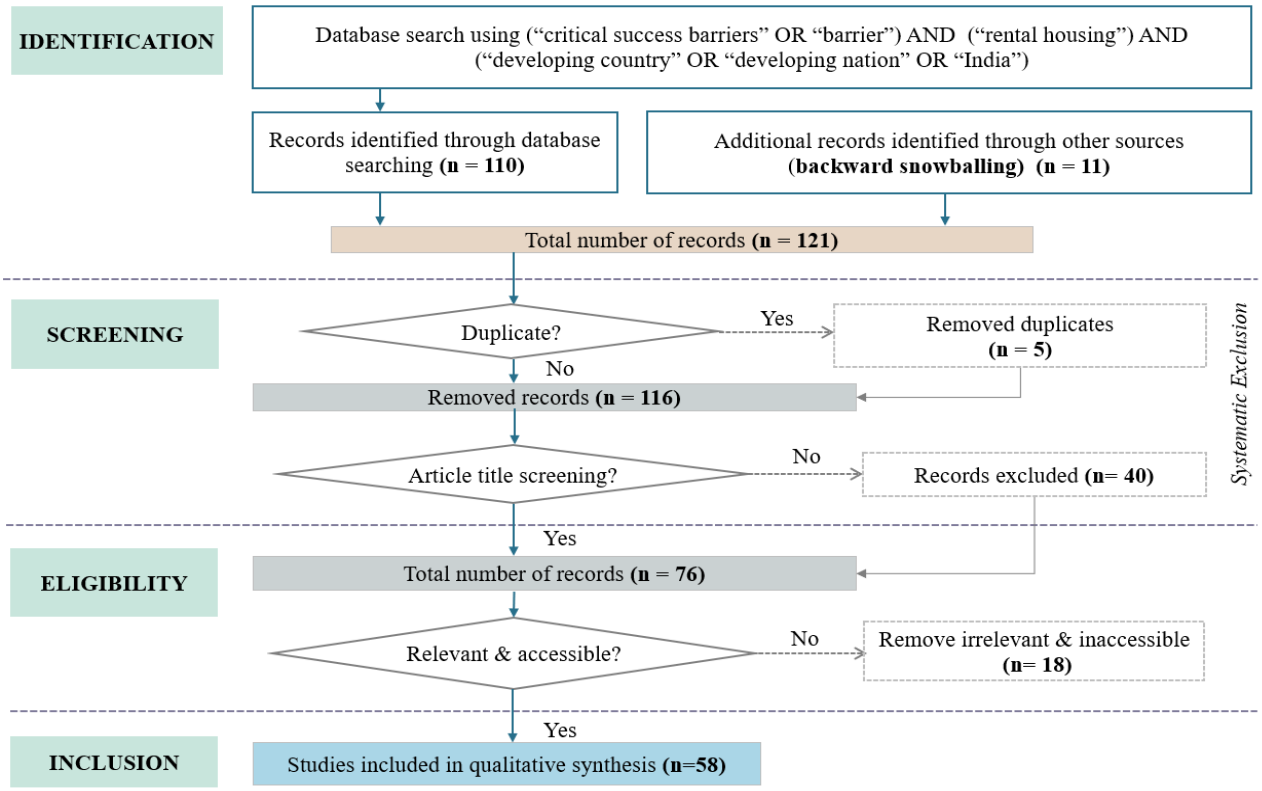

Figure 1. The process of literature selection – PRISMA flow diagram (Moher et al., 2009).

The research process commenced with a systematic literature review (SLR) utilizing the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) technique to ensure transparency and reproducibility (Moher et al., 2009). To conduct the SLR, authors accessed prominent databases such as Scopus and Web of Science, focusing on peer-reviewed publications from 2010 to 2023. To enhance the comprehensiveness of the review, a systematic backward snowballing process was employed, incorporating highly cited references and frequently referenced research publications (Anirudh et al., 2021; Shukla et al., 2023; Singh et al., 2021). Through this rigorous process, 58 articles were selected for in-depth analysis. These documents underwent a

thorough manual content analysis to extract and analyze relevant indicators or CSBs. As a result of this comprehensive review, 32 potential CSBs were identified (Figure 1), each meticulously referenced to its source. This methodical approach ensures a solid foundation for the subsequent phases of the study, providing a clear and traceable path from existing literature to the identification of critical barriers in RH policy implementation.

2.2 Identification of Potential CSB for Rental Housing

The identification of barriers to RH development reveals a global pattern of challenges, transcending national boundaries. To facilitate a more structured approach to addressing these barriers, they have been categorized based on the level of intervention required: national-level, state-level, and city-level policy (Table 1). At the national level, broad policy frameworks and financial incentives can be established to guide and support state and local initiatives. These overarching strategies provide a foundation for coherent RH development across the country. Building upon the national framework, state-level interventions allow for the adaptation of policies to regional contexts, ensuring that they address specific local needs and conditions. Finally, city-level interventions represent the ground-level implementation of these policies, dealing with the unique urban challenges and opportunities that arise in diverse metropolitan settings. This multi-tiered categorization of barriers serves a crucial purpose: it enables policymakers and stakeholders to allocate resources more effectively and tailor interventions to the appropriate administrative level (Frank & Khaitan Co., 2019).

Table 1: List of indicators from the literature review.

Code	Barriers	Countries	Level of intervention	Impact on stakeholders	Reference
CSB 1	Public unawareness regarding rental housing	India	National Level (Policy), State Level (Awareness campaigns)	Tenants unaware of rental options; Investors see underutilized stock	(Gupta & Gupta, 2017)
CSB 2	Resistance to housing mortgages and loans	USA, Australia, Malaysia, Italy, Hong Kong, Sweden China, Canada, Ghana, New Zealand, Singapore Brazil, India, Spain, South Africa, Japan, Norway, Papua New Guinea	National Level (Policy), State Level (Financial programs)	Limited access to loans for tenants	(Adabre & Chan, 2019)
CSB 3	Policy conflicts between government authorities	UAE, UK	State Level (Policy coordination)	Uncertainty for developers- risky investment	(Osei-Kyei et al., 2017)
CSB 4	Absence of government incentives for private housing entities	England	National Level (Policy)	Reduced supply of rental housing; Low investment from developers	(Oyebanji et al., 2017)
CSB 5	High cost of capital (i.e., interest rates on loans)	UK	National Level (Monetary policy)	High financing costs for developers; Reduced number of projects	(Adabre & Chan, 2019)
CSB 6	Increasing rent compared to income	USA, Australia, Malaysia, Italy, Hong Kong, Sweden China, Canada, Ghana, New Zealand, Singapore	National Level (Policy), State Level (Regulations)	Tenants face affordability issues; Investors see reduced returns	(Chan & Adabre, 2019)

		Brazil, India, Spain, South Africa, Japan, Norway, Papua New Guinea			
CSB 7	Stringent rent control policies	Nigeria, Malaysia		Reduced profitability for landlords; Limited supply for tenants	(Muhammad & Johar, 2018)
CSB 8	Inflexible rental agreements	Netherlands, China, United States, Belgium, South Africa		Low retention for tenants; Reduced participation for landlords	(Abidoye et al., 2022a)
CSB 9	High cost of serviced land	Ghana, China, Hong Kong, Nigeria, Malaysia	State Level (Land Use Planning)	High costs for developers; Reduced profitability	(Makinde, 2013; Muhammad & Johar, 2018)
CSB 10	High approval cost (high taxes and fees on developers)	USA, Australia, Malaysia, Italy, Hong Kong, Sweden China, Canada, Ghana, New Zealand, Singapore Brazil, India, Spain, South Africa, Japan, Norway, Papua New Guinea	State Level (Regulatory Reform), City Level		(Liang & Jia, 2018)
CSB 11	Limited supply of rental units against high demand	Nigeria	State Level (Development Programs), City Level (Project Implementation)	High rents and dissatisfaction for tenants; Investors see limited returns	(Ezennia, 2022a)
CSB 12	Negative attitudes to social mix	India	City Level (Community Programs)	Segregation and limited options for tenants	(Roy et al., 2018)
CSB 13	Limited land availability in urban areas for RH projects	Nigeria	State Level (Land Use Planning), City Level (Zoning Regulations)	High costs for developers; Limited new projects for tenants	(Ogwueleka, 2011)
CSB 14	Poor stakeholder engagement and communication	Nigeria	City Level (Community Engagement)	Misaligned goals for stakeholders-reduced project success	(Oluleye et al., 2020)
CSB 15	Low utilization of land for high-density development	Nigeria	City Level (Local Zoning)	Limited availability of rental units; Low returns for investors	(Ezennia, 2022a)
CSB 16	Deficient infrastructure for housing	India	City Level (Project Implementation)	Poor infrastructure for tenants; Reduced viability for projects	(Agarwal et al., 2021)
CSB 17	Substandard rental housing design and construction	Nigeria	National Level (Building Codes), State Level (Enforcement)	Unsafe housing for tenants; High maintenance costs for landlords	(Haruna et al., 2023; Mukhtar et al., 2016)
CSB 18	Environmental challenges (pollution, flooding, land issues)	Switzerland	State Level (Environmental Regulations), City Level (Local Management)	Unsafe conditions for tenants; Reduced investment attractiveness	(Marnane & Greenop, 2023)

The study presents a comprehensive analysis of barriers to the development and implementation of RH across various countries, illuminating the multifaceted challenges that impede progress in this sector. A deeper examination of these barriers reveals common economic challenges, particularly prevalent in lower-middle-income countries. Notably, the research identified that nations such as Nigeria, Ghana, India, and Papua New Guinea—all classified as lower-middle-income economies—face significant economic hurdles in implementing effective RH policies (Adetokunbo & Emeka, 2015). These challenges are manifested in several key areas, including high costs of serviced land, stringent rent control policies, and limited land availability in urban areas. In the specific context of India, the study highlights additional barriers that compound these challenges. Gupta and Gupta (2017) emphasize that high costs associated with land acquisition and development, coupled with stringent regulations and inadequate infrastructure, significantly hinder the growth of the RH sector. These factors create a formidable obstacle to increasing the supply and improving the quality of RH options. The cumulative effect of these barriers is particularly detrimental to low and middle-income populations. As Attia (2021) notes, the constrained supply and compromised quality of RH units make it increasingly difficult for these demographic groups to access affordable housing options. This situation exacerbates existing housing inequalities and poses a significant challenge to urban development and social equity goals.

Public unawareness regarding RH, particularly in India, significantly reduces demand and investor confidence, leading to underutilization of the existing RH stock (Gupta & Gupta, 2017). Resistance to housing mortgages and loans is another critical barrier, limiting the pool of potential tenants and dampening investor interest in countries like the USA, Australia, and several others (Adabre & Chan, 2019). Policy conflicts between government authorities create regulatory uncertainty, deterring cohesive investment strategies (Osei-Kyei et al., 2017). The absence of subsidized government incentives for private housing entities in England further exacerbates the problem by reducing the supply of RH (Oyebanji et al., 2017).

High capital costs, including interest rates on loans, are a significant barrier in the UK, where financing costs deter investment in others (Adabre & Chan, 2019). Similarly, increasing rent compared to income in numerous countries, including the USA and Australia, makes housing unaffordable for many, reducing demand and investment returns (Chan & Adabre, 2019). However, these countries have implemented various affordable housing policies to provide tax credits to private housing entities investing in the affordable housing sector. Stringent rent control policies in Nigeria limit landlords' ability to adjust rents, making investments less profitable (Muhammad & Johar, 2018). Inflexible rental agreements in the Netherlands and other countries reduce the rental market's attractiveness by discouraging tenants and landlords (Abidoye et al., 2022).

High land prices in Hong Kong, China, and other nations increase development costs, deterring investment due to reduced profitability (Makinde, 2013; Muhammad & Johar, 2018). Negative attitudes toward social mix, particularly in India, limit rental options and lead to segregation, reducing the attractiveness of investment (Roy et al., 2018). Limited land availability in urban areas for RH projects in Nigeria further increases costs and deters investment (Ogwueleka, 2011). Poor stakeholder engagement and communication, particularly in middle-income cities, lead to misaligned expectations and reduced project success (Oluleye et al., 2020). Low land utilization for high-density development in Nigeria limits the availability of rental units and reduces investment returns (Ezennia, 2022). Deficient infrastructure for housing in India affects project viability, deterring investment and reducing tenant interest (Agarwal et al., 2021). Additionally, substandard RH design and construction in Nigeria result in unsafe conditions and high maintenance costs, deterring tenants and investors (Mukhtar et al., 2016). The insights gained from this comprehensive analysis are crucial for developing sustainable and scalable solutions for the RH sector, particularly in lower-middle-income countries facing similar challenges (Sohaimi & Shuid, 2023). This study contributes significantly to the global discourse on affordable and sustainable housing by meticulously identifying these critical barriers and proposing effective interventions.

2.3 Data collection

The study employs a comprehensive questionnaire survey to achieve its objectives and collect quantifiable data, following a meticulous design process to ensure reliability and validity. The questionnaire, based on the 18 CSBs identified from the literature, was crafted with three primary objectives: to determine the criticality of each CSB, to assess the agreement level between academic and industrial experts on the ranking of these CSBs, and to categorize the CSBs into underlying groups. Structured in two sections, the questionnaire first gathers background data from respondents in Section A to establish the reliability of their responses before proceeding to further analysis. Section B presents the CSBs using a 5-point Likert scale, ranging from 1 (Very Important) to 5 (Very Unimportant), a format chosen for its brevity and effectiveness in capturing the perceived importance of each barrier (Pitale, Sadhukhan, et al., 2023). To ensure comprehensiveness, the questionnaire concludes with an opportunity for respondents to identify and rate any additional critical barriers to RH they deem significant, thereby allowing for the capture of potentially overlooked factors. This thoughtful design ensures a thorough exploration of the CSBs while maintaining a user-friendly format that encourages meaningful participation from the diverse pool of experts surveyed.

A rigorous review and refinement process was implemented to ensure the questionnaire's validity and effectiveness. Initially, two professors and three research associates, all experts in affordable housing and urban planning, conducted a thorough review. This expert evaluation aimed to validate the questionnaire's accuracy, ensure respondent comprehension, assess acceptability, and confirm its relevance to the study context (Mukhtar et al., 2016). The experts also scrutinized the appropriate use of technical terms and the comprehensiveness of the barrier list, leading to revisions based on their constructive feedback. A pilot survey involving eight additional field experts was conducted following this expert review to refine the questionnaire further. This pilot phase was crucial in identifying potential ambiguities or issues that might have been overlooked during the initial review, thereby validating the reliability and clarity of the questions (Sadhukhan et al., 2015). Furthermore, it served as a critical tool for identifying and mitigating potential biases in the data collection process. The research team meticulously analyzed feedback from the pilot participants, making necessary adjustments such as rephrasing ambiguous questions, eliminating leading or loaded inquiries, and ensuring a balanced representation of all CSBs. To ensure that the respondents completely comprehended the context, the questionnaire incorporated a preliminary question about the outcomes or goals for RH. This strategic approach not only informed respondents about the objective of the study but also solicited their opinions on these outcomes, enabling them to rate the criticality of the barriers more accurately to achieving these goals (Adabre & Chan, 2019).

Following the rigorous development process, the finalized questionnaire was distributed to a carefully selected group of housing experts from both academic and industrial sectors. These experts were identified based on their publications in top-tier journals and through member directories, ensuring a knowledgeable and diverse respondent pool. To maximize the response rate, the questionnaire was administered via email using Google Forms, an accessible online platform. Additionally, participants were encouraged to forward the questionnaire to other relevant experts, employing a snowball sampling technique to expand the reach. Out of approximately 115 questionnaires distributed, 36 valid responses were received, yielding a response rate of 30%. Given the challenges in soliciting expert opinions, this response rate is considered representative and acceptable in the context of expert opinion surveys, surpassing response rates in similar studies within the literature. Moreover, the sample size of 36 meets the threshold of at least 30 respondents, generally deemed sufficient for statistical analysis in social science research (Adabre & Chan, 2019; Mokkink et al., 2022). The comprehensive research framework, including the various stages of the study, is illustrated in Figure 2, providing a visual representation of the methodological approach. This meticulous survey design and administration process ensured the collection of high-quality, representative data, offering a robust foundation for analyzing the CSBs in RH development.

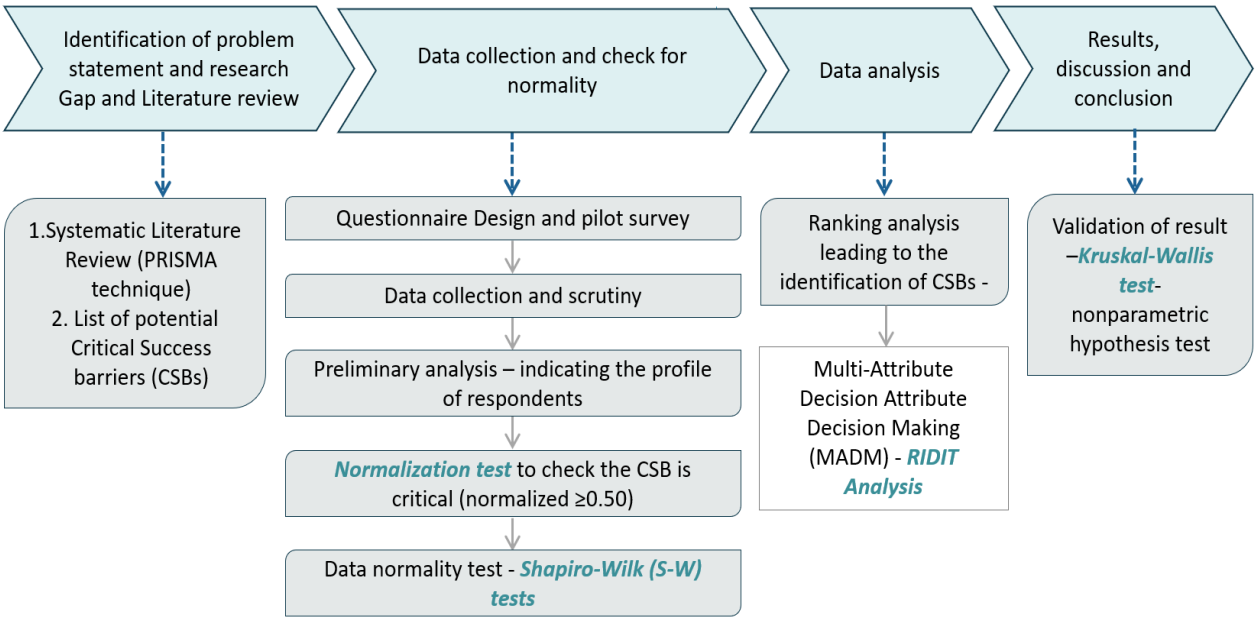

Figure 2. Research framework for the study.

2.4 Data Interpretation

Following data collection, the study employs a comprehensive analytical approach to interpret and derive meaningful insights from the survey responses. Initially, descriptive statistics were used to summarize the respondents' backgrounds and provide an overview of the data. The database undergoes cleaning and a preliminary review to ensure data adequacy and quality. This step is crucial for assessing the reliability and credibility of the responses (Chan & Adabre, 2019; Kar et al., 2024). For the quantitative analysis, the study utilizes IBM SPSS 29 for statistical tasks and MS Excel for detailed calculations. To determine the relative importance of the identified CSBs, the study employs the Relative to an Identifiable Distribution Integral Transformation (RIDIT) analysis, a Multi-Criteria Decision Analysis (MCDA) technique.

In 1958, Bross coined the term RIDIT, drawing inspiration from existing statistical transformations such as Probit and Logit, and emphasizing the method's distinctive approach to data analysis (Mandal & Dey, 2022). Over time, RIDIT has established itself as a valuable statistical tool for comparing responses on ordinal scales. Its effectiveness in handling Likert scale data, frequently employed in survey questionnaires, makes it particularly relevant for research involving ordered categorical responses (Sarkar & Banerji, 2024). One of the key advantages of RIDIT analysis is its distribution-free nature, meaning it makes no assumptions about the distribution of the studied samples (Bross, 1958). This characteristic is particularly significant when dealing with ordinal data or ranked responses, as in this study. Instead of relying on any theoretical distribution, RIDIT analysis utilizes the relative distribution of the reference population under examination. This approach requires fewer assumptions, simplifying computations and interpretations (Sadhukhan et al., 2015). The RIDIT method allows for a robust ranking of the CSBs based on their perceived importance, providing a clear prioritization that can inform policy recommendations and future research directions. The detailed RIDIT analysis procedure will be presented in the subsequent section, including the step-by-step calculations and interpretation of results. This analysis will provide a comprehensive understanding of how the various CSBs are prioritized by the housing experts surveyed, offering valuable insights into the most critical barriers facing RH policy implementation in urban India.

3. Results

3.1 Respondent profile

The survey successfully gathered responses from diverse stakeholders in the RH sector. Table 2 provides a detailed breakdown of the respondents' profiles, highlighting the distribution across

various professional roles, geographical locations, years of experience, and areas of housing expertise.

Table 2: Respondents' Detail.

Profession	**No. Of response (36 nos.)**	**Percentage**
Academic/researcher	4	11.11%
Architect	3	8.33%
Project/Construction managers	4	11.11%
Financial institutions	4	11.11%
Planner	6	16.67%
Tenants	8	22.22%
Local government officials	7	19.44%
Geographical location	**No. Of response (36 nos.)**	**Percentage**
Tier 3	5	13.89%
Tier 2	9	25.00%
Tier 1	22	61.11%
Years of experience	**No. Of response (36 nos.)**	**Percentage**
<10 years	5	13.89%
11-20 years	19	52.78%
>20 years	12	33.33%
Housing expertise domain	**No. Of response (36 nos.)**	**Percentage**
Public housing	9	25%
Social housing	14	38.88%
Cooperative housing	8	22.22%
Others	5	13.88%

The survey aimed to capture a broad range of stakeholder perspectives, with tenants (22%) and local government officials (19%) forming the largest groups of respondents. This distribution ensures that the study incorporates both user experiences and policy implementation insights. The inclusion of planners (16.67%), academics/researchers (11.11%), project/construction managers (11.11%), financial institutions (11.11%), and architects (8.33%) further enrich the dataset with diverse professional viewpoints. Notably, the geographical distribution of respondents shows a concentration in Tier 1 cities (61.11%), providing valuable insights into urban housing challenges in major metropolitan areas. The representation from Tier 2 (25%) and Tier 3 (13.89%) cities offers a comparative perspective on housing issues across different urban scales. The respondents' extensive experience in the housing sector adds significant credibility to the findings. An overwhelming majority (86.11%) possess over ten years of experience, with 33.33% having more than two decades in the field. This depth of experience enhances the reliability of the insights gathered. The diversity in housing expertise domains, spanning social housing (38.88%), public housing (25%), cooperative housing (22.22%), and other forms (13.88%), ensures a comprehensive understanding of various housing models and their associated challenges.

3.2 Descriptive analysis

Building upon the insights gained from the respondent profile, the study proceeded with a descriptive analysis to determine the relative criticalities of each of the CSBs. Normalization scores were computed based on the mean values of respondents' ratings to facilitate meaningful comparisons across different barriers. Normalization is crucial in this context as it brings the data to a standard scale without distorting differences in the ranges of values, enabling a more accurate and equitable comparison of the criticalities of different barriers. The criticality assessment was based on these normalized scores, with barriers achieving scores of 0.5 or higher being considered for further analysis (Osei-Kyei & Chan, 2017). This threshold ensures that only the most critical barriers are prioritized for detailed examination, focusing the study on the most significant challenges perceived by the expert respondents.

In cases where barriers shared identical normalized scores, their standard deviations (SD) were used as a tiebreaker for ranking. Barriers with lower SDs received higher rankings, indicating more consistent agreement among experts about the criticality of these barriers (Adabre et al., 2020). Table 3 presents the results of this descriptive analysis, showcasing the normalized scores and SDs.

Table 3: Normalization score for CSB to Rental Housing.

Barrier code	Mean	Standard deviation	Normalization score
CSB 1	**2.69**	**1.00**	**0.00* (Rejected)**
CSB 2	4.50	0.50	0.95
CSB 3	4.41	0.5	0.91
CSB 4	4.52	0.50	0.97
CSB 5	3.97	0.81	0.67
CSB 6	4.38	0.49	0.89
CSB 7	4.44	0.55	0.92
CSB 8	4.58	0.5	1.00
CSB 9	3.72	1.36	0.54
CSB 10	3.75	1.33	0.55
CSB 11	4.25	0.73	0.82
CSB 12	4.52	0.60	0.97
CSB 13	3.72	1.30	0.54
CSB 14	3.80	1.19	0.58
CSB 15	4.41	0.5	0.91
CSB 16	4.41	0.5	0.91
CSB 17	4.47	0.55	0.94
CSB 18	**3.02**	**1.53**	**0.17* (Rejected)**

Note: Normalized score = (mean - minimum mean)/ (maximum mean - minimum mean)
* The barrier is rejected if the normalized value is less than 0.50.
As a result of this analysis, CSB 1 and CSB 18 were excluded from further consideration due to their low normalized scores, indicating that they are not critical barriers based on the respondents' perceptions.

3.3 Data Normality

Before conducting any statistical analysis, it was crucial to assess the normality of the data distribution to determine the most appropriate statistical approach. The Shapiro-Wilk (S-W) test was employed for this purpose, given its effectiveness for small to moderate sample sizes ($n < 50$) (Shapiro & Francia, 1972). With a sample size of 36 in this study, the S-W test was deemed particularly appropriate due to its enhanced sensitivity in detecting deviations from normality in smaller datasets. The procedure for the S-W test involves formulating the null hypothesis, which is that the data follows a normal distribution, and the alternative hypothesis, which is that it does not. Using IBM SPSS 29, the test can be conducted by inputting the dataset and obtaining a test statistic and a p-value. The results from the test showed statistics ranging between 0.619 and 0.867, with p-values significantly below the 0.05 threshold at a 95% confidence level. These findings suggest that the data does not meet the criteria for normality, implying that non-parametric methods are more appropriate for further analysis (Yamanappa et al., 2018). RIDIT analysis was selected as the most appropriate Multi-Attribute Decision Making (MADM) technique for its particular strengths in handling ordinal data from Likert scales and its ability to provide robust rankings without making assumptions about the underlying distribution of the data (Bross, 1958; Sadhukhan et al., 2015).
One of the critical advantages of RIDIT analysis is its applicability in situations, where traditional statistical methods, such as chi-square tests or t-tests, may not be appropriate or sufficient. Unlike these methods, RIDIT analysis is distribution-free, meaning it makes no assumptions about the distribution of the studied samples (Bross, 1958). Instead of relying on any theoretical distribution,

RIDIT analysis utilizes the relative distribution of the reference population under examination. This approach requires fewer assumptions, simplifying computations and interpretations (Sadhukhan et al., 2015). These characteristics make RIDIT a robust choice for evaluating ordinal data or ranked responses without relying on specific distributional assumptions (Pitale, Parida et al., 2023; Pitale, Sadhukhan et al., 2023).

3.4 Multi-Attribute Decision Making (MADM) - RIDIT analysis

The RIDIT scoring method was employed to generate a rank order of the selected indicators based on the perceptions captured from the survey respondents (Kar et al., 2024; Mandal & Dey, 2022; Sadhukhan et al., 2015). The detailed algorithm for RIDIT analysis is presented below.

Step 1: Identify a reference dataset - Use the complete survey responses as the reference for ordinal data from a Likert scale (Table 4).
Step 2: Compute the frequency 'F_j' for each response category - Calculate the frequency F_j for each response category, denoted by j, where j = 1, 2, ……, n (Table 4).
Step 3: Determine the Midpoint Accumulated Frequency - Find the midpoint accumulated frequency F_j for each response category (Table 4).

$$F_1 = \frac{1}{2} f_1 \quad (1)$$

$$F_j = \frac{1}{2} f_j + \sum_{k=1}^{j} f_k \quad \text{where, j = 1, 2, 3, …, n} \quad (2)$$

Step 4: Calculate the RIDIT Value for Each Category **-** Compute the RIDIT value R_j for each category in the reference dataset (Table 4).

$$R_j = \frac{F_j}{N} \quad \text{where, j = 1, 2, 3, …, n} \quad (3)$$

Here, N represents the total number of responses in the survey. By definition, the expected value of R for the reference dataset is 0.5.

Table 4: RIDIT dataset used for reference in calculations.

Barrier Code	5 -POINT LIKERT SCALE DATA					Total (π_i)
	Very Important -(5)	Important - (4)	Relatively Important - (3)	Unimportant - (2)	Very Unimportant - (1)	
CSB 2	18	18	0	0	0	36
CSB 3	15	21	0	0	0	36
CSB 4	19	17	0	0	0	36
CSB 5	10	16	9	1	0	36
CSB 6	14	22	0	0	0	36
CSB 7	17	18	1	0	0	36
CSB 8	21	15	0	0	0	36
CSB 9	11	16	3	0	6	36
CSB 10	14	10	4	5	3	36
CSB 11	15	15	6	0	0	36
CSB 12	21	13	2	0	0	36
CSB 13	9	20	0	2	5	36
CSB 14	11	15	5	2	3	36
CSB 15	15	21	0	0	0	36
CSB 16	15	21	0	0	0	36
CSB 17	18	17	1	0	0	36
fi	243	275	31	10	17	**576**
1/2 * fi	121.5	137.5	15.5	5	8.5	
Fj	121.5	380.5	533.5	554	567.5	
Rj	0.210	0.660	0.926	0.961	0.985	

Step 5: Compute the RIDITs (r_{ij}) and mean RIDITs (ρ_i) for comparison datasets (Table 4).

$r_{ij} = \frac{Rj\ X\ \pi_{ij}}{\pi_i}$ where i = 1, 2, 3, …, m; 'm' = number of Likert scale items (4)

Here, π_{ij} is the frequency of category j for the ith scale item, and π_i is the total frequency for all categories (Table 5).

$\pi_i = \sum_{k=1}^{n} \pi_{ik}$ (5)

$\rho_i = \sum_{k=1}^{n} r_{ik}$ (6)

Step 6: Establish a 95% Confidence Interval for ρ_i

$\rho_i \pm \frac{1}{\sqrt{3\pi_i}}$ (7)

Table 5: Comparison of RIDIT calculations across the respondents' sample dataset.

Code	(5)	(4)	(3)	(2)	(1)	$\boldsymbol{\rho_i}$	LB	UB	Square of $(\boldsymbol{\rho_i - 0.5})$	$\boldsymbol{W}$ - Value
CSB 2	0.105	0.33	0	0	0	0.436	0.38	0.491	0.004	1.733
CSB 3	0.088	0.385	0	0	0	0.473	0.418	0.529	0.001	0.301
CSB 4	0.111	0.312	0	0	0	0.423	0.368	0.479	0.006	2.473
CSB 5	0.059	0.294	0.232	0.027	0	0.61	0.555	0.666	0.012	5.125
CSB 6	0.082	0.404	0	0	0	0.486	0.43	0.541	0	0.086
CSB 7	0.1	0.33	0.026	0	0	0.456	0.4	0.511	0.002	0.827
CSB 8	0.123	0.275	0	0	0	0.398	0.343	0.454	0.01	4.345
CSB 9	0.064	0.294	0.077	0	0.164	0.599	0.544	0.655	0.01	4.153
CSB 10	0.082	0.183	0.103	0.134	0.082	0.584	0.529	0.64	0.007	2.973
CSB 11	0.088	0.275	0.154	0	0	0.518	0.462	0.573	0	0.129
CSB 12	0.123	0.239	0.051	0	0	0.413	0.357	0.469	0.008	3.175
CSB 13	0.053	0.367	0	0.053	0.137	0.61	0.554	0.666	0.012	5.082
CSB 14	0.064	0.275	0.129	0.053	0.082	0.604	0.548	0.659	0.011	4.532
CSB 15	0.087	0.385	0	0	0	0.473	0.418	0.529	0.001	0.301
CSB 16	0.087	0.385	0	0	0	0.473	0.418	0.529	0.001	0.301
CSB 17	0.105	0.311	0.025	0	0	0.443	0.388	0.499	0.003	1.358
										36.891

Kruskal-Wallis value (W) = 36.891; Chi-Squared value $\chi 2(16\text{-}1) = 24.99$ at 0.05 significance level

LB is the lower bound of the 95% confidence interval for the mean RIDIT $\boldsymbol{\rho_i}$
UB is the upper bound of the 95% confidence interval for the mean RIDIT $\boldsymbol{\rho_i}$

Note: The relevance levels indicated by respondents on a scale from 1 to 5 are represented by the numbers in parenthesis.

Step 7: Utilise Kruskal-Wallis statistics 'W' (a non-parametric statistical test) to test the hypothesis - The use of the Kruskal-Wallis 'W' test in this context serves as a validation technique, confirming the reliability and accuracy of the survey data findings.

Null Hypothesis, Ho : $\forall i, \rho_i = 0.5$

Alternative Hypothesis, Ha : $\exists i, \rho_i \neq 0.5$

$W = 12 \sum_{i=1}^{m} \pi_i \ (\rho_i - 0.5)^2$ (8)

The statistic 'W' adheres to a chi-squared (χ^2) distribution with $m-1$ degrees of freedom.

To reject the null hypothesis Ho, the confidence intervals of the mean RIDIT scores (ρ_i) was critically examined. If a mean RIDIT score (ρ_i) is significantly different from 0.5, indicating a notable difference in respondents' reactions to that item, providing evidence to reject the null hypothesis. Conversely, if it falls within the confidence interval of ρ_i, the response patterns do not significantly differ. A lower ρ_i suggests a reduced likelihood of a negative response trend. Overlapping confidence

intervals of ρ_i value across different items implies statistically similar response patterns among respondents. In this study, the Kruskal-Wallis value (W) of 36.891 was calculated and compared with the Chi-squared value (χ^2) of 24.99 for 15 degrees of freedom at a 0.05 significance level. This implies that the calculated Kruskal-Wallis value (36.891) exceeds the critical Chi-Squared value (24.99). As a result, the null hypothesis (Ho) was rejected, indicating significant differences in the mean RIDIT scores (ρ_i) among the various groups. This outcome supports the reliability and validity of the survey data, confirming that the observed differences are statistically significant and not due to random chance (Mandal & Dey, 2022). Consequently, the findings provide robust evidence that respondents perceive specific barriers as more critical than others.

3.5 Prioritization of CSB for Rental Housing using RIDIT

As part of the second objective, the survey employed the RIDIT method to analyze the importance ratings assigned to selected CSBs by respondents. This analytical approach facilitated the derivation of rankings to identify critical barriers in RH policy implementation. Table 6 presents the comprehensive results, where CSBs are ranked according to their RIDIT scores derived from survey responses.

The statistical significance of the findings is substantiated by comparing the critical chi-squared value (χ^2) with the Kruskal-Wallis (W) value. At a 0.05 significance level, the critical chi-squared value (χ^2) with 15 degrees of freedom [χ^2 (16-1) = 24.99] was significantly lower than the calculated Kruskal-Wallis (W) value of 36.89. This comparison validates the conclusion that respondents perceive certain indicators as significantly more critical than others, lending robust statistical support to the prioritization. In interpreting the RIDIT scores, it is crucial to note that a lower ρ_i value corresponds to a higher rank. This inverse relationship indicates that responses for higher-ranked barriers were more frequently at the extremes of the Likert scale, such as strong agreement or high criticality ratings. This pattern suggests a consensus among respondents regarding the most pressing challenges in RH policy implementation.

The RIDIT analysis revealed a clear hierarchy of critical barriers, with the top three identified as inflexible rental agreements (ρ_i = 0.398), negative attitudes to social mix (ρ_i = 0.413), and the absence of government incentives for private housing entities (ρ_i = 0.423). These findings underscore the complex nature of the challenges facing RH policy implementation. Identifying inflexible rental agreements as the most critical barrier highlights the need for regulatory reform to enhance flexibility and adaptability in housing contracts. The prominence of negative attitudes towards social mix as the second most critical barrier points to deep-seated social and cultural issues that may impede the success of inclusive housing policies. The third-ranked barrier, the absence of government incentives for private housing entities, emphasizes the crucial role of public-private partnerships and the need for supportive policy frameworks to stimulate investment in the RH sector. Collectively, these results illuminate the multifaceted nature of obstacles in RH policy implementation, spanning legal, social, and economic domains. They suggest that effective solutions will require a holistic approach, addressing regulatory and economic factors, social attitudes, and stakeholder engagement.

Table 6: RIDIT Calculations and CSB Indicator Rankings from the Sample Dataset.

Code	Barrier	Thematic grouping code	ρ_i	Priority Ranking
CSB 8	Inflexible rental agreements	RI	0.398	1
CSB 12	Negative attitudes to social mix	RI	0.413	2
CSB 4	Absence of government incentives for private housing entities	RI	0.423	3
CSB 2	Resistance to housing mortgages and loans	RI	0.436	4
CSB 17	Substandard rental housing design and construction	ID	0.443	5
CSB 7	Stringent rent control policies	RI	0.456	6
CSB 3	Policy conflicts between government authorities	RI	0.473	7

CSB 15	Low utilization of land for high-density development	ID	0.473	
CSB 16	Deficient infrastructure for housing	ID	0.473	
CSB 6	Increasing rent compared to income	EM	0.486	8
CSB 11	Limited supply of rental units against high demand	EM	0.518	9
CSB 10	High approval cost (high taxes and fees on developers)	EM	0.584	10
CSB 9	High cost of serviced land	EM	0.599	11
CSB 14	Poor stakeholder engagement and communication	ID	0.604	12
CSB 13	Limited land availability in urban areas	ID	0.61	13
CSB 5	High cost of capital (i.e., interest rates on loans)	EM	0.61	

RI = Regulatory and Institutional- related Barriers
EM = Economic and Market- related Barriers
ID = Infrastructure and Development- related Barriers
Note: A lower RIDIT score corresponds to a higher rank.

Further, the identified CSBs in the study were grouped into three distinct thematic sections to provide a clear and structured understanding of the barriers facing RH initiatives. This classification offers a comprehensive overview of the barriers and facilitates the development of targeted and practical solutions. The three thematic groups are—Regulatory and Institutional Barriers (RI), Economic and Market Barriers (EM), and Infrastructure and Development Barriers (ID). These categories were carefully delineated based on the nature and underlying causes of the identified barriers, ensuring a holistic approach to addressing RH challenges. The RI barriers encompass a wide range of issues that directly impact the governance and administrative framework of RH. The EM barriers include financial and market-driven challenges that impact the affordability and economic feasibility of RH. Lastly, the ID barriers address the physical and developmental aspects, focusing on the availability, quality, and sustainability of housing infrastructure. This classification ensures a comprehensive understanding of the barriers, facilitating targeted and practical solutions to improve RH initiatives.

4. Discussion and Policy level implication

This study addresses the significant challenges within the urban RH sector in India, revealing through RIDIT analysis that the most significant barriers are inflexible rental agreements (CSB 8), negative attitudes towards social mix (CSB 12), and the absence of government incentives for private housing entities (CSB 4). These barriers are critical and must be prioritized in the Indian housing market. However, achieving success in RH requires addressing all identified barriers comprehensively, not just the most significant ones. Studying these barriers as an interconnected system is essential because they are interdependent. Addressing barriers in isolation may lead to incomplete or ineffective solutions. For instance, reforming rental agreements without addressing the lack of government incentives might not attract the private investment necessary to expand the RH supply. Thus, each barrier influences and exacerbates the others, creating a complex web of challenges that must be tackled together.

4.1 Regulatory and Institutional - related Barriers (RI)

RI-related barriers were significantly measured in six indicator items: “inflexible rental agreements”, “negative attitudes to social mix”, “absence of government incentives for private housing entities”, “resistance to housing mortgages and loans”, and “policy conflicts between government authorities”. A comprehensive strategy involving multi-level governance and policy reform is necessary to address these barriers. This strategy includes providing significant incentives to private entities investing in RH, such as tax credits for investors and interest-free loans for developers. These incentives should be implemented nationally, with the central government allocating funds to each state, which would then be responsible for disbursement and management. Additionally, rental agreement policies must be reformed to introduce flexibility and accommodate diverse tenant and landlord needs (Kadi et al., 2021). National guidelines should be established, while states could adapt these to local contexts.

Establishing a coordinated framework to align policies between different government levels and departments would reduce policy conflicts and ensure a unified approach to RH. Furthermore, nationwide awareness campaigns should be launched to educate the public about RH options and benefits, with state and local governments playing critical roles in executing these campaigns (Wan et al., 2017).

To further enhance this strategy, it is essential to establish a comprehensive monitoring and assessment system (Kissi et al., 2019). This approach would guarantee the efficient administration and adaptation of policies and incentives in response to feedback and changing circumstances. Periodic audits and evaluations should be carried out to evaluate the influence of these policies on RH development and occupancy rates (Keken et al., 2022). Additionally, establishing a collaborative environment among stakeholders, including tenants, landlords, developers, and government agencies, through regular forums and discussions can ensure that diverse perspectives are considered and integrated into policy decisions (Adabre & Chan, 2019).

4.2 Economic and Market – related Barriers (EM)

The indicators under the EM-related barriers include "increasing rent compared to income", "limited supply of rental units against high demand", "high approval cost", "high cost of serviced land", and "high cost of capital". To tackle this barrier, various strategies involving implementing rent control measures to ensure affordability, setting rent at 60% below the Average Median Income (AMI), can make RH accessible to low-income groups (Isalou et al., 2015). National policies should dictate these measures, while states manage implementation and monitoring. Encouraging the development of new rental units through public-private partnerships and incentives is also crucial (Węgrzyn, 2016). Providing subsidies or reduced pricing for serviced land to developers, particularly in high-demand areas, requires coordinated efforts at national, state, and local levels (Chan & Adabre, 2019). Additionally, reducing taxes and fees for developers to lower project costs will incentivize more developments (Adabre & Chan, 2019). This could be managed through state-level regulatory reforms supported by national policies. Offering low-interest loan programs or interest rate subsidies to developers will mitigate high capital costs, with the national government providing funding and state agencies managing distribution and oversight (Olayiwola & Ajala, 2022).

Further measures include ensuring transparent and efficient allocation of funds and resources (Osei-Kyei & Chan, 2015). Establishing an RH development fund at the national level, which states can tap into for specific projects, would ensure dedicated financial support for RH. Lastly, implementing regular market assessments to monitor rent levels and housing demand can help adjust policies and incentives as needed to remain responsive to market conditions (Gupta & Gupta, 2017).

4.3 Infrastructure and Development – related Barriers (ID)

The indicators for ID-related barriers were significantly visible in "substandard rental housing design and construction", "low utilization of land for high-density development", "deficient infrastructure for housing", "poor stakeholder engagement and communication", and "limited land availability in urban areas". This strategy involves enforcing stringent national building codes and standards to ensure high-quality RH construction with local enforcement (Maliene & Malys, 2009). modifying zoning regulations to encourage high-density development will optimize land use, increase rental units, and require substantial investments in infrastructure projects, including utilities, transportation, and community facilities (Tandel et al., 2016). These efforts should be managed at the city level with state-level support, ensuring comprehensive development. The central government should act as the facilitator, providing national funds to states. States, in turn, should act as providers who oversee project implementation, ensuring that local governments manage ongoing maintenance effectively (Government of India, 2015). Additionally, creating a streamlined permitting process for RH projects can reduce delays and costs associated with development. Establishing one-stop-shop permit offices or online platforms can facilitate quicker approvals and better coordination among regulatory bodies. Regular reviews and updates of zoning laws and building codes will ensure they remain relevant and

supportive of current housing needs and technological advancements (Kissi et al., 2019). Lastly, fostering community engagement in the planning and development process ensures that the basic infrastructure facilities meet the needs and preferences of residents (Parikh et al., 2015). Public consultations, workshops, and forums can provide valuable feedback and build public support for new developments.

In addition to addressing each thematic barrier individually, it is essential to recognize the interdependencies among these barriers and develop integrated strategies that create synergy. For example, economic incentives for developers (EM) can be aligned with regulatory reforms (RI) to streamline processes and reduce bureaucratic hurdles. This comprehensive approach will ultimately lead to the success of RH initiatives.

5. Conclusion

This study has successfully identified and prioritized the CSBs in India's RH sector through RIDIT analysis, highlighting significant challenges such as inflexible rental agreements, negative social attitudes towards mixed-income housing, and the lack of government incentives for private housing investments. The research highlights the interdependence of these barriers, emphasizing the need for a holistic approach to address them effectively. Addressing these barriers requires comprehensive regulatory, economic, and infrastructural reforms. Policy recommendations include revising rental agreements to introduce flexibility, offering substantial incentives to encourage private investment in RH, and promoting high-density development through modified zoning regulations. The study highlights the importance of establishing collaborative frameworks that engage all relevant stakeholders from planning to project execution and management.

This research contributes significantly to the existing literature by offering a detailed framework for identifying and prioritizing CSBs in the RH sector, particularly in developing countries. RIDIT analysis not only quantifies the barriers but also provides a structured approach to addressing the most critical issues first, enhancing the feasibility and sustainability of RH projects. This methodological approach fills a crucial gap in existing research by providing specificity in addressing the unique challenges RH faces in India.

However, the study acknowledges limitations, such as potential biases in the choice of reference group or dataset that may skew analytical outcomes and the challenges posed by small sample sizes in distinguishing closely ranked categories using RIDIT scores (Kar et al., 2024). Despite these issues, the methodological approach effectively identifies and prioritizes CSBs, suggesting that further research could involve a gap analysis to optimize resource allocation.

Future research should focus on several key areas to ensure continuous improvement and adaptability of strategies: (1) Conduct comparative studies with nations experiencing comparable challenges with RH, such as Brazil, South Africa, and Malaysia. These countries have successfully implemented diverse housing laws and programs and may provide valuable insights and exemplary approaches that can be tailored to India's specific needs and circumstances. (2) Exploring the social dimensions of RH, including the impact of housing policies on social equity, community cohesion, and environmental sustainability. Understanding these social implications is crucial for promoting equitable and inclusive urban development. (3) Implementing longitudinal studies to track the long-term impacts of policy interventions and reforms. This could provide valuable insights into the effectiveness of various strategies over time and help refine approaches. (4) Investigating the potential of technology and digital solutions in addressing RH barriers, recognizing the increasing importance of these tools in urban development and housing policy.

By leveraging these research directions, policymakers and urban planners can develop more effective and sustainable housing strategies tailored to meet the dynamic needs of urban populations in developing countries. This study's findings and methodological approach provide a solid foundation for addressing the complex challenges in India's RH sector, potentially leading to improved urban development, enhanced quality of life, and more significant social equity in India's rapidly growing cities.

The insights gained from this research have the potential to impact housing accessibility and urban living conditions in India. By addressing the identified CSBs through comprehensive, evidence-based policies, India can work towards creating more inclusive, sustainable, and economically vibrant urban communities. This, in turn, can contribute to broader social and economic development goals, making this research a valuable contribution to both academic understanding and practical policy implementation in the field of urban housing.

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The Authors declare that there is no conflict of interest.

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Assessing Key Factors Influencing Rental Housing Choices and Affordability for Economically Weaker Sections (EWS): A Neighborhood Study in Delhi

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ABSTRACT

The Economically Weaker Section (EWS) is constrained to live in slums and unauthorized colonies due to the lack of suitable housing options and affordability issues. Various factors such as building characteristics, financial constraints, and social considerations influence individuals' decisions regarding accommodation. A neighborhood in Delhi was chosen for a study to assess the importance of these factors for the EWS in rental housing. A total of 383 sample surveys were carried out to examine the socioeconomic variables and key factors influencing their choice of location, supplemented by 10 in-depth interviews to uncover hidden factors not typically found in existing literature. Principal Component Analysis was employed to identify the most crucial factors influencing accommodation choices. The study findings indicate that while the physical, locational, and economic aspects of rental housing are crucial, social factors also play a significant role. This research will offer invaluable insights to urban planners and policymakers to facilitate the provision of rental housing based on individual preferences in formulating housing policies.

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Highlights:

- Social linkages significantly influence EWS rental housing choices in Delhi.
- Housing characteristics like type and condition affect affordability and choices for EWS households.
- Proximity to neighbourhood amenities plays a crucial role in EWS rental housing selection.
- Government subsidies and schemes significantly impact EWS housing decisions.

Contribution to the field statement:

This study contributes to the literature by addressing a gap in understanding the rental housing choice factors for economically weaker sections. It emphasises the importance of social factors in decision-making, highlighting the need to consider user perspectives in urban housing policies. The findings reveal that social factors are crucial, in advancing knowledge of affordable housing dynamics.

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1. Introduction

Comprehending the significance of choice determinants in the provision of cost-effective rental housing for low-income individuals is crucial in addressing the housing requirements of marginalized communities residing in urban regions (Opoku & Abdul-Muhmin, 2010). The importance of choice as a determinant in the provision of affordable rental housing for economically disadvantaged groups in urban areas is of utmost importance, given its direct influence on the quality of life of numerous vulnerable individuals (Ezennia & Hoskara, 2019). While formal housing markets cater to the needs of middle and high-income groups, low-income individuals often rely on informal rental housing, such as slums and unauthorized settlements, which accommodate a substantial portion of the urban poor (Ren, 2017). The 2011 Census revealed that 13 million households reside in such slums, comprising 17% of the total urban population, highlighting the critical role of informal housing in sheltering those who cannot access formal housing options. However, the living conditions in these settlements are often substandard, with issues like overcrowding, poor ventilation, inadequate water supply, and lack of sanitation, exacerbating the challenges faced by the urban poor (Azmi & Bujang, 2021, Tiwari et al 2016). This situation is further compounded by over 11 million homes remaining vacant across urban India, illustrating a significant disconnect between housing availability and affordability (Kundu et al., 2012). The absence of formal affordable housing, especially in the form of public rental housing, forces many to live in unsafe and unhealthy environments. By examining the factors influencing rental accommodation choices among vulnerable populations, this research seeks to provide insights that could inform housing policies and strategies, ultimately contributing to the broader goal of "Housing for All". Understanding these choice factors is crucial for developing targeted housing solutions that address the diverse needs of low-income groups, ensuring access to safe, affordable, and decent living conditions in urban areas (Ghumare et al, 2021, Tiwari et al, 2020). Factors such as location, cost, proximity to employment, and access to amenities play a significant role in the housing decisions of low-income households (Ezennia & Hoskara, 2019). Therefore, understanding these choice factors is vital for developing housing policies and strategies that ensure affordable and adequate rental housing options are accessible to the poor (Taiwo et al., 2019). By addressing these factors, policymakers can work towards creating more inclusive and equitable urban environments, ultimately contributing to reducing urban poverty and achieving broader social and economic goals (Mottleson, 2023; Naik, 2015).

a. Urbanization and Housing Supply

Achieving broader social and economic development requires addressing the challenges posed by rapid urbanization. According to the United Nations, as of 2020, over 55% of the global population resides in urban regions, and this percentage is anticipated to rise to approximately 68% by 2050, primarily driven by a surge of around 90% in urbanization across Asia and Africa. By 2050, around 50% of India's population is projected to live in urban areas. Approximately 40% of the global urban growth is projected to occur in informal settlements, leading to increased economic inequality and unhygienic living conditions (UN, 2018, Hoelscher & Aijaz, 2016). Unprecedented rates of urbanization and population growth have made housing affordability a concern around the world (OECD, 2019), while people accommodate themselves in informal housing. Due to rising urbanization in India, the provision of urban housing, both for rental and ownership, has gained importance over the past two decades, with more than one-third of the population now living in urban areas (Kundu et al., 2012; MoHUPA, 2015; Gilbert A. 2016). Housing remains one of the most important factors in an individual’s well-being since it has several related aspects that affect one's mental and physical health, as well as socioeconomic and cultural diversity.

The majority of the estimated 24.71 million housing shortage in 2007, and the anticipated 26.53 million needed at the end of the 11th Five Year Plan in India account for the Economically Weaker Section (EWS) and Low-Income Group (LIG) categories. 96 % of the 18-million urban housing shortage in India was confined to LIG and EWS sectors for 2012-17 (Technical Group for the Twelfth Five-Year Plan, TG12). Unofficial estimates, using a similar methodology of calculating housing

need and extending out to include family expansion, obsolescence of existing stock and numbers of the homeless, place the requirement much higher, at 29 million units in 2018 (Roy, D., & ML, M., 2020). The majority of the newly constructed housing stock in metropolitan areas is out of reach for the EWS and LIG sectors (Olayiwola et al (2022) as the developers and private players, in particular, have focused mainly on the luxury, high-end, and upper-mid housing categories due to the profit margins (KPMG Naredco, 2012). The empirical evidence indicates that the affordability gap in urban areas in India affects more than 50% of the urban population (Mukherjee, A. et al, 2020) and the formal housing supply has not kept up with low-income residents' need for affordable housing (Patel B. et.al, 2018). In the challenge of housing, metropolitan areas are facing strong challenges which are home to numerous migrants, the rise in increase of slum population settlements despite governmental efforts signifies it. Thus, by taking up a study in Delhi, an attempt has been made to understand the low-income residents. Housing policies in India have always favoured and glorified the ownership of housing globally. But the market cannot function without rental supply. The private market caters to rental supplies in the formal market for HIG and MIG classes. The question which is tried to be addressed is, "What are the primary choice factors influencing the selection of affordable rental housing among existing options by the EWS?", To delve deeper into this inquiry, the study in Delhi focused on analyzing the key determinants that drive the EWS to choose specific affordable rental housing options over others.

b. Renting as an option and Government Policies

The Indian government's housing policies have historically prioritized home ownership over rental housing, reflecting a deep-rooted cultural and policy bias towards owning property as a symbol of economic stability and social status. The Indian government has implemented an array of schemes and strategies that aim to furnish economically feasible shelter to the underprivileged in urban areas. Such initiatives include the Urban Basic Services for the Poor, Nehru Rozgar Yojana, National Slum Development Programme, Valmiki Ambedkar Awas Yojana, Integrated Housing and Slum Development Programme, National Urban Housing and Habitat Policy, and Pradhan Mantri Awas Yojana. The primary objective of these programs is to provide not only housing but also employment opportunities, skill enhancement, and financial support for self-employment. Moreover, these initiatives offer central assistance for ownership houses, thereby catering to the needs of the urban poor. Interventions for affordable housing focused on ownership, but the private sector found it unattractive due to a lack of government support (Khaire, M., & Jha, S. K., 2022; Mack, 2013). Historically, rental accommodation has not attracted much attention, especially for EWS. It is very recently that the government has given notice to the importance of rental accommodation, especially for low-income migrants. This shift in focus towards rental accommodation for low-income migrants reflects a growing recognition of the diverse housing needs within urban populations and the necessity for comprehensive solutions to address housing insecurity across different socioeconomic groups. Along with ownership-driven housing programs like the Pradhan Mantri Awas Yojana (PMAY), which aims at "addressing the urban housing shortage among the EWS/LIG and MIG categories including the slum dwellers by ensuring a pucca house to all eligible urban households by the year 2022" (MOHUA, 2021), the Ministry of Housing and Urban Affairs has given attention to the provision of rental accommodation by introducing the scheme "Affordable Rental Housing Complexes (ARHCs)" for urban migrants/poor. The reverse migration of the urban poor that resulted in India, especially the EWS/LIG categories during the COVID-19 pandemic, has resulted in governments announcing a sub-scheme under the PMAY with an objective "to provide ease of living to urban migrants/poor in the industrial sector as well as in non-formal urban economy to get access to dignified affordable rental housing close to their workplace" (MOHUA, 2020; Yates et al, 2004). The launch of ARHCs and Model Tenancy Act 2021 aimed to streamline rental housing in India, but issues persist, such as inadequate land supply, lack of housing options, poor infrastructure, and low yield from rentals (KPMG, NAREDCO 2012). Despite these challenges, the implementation of the ARHCs and Model Tenancy Act 2021 marks a significant step towards addressing the longstanding

issues in the rental housing sector in India. Further, it becomes essential for local and national governments to understand and identify the significant factors influencing residential location choice and the tradeoff made (Olanrewaju, A. L., & Woon, T. C., 2019). The lack of attention to rental housing has resulted in a severe shortage of affordable rental units, forcing many to live in informal settlements with inadequate infrastructure and services. Furthermore, rental laws in India have historically been skewed in favour of tenants, discouraging private investment in rental housing. As a result, the rental housing sector remains underdeveloped, with minimal institutional participation, limited availability of quality rental units, and insufficient policy support to address the needs of urban dwellers who rely on rental accommodation. In response, the government has unveiled the 2015 preliminary National Urban Rental Housing Policy and the 2019 preliminary Model Tenancy Act. These initiatives are designed to offer economical rental accommodations to disadvantaged populations such as low-income individuals, daily labourers, and informal sector migrant workers (Roy, D., & ML, M. 2020; Galster, G., 2007).

c. The choice factors

Choices and preferences, though conceptually similar, are operationally distinct in housing studies, with preferences often reflecting desired attributes and choices representing actual decisions made by individuals or household members based on a combination of factors such as affordability, proximity to amenities, and social connections within the community (Aliu, I.R.,2024). Motivational factors such as the physical condition of the environment, home financing, and location accessibility significantly influence housing choices, with variations observed between that purchasing for consumption versus investment purposes (Nugroho et al 2018). Individuals evaluate available alternatives based on the choice's availability, preferences and changing circumstances (David Taiwo, O., & Misnan, S. H., 2020 Peter et al 2011). The state of the national economy also plays a crucial role, as many individuals find housing costs beyond their family budgets, highlighting the need for policy measures like low-cost social housing and subsidies to improve housing delivery systems (Nooraini et al, 2018). The study by Nooraini et al., found that individuals preferred 3-bedroom flats, followed by 2-bedroom flats and self-contained units. Biases in housing search and choice can also be influenced by external factors, such as estate agents acting as choice architects, leading to predictable biases in outcomes (Scott. Et al, 2011). Household resources, restrictions, and housing market opportunities and constraints also shape the choice set for housing options (M Van Hem, 2012). Housing, as an amalgamation of different elements such as tenure, size, style, quality, and (relative) location, forms a complex entity (Ibrahim, 2024). Given that dwellings are composed of multiple characteristics, households have to make trade-offs and compromises when deciding on housing options. The selection of a particular dwelling and its associated set of attributes is contingent upon the specific needs and preferences of households, as well as the practical constraints imposed by available resources, restrictions placed upon them, and the prevailing conditions within the housing market. It is important to acknowledge that some households possess greater capacity to actualize their housing preferences compared to others. Nevertheless, for the majority of households, the realm of choice is severely restricted and confined within specific geographic boundaries (M Van Hem, 2012; Byun, G., & Ha, M., 2016). Olanrewaju et al in their findings state that income among other factors were important, while non-financial determinants including location, security and building is important. Economic factors such as employment, housing prices, income, and expenditure play a crucial role in determining rental affordability (Amos, 2023). Social factors like housing characteristics, access to amenities like day-care and malls, and security are also significant determinants of affordable housing choices (Singla & Bendigiri, 2019). Additionally, environmental factors such as waste management, energy efficiency, materials used in construction, and noise pollution contribute to sustainable housing choices for affordable rentals (Amos, 2023; Abdul, 2018; Ikenna et al, 2019). Waddell (2018) highlights the importance of understanding socioeconomic factors to inform urban policies that reduce segregation and enhance access to amenities. Chen and Jim (2022) emphasize the role of environmental factors in shaping healthier and more sustainable

urban spaces through informed planning. Schwanen (2020) Discusses how understanding transportation needs can guide the development of efficient transit systems and reduce urban sprawl. Clark and Huang (2019) explore how life cycle stages impact mobility, underscoring the need for adaptable housing policies that cater to different life stages. Bischoff & Reardon (2014) analyze how residential choice factors contribute to segregation, advocating for policies that promote social cohesion and equitable urban development. The existing literature covers a wide range of factors that influence choices related to location, sustainability, affordability, and building characteristics. However, there is a lack of in-depth research on the EWS concerning these choice factors. To address this gap, additional choice factors specific to the EWS demographic have been identified from the literature for a more detailed analysis in the study.

d. Theories

Housing choice and preference are influenced by several important theories that help explain the complex decision-making processes involved. One foundational theory is the theory of urban spatial structure, which examines how the spatial arrangement of urban areas affects residential choices and housing quality. Herbert's Residential Choice Decision (RECD) Theory and McFadden's Random Utility (MORE) Theory further elaborate on how individuals make housing decisions based on utility maximization and the trade-offs between different housing attributes (Abraham, 2024; Lents & Ross 1957). In view of the research intended, a few theories are studied which fall in line with the research intended. Clark and Telemann (1996) discussed how life cycle stages significantly influence housing mobility and the demand for different types of housing. They observed that households tend to move as their housing needs change, often seeking more space during the child-rearing phase and downsizing in later life. Additionally, Ross (1980) emphasized that housing adjustments are frequently driven by life events such as marriage, childbirth, and retirement, highlighting the dynamic nature of residential choice throughout the life cycle. These changes are not only influenced by internal household factors but also by external factors such as economic conditions, housing market availability, and urban planning policies. Ajzen's Theory of Planned Behavior has been applied in various studies to understand residential decision-making. For instance, Jansen et al. (2011) used the Theory of Planned Behavior framework to analyze how attitudes, norms, and perceived control affect housing preferences and choices, revealing that these factors significantly influence the types of housing people select, as well as their satisfaction with those choices. Similarly, Coolen and Hoekstra (2001) found that Theory of Planned Behaviour could effectively predict housing choices by examining how these three components interact to shape residential decisions. The planned behavior model, rooted in the expectancy-value theory, explores how behavior is influenced by the expected values of different attributes. De Jong and Fawcett applied this model to migration decision-making in housing studies, assessing the importance of values to calculate an attraction score for specific locations and housing types. Factors like personal backgrounds, structural backgrounds, marital status, and financial capacity impact the decision to move. Decision-making in housing selection is viewed as problem-solving technique to transform complex situations into satisfactory ones, emphasizing goal-oriented behavior for achieving a desired quality of life (Nusrat et al 2023; Quoc et al 2022). In the realm of rental housing, prospective tenants (individuals or households) seek to utilize residential space on the demand side. At the same time, property owners rent out space to tenants on the supply side. Tenants place value on specific spaces within particular locations, while homeowners offer rental properties with distinct features in specific areas. Hence, the market for rental housing is characterized by a high level of segmentation due to its location and type-specific nature. An in-depth analysis of this segmentation can provide insights into the rental housing sector (Jiayi, 2023; Ekaterina, 2022). Firstly, the theory of housing's spatial immobility suggests that locational attributes are inherent to a set of housing characteristics (Azmi & Bujang 2021). Secondly, the durability of housing, differentiating it from other commodities, influences its relatively high cost and its connection to the mortgage market (Assaf et al, 2022). Thirdly, the diverse physical attributes of housing encompass factors such as type, size, age, building materials, exterior and interior

structures, architectural designs, and various forms of land tenure (Opoku & Abdul, 2010). The multifaceted heterogeneity of an urban housing market leads to market segmentation, comprising interconnected yet distinct housing subcategories. The trade-off theory posits that households strive to maximize their utility from owner-occupied or rental housing to balance considerations like job accessibility, as measured by monetary and time costs for commuting to a central workplace and retail areas (Henderson & Ioannides, 1983). Consequently, housing decisions involve a trade-off process influenced by homeowners' or tenants' assessments of housing quality, locational amenities, and accessibility.

2. Materials and Methods

This section discusses the methodology adopted for the study, with a brief description of the case area, descriptive results of the surveys done and analysis performed.

2.1 Methodology

Factors related to the choice have been extensively studied in various contexts within the literature, including the context of EWS. To further explore these factors, a study conducted in-depth interviews with 10 respondents to gain insights into the significance of different aspects of choice factors. This research aimed to introduce additional factors to the existing body of knowledge. The factors selected for inclusion in the study cover a wide range of elements such as Safety, Political Representation, Landlord-tenant relation, Financial Help from relatives, Relative Support, Unit Area, number of rooms, age of building, House Typology, Nearness to parks & playgrounds, Nearness to school, Nearness to hospitals, Nearness to Market, Drainage, Sewerage, Electricity, Water Supply, Solid Waste Management, Expenditure on Food, House rent, Employment Zone, Distance to public transport, Government Scheme Subsidy/scheme (Education/Health), and Subsidy/scheme (Housing). This comprehensive list of factors provides a detailed understanding of the various considerations that influence choices in the context of the EWS, shedding light on the complexity of decision-making processes in this domain.

a. Data Collection and Sampling Technique

The primary data was collected using a convenient sampling technique. Convenience sampling is a non-probability sampling method where the sample is taken from a group of people who are easy to contact or reach. This method was chosen because it allows for quick and easy data collection from respondents who are readily available, accessible, and willing to participate (Sekaran and Bougie, 2010). A total of 383 respondents participated in the survey. This sample size was deemed adequate to achieve enough statistical power and reliability in the results. The respondents included tenants from various locations to ensure a diverse representation of housing preferences and rent patterns.

b. Analysis

Prior to performing any statistical analysis, normalizing the gathered data is crucial. Normalization is a critical pre-processing step that ensures all variables are on a comparable scale. This process is crucial for reducing biases and enhancing the accuracy of subsequent analyses. The normalization process typically involves transforming the data so that the mean of each variable is zero and the standard deviation is one. Descriptive statistics were then calculated to offer a summary of the data and gain insights into the distribution and central tendencies of the variables being studied. Specifically, within the accommodation type, factors such as average expenditure, income, rent paid, and access to amenities were analyzed. Following existing trends in the literature, Principal Component Analysis (PCA) was employed to reduce the dimensionality of the data and identify the key factors influencing housing choices and rent levels. PCA is a statistical technique that transforms the original variables into a smaller set of independent variables called principal components. These components capture the most significant amount of variability present in the dataset. By utilizing PCA, researchers were able to pinpoint the crucial determinants influencing decisions related to housing selection and rental prices.

This approach facilitated a more focused examination of the dataset, enabling a deeper understanding of the factors driving housing choices and rent levels.

2.2 Case Area

Delhi remains one of the first choices for the people of the low-income sector while they migrate in search of employment, mostly informal. In accordance with the projections outlined in the draft of the Master Plan for Delhi 2041 (DDA, 2021; NIUA 2021), the city will require 34.5 lakh new housing units by the year 2041. Among these, 54% will be needed for the EWS and lower-income groups (LIG). A recent analysis on housing and urban development featured in the Economic Survey of Delhi 2016-17 reveals that the number of low-income settlements has been steadily rising for more than 55 years. Presently, these settlements accommodate 6.75 million individuals out of a total population exceeding 9 million residents. These individuals reside in substandard housing, which comprises 695 slum settlements, Jhuggi Jhompri clusters, 1797 unauthorized colonies, and 362 urban villages. The study suggests that Delhi's housing deficit represents nearly half of the housing shortfall in other major Indian metropolitan cities as reported by the Ministry of Housing and Urban Affairs in 2012 and the National Housing Bank in 2018. Around 6343 informal settlements containing approximately 10.20 lakh households were reported to be present in urban Delhi in 2012. The majority of these settlements, about 90%, were situated on public land, predominantly owned by local authorities (46%), the railway sector (28%), and the state government (16%), among others. It was observed that about 74.46% of these settlements were located near residential areas, while 3.36% were adjacent to industrial zones, 0.66% were in close proximity to commercial areas, and the remaining were surrounded by various other types of areas. Furthermore, a significant, 86.74% of the settlements had primary schools situated within a distance of less than 0.5 km (NIUA, 2021). As asserted by Ramudu et al. (2023), the urban center of Delhi houses a mean of 28.5% of the population residing in rental accommodation, a statistic also reported in the Census undertaken in 2011.

Various governmental initiatives have been implemented to cater to housing needs through targeted strategies and enhancements in infrastructure. These initiatives included measures such as clearing squatter settlements through demolition and relocation to resettlement colonies in the 1950s, the Jjuggu jhompri Clearance scheme which provided 80 sq. mt. plots to eligible squatter families in the 1960s, and the construction of resettlement colonies on the outskirts of urban areas for those displaced from old slums and demolished squatter settlements in the 1960s and 70 (Gupta & Gupta 2017). Additionally, central housing schemes like RAY, BSUP, IHSDP, and PMAY have been carried out to address housing issues in the National Capital Territory of Delhi, focusing on upgrading Jhuggi Jhompri, redeveloping notified slums, and providing public housing for low-income groups (Noopur Gupta, A, 2018). The latest step is the provision of rental accommodation through the Affordable Rental Housing Complexes Scheme where the government started addressing the need for rental housing for the poor after seeing a mass exodus of people during the Covid-19 (MoHUA, 2020; Dubey et al 2022).

The selected site for the study is the Maharani Bagh area which consists of parts of Khazirabad village, Taimoor Nagar, New Friends Colony, and Zakir Nagar. The site falls in the southeastern district of Delhi. The entire case study area consists of 450 Ha and belongs to zone F1. Zone ‘F’ is identifiable with its low density and green character. This zone is mainly comprised of planned, well-maintained posh residential localities. This also includes rehabilitation colonies and government housing areas. The study area is diverse with an interesting interplay of land use mix, rental characteristics and intermixes of social and economic diverse groups.

The study explores the technical elements interconnected with wide-ranging social aspects; therefore, with a focus on personal decision-making, information is collected from primary resources. The participants were chosen from the Maharani Bagh Area of Delhi which comprises a diverse social mix of people where there are pockets of planned development in the form of Gated Housing Societies, plotted developments for MIG and HIG Groups, and slums- Taimoor Nagar and Batla house along with unauthorized colonies of Khazirabad and Zakir Nagar. The surveys were done with households

residing in the informal settlements and people working in informal occupations like selling fruits, vegetable vendors, workers of restaurants, rickshaw pullers and auto-rickshaw drivers.

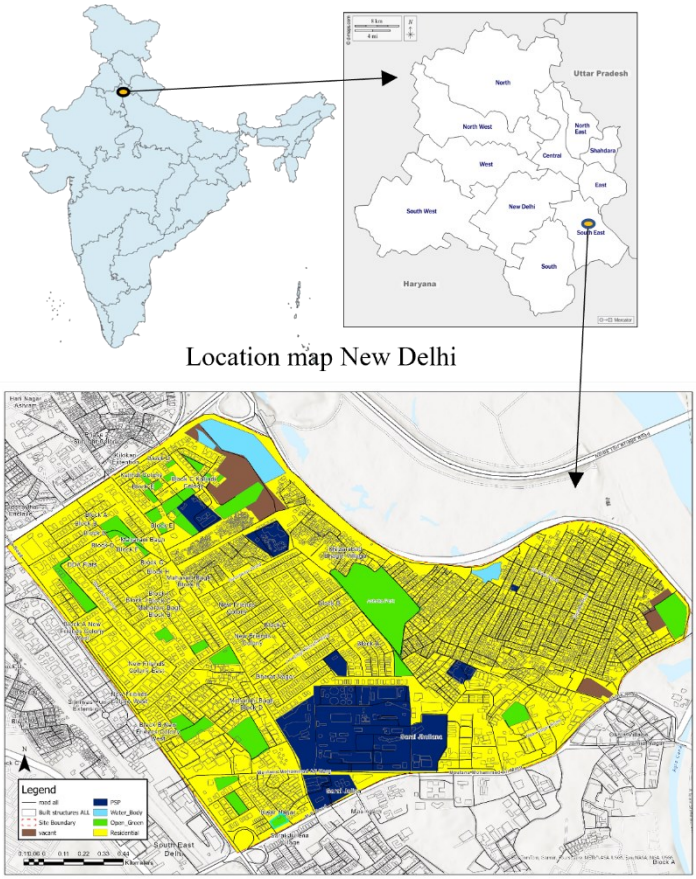

Figure 1. Case Area location map, land use- Maharani Bagh study area.

The case area is characterized by a mix of residential, commercial, and institutional land use. It includes notable landmarks such as Jamia Milia Islamia University, New Friends Colony, and community centre, which serve as key hubs for generating a wide range of informal job opportunities within the community. These areas not only provide essential services and facilities for residents but also contribute to the local economy by fostering informal employment opportunities.

3. Results

The first section of the descriptive analysis delves into a detailed examination of various aspects such as demographics, housing conditions and accessibility of amenities based on the surveys conducted. It provides a comprehensive overview of the characteristics and features related to these areas, offering insights into the current state of the community or population under study. Moving on to the second section, it focuses on the principal component factor analysis. This analytical approach involves identifying the key underlying factors or variables that explain the patterns and relationships within the data. By exploring these principal components, researchers can gain a deeper understanding of the underlying structure and dynamics of the data set, helping to uncover important insights and trends that may not be immediately apparent through traditional analysis methods. Furthermore, the second section delves into the process of extracting and interpreting eigenvalues and eigenvectors, which play a crucial role in determining the significance and contribution of each principal component to the overall variance within the dataset.

3.1 Descriptive Analysis

Demographic profiles of the households:

A total of 383 sample surveys were performed, by using the convenience sampling method using the structured questionnaire survey method. The existing statistics of the slums suggest that the percentage of married people is higher in any informal settlement. A couple of households generally have two earning members and pay a good some of the income on rent while they want to move out of the poor condition of informal settlements and be ready to move out of it. But in the absence of any appropriate supply from the market, they are bound to live in the poor living conditions of informal settlements. Out of 383 samples with the frequency table of households, it can be seen that 75% of the households are composed of up to 4 members. 30% of the households have size 4.

Accommodation: 85 % of the people have stayed in the locality for up to 20 years, one-third of surveyed households have stayed for the last 5 to 10 years and 44 percent have migrated for more than 10 years. More than 50% of the houses have two habitable rooms. The number of rooms is based on counts only which is assumed that the house might have one bedroom and one living room. As presented in Table 1, 65% of the households chose to stay in houses with personal toilets and 35% chose to stay in houses with shared toilets. More than 76 per cent of the households are staying in houses which are up to 20 years old. One-fourth of people live in houses which are even older than 20 years, which shows that, in addition to poor living conditions, the age of buildings is of concern.

Table 1: Type of Accommodation.

S. No.	Type of Accommodation	No.	Percentage
1	House with shared toilet	134	35
2	House with toilet	249	65

Expenditures: As presented in Table 2, the Average income for the households is Rs. 30483.03. The average expenditure on accommodation is Rs. 4368.15 while spending approximately Rs.1000 on electricity(monthly), Rs. 100 on water, Rs. 1442.48 on health, Rs. 873.76 on travel, a good sum of Rs. 53953.13 on an average is spent on education. Education stands as one of the most important expenditures with the rise in awareness of education.

Table 2: Average Expenditure details and income.

	Rent	Exp_accommodation	Exp_Electricity	Exp_Water	Exp_Healthcare	Exp_ Travel	Exp_Edu_Annual	Income
Mean	5112.27	4368.15	982.25	119.08	1442.48	873.76	53953.1	30483.03
Std. Dev.	2409.99	1981.98	963.73	318.34	3730.45	911.61	41678.9	15223.95
Minimum	1500	1500	0	0	0	0	0	10000
Maximum	10000	10000	7000	3000	70000	6000	400000	60000

Table 3 presents the rents paid by the households. 67.624 % of the households, approximately two-thirds of the households are paying rent up to Rs 6000. 24.8% of households paying rent between Rs 6000 to Rs 9000. And 7.5 per cent of the people are also paying rent more than Rs. 9000.

Table 3: Rent paid.

Rent (in Rs)	Frequency	Per cent	Cumulative Percent
<3000	70	18.277	18.277
3000- 6000	189	49.347	67.624
6000-9000	95	24.804	92.428
>9000	29	7.572	100
Missing	0	0	
Total	383	100	

92.17% of people earn up to Rs.40000, 7.83% of people earn more than Rs. 40000, and one-third of people earn between RS. 10000- 15000.
Access to amenities: As presented in Table 4, for at least 50% of the households, the hospital, schools, playgrounds, and religious places are within the range of 1.5 km. For 80% of the household's general store is within a radius of 500 meters. The police station is available within 2 km range.

Table 4: Distance of amenities.

Distance range	Hospital/Clinic	School	General Store	Playground	Police	Community Place	Religious place
<500	85	75	306	88	22	53	158
500-1500	197	191	48	181	45	87	198
1500-2500	76	92	14	81	208	173	19
2500-4500	17	15	13	28	96	54	6
6000	8	10	2	5	12	16	2
Total	383	383	383	383	383	383	383

3.2 Principal Component Analysis

Principal component analysis, known as PCA, is a technique for reducing the dimensionality of extensive datasets by transforming a multitude of variables into a smaller set that retains the majority of the original information. The primary objective of conducting this analysis is to pinpoint the key components that play a pivotal role in decision-making processes among married couples affiliated with the EWS. Upon examination of Table 5, it is evident that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy exceeds the threshold of .7, indicating the presence of an adequate number of items for each factor within the analysis. Furthermore, the statistical significance level falls below .05, thereby establishing the significance of Bartlett's test in this context.

Table 5: KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.782
Bartlett's Test of Sphericity	**Approx. Chi-Square**	17863.941
	df	253
	Sig.	0.000

After performing PCA, the positive Eigenvalues and the scree plot suggest the most important 7 components which are relatively important for the study.

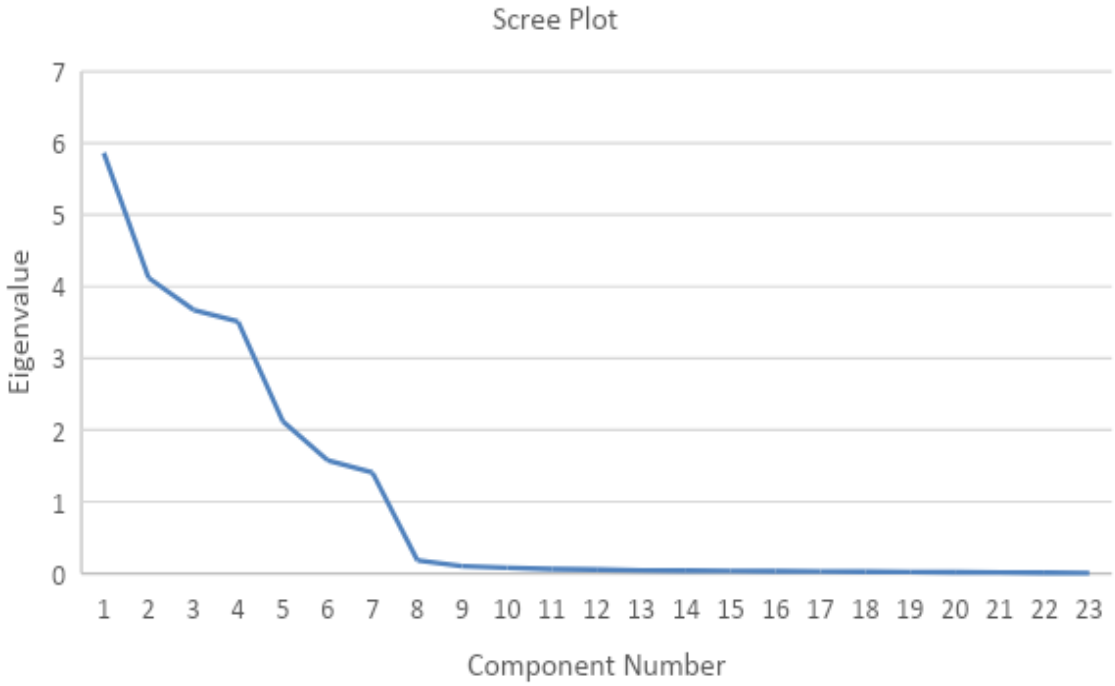

Figure 2. Scree Plot.

Table 6: Rotated Component Matrix.

	Component						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Safety	0.972						
Political Representation	0.971						
Landlord-tenant relation	0.968						
Financial_Help from relatives	0.967						
Relative_Support	0.916						
Unit Area		0.974					
Number of rooms		0.970					
Age of building		0.969					
House_Typology		0.959					
Nearness to parks & playgrounds			0.984				
Nearness to school			0.981				
Nearness to hospitals			0.981				
Factor_Market			0.977				
Drainage Sewerage				0.981			
Electricity				0.977			
WaterSupply				0.971			
Solid Waste Management				0.970			
Expenditure on Food					0.991		
House rent					0.991		
Employment Zone						0.971	
Distance_publictransport						0.970	
Government Scheme Subsidy/ scheme (Education/ Health)							0.964
Subsidy/ scheme (Housing)							0.964

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

The table presents the Rotated Component Matrix, which is the result of a Principal Component Analysis (PCA) using the Varimax rotation method. The matrix displays the relationships between different components and variables in the study.

a. Components in the Matrix:

- **Component 1:** Variables such as Safety, Political Representation, Landlord-tenant relations, and Financial Help from relatives have high loadings (0.916 to 0.972) on this component.
- **Component 2:** Variables related to Unit Area, Number of Rooms, Age of Building, and Housing Type have significant loadings (0.959 to 0.974) on this component.
- **Component 3:** Variables such as Proximity to Parks/Playgrounds, Schools, Hospitals, and Market Factors show strong associations (0.977 to 0.984) with this component.
- **Component 4:** Variables like Drainage, Sewerage, Electricity, Water Supply, and Waste Management exhibit high loadings (0.970 to 0.981) on this component.
- **Component 5:** Variables related to Expenditure on Food and House Rent are strongly correlated (0.991 to 0.991) with this component.
- **Component 6:** Variables related to the Location of Employment Zone and Public Transport Distance are strongly correlated (0.970 to 0.991) with this component.
- **Component 7:** This component includes variables like Government Scheme Subsidies (Education/Health) and Housing Scheme Subsidies, with loadings of 0.964 to 0.971.

The rotation method used in this analysis is Varimax with Kaiser normalization, which helps simplify the interpretation of the components. The rotation process converged after 5 iterations, indicating that the components are now more orthogonal and easier to interpret in the study.

4. Discussions

The study provides a comprehensive analysis of the key factors influencing rental housing choices among the EWS in a neighborhood in Delhi. The findings from the Principal Component Analysis (PCA) identify seven crucial components that significantly shape these decisions: social factors, housing factors, neighborhood factors, utilities, expenditure on basic needs, location factors, and government subsidies/schemes. Each of these components plays a distinct yet interconnected role in determining the housing choices of the EWS.

Social Factors: Social factors emerged as the most influential component in the housing choice decision-making process. The study reveals that social networks, particularly relationships with relatives and community members, play a critical role for the EWS, especially for newly migrated individuals. In the absence of established social and economic resources, migrants often rely on their social connections to find initial accommodation, employment, and support within the city. This finding underscores the importance of social safety nets and the role of local political representation, which helps in addressing the needs for basic amenities and upholding the rights of the community members. The study also highlights the role of landlords as key stakeholders, influencing both financially and politically the living conditions of the EWS. These insights, which were gleaned from in-depth interviews, provide an original contribution to the literature by revealing the critical role of social relations in the housing choices of the EWS, a factor that is often overlooked in existing studies.

Housing Factors: The study identifies housing characteristics—such as the type of accommodation, age of the building, and building conditions—as significant determinants of rental housing choices. These factors correlate strongly with demographic characteristics, rent affordability, and household preferences. For instance, married couples tend to prefer private accommodations with separate kitchens and toilets, while single households may opt for shared facilities to minimize costs. This pattern aligns with findings from other studies, where affordability and suitability to household size and structure are key considerations in housing decisions (Ezennia & Hoskara, 2019; Tiwari et al., 2020). These factors reflect the fundamental housing needs of EWS households, which are often constrained by limited financial resources and the lack of affordable, decent housing options in the formal market.

Neighborhood Factors: The availability and accessibility of essential services such as hospitals, schools, parks, and markets are critical neighborhood factors influencing housing choices. These amenities contribute to the overall livability of a neighborhood and are particularly important for EWS households, whose limited resources often require them to optimize their location relative to essential services. The presence of such amenities within close proximity supports a diverse and economically integrated community, which is essential for sustaining the social fabric of EWS settlements. This finding is consistent with existing literature, which emphasizes the importance of neighborhood quality and access to services in the housing choices of low-income households (Taiwo et al., 2019; Ghumare et al., 2021).

Utility Factors: Access to utilities, including water supply, sewerage, drainage, and solid waste management, also emerged as a significant determinant in the study. The availability of reliable utilities is a crucial consideration for EWS households, which often reside in informal settlements with inadequate infrastructure. Poor utility services directly impact the quality of life and health of residents, making this factor a vital element in housing choices. This finding aligns with the broader literature on the role of infrastructure and services in housing decisions, which highlights that inadequate access to utilities often drives low-income households to seek better living conditions (Mukherjee et al., 2020; Amos, 2023).

Expenditure on Basic Needs: The study reveals that EWS households tend to prioritize affordable rental accommodation and proximity to areas where basic goods and services, such as food, are inexpensive. This expenditure pattern reflects the economic constraints faced by EWS households, who must balance limited incomes against the need for affordable housing and daily living expenses. This finding is consistent with existing research, which shows that low-income households often have to make trade-offs between housing costs and other essential needs (Nooraini et al., 2018; Olanrewaju et al., 2019).

Location Factors: The location of housing relative to employment opportunities and public transportation options significantly affects the choices of EWS households. As many EWS residents are migrants employed in informal sectors, they often prefer to reside close to their workplaces or in areas with affordable public transportation. This preference minimizes transportation costs and time, which is crucial for households with limited financial resources. The importance of location in housing choices is well-documented in the literature, which identifies accessibility to employment and transportation as key determinants of housing affordability and suitability (Schwanen, 2020; Clark & Huang, 2019).

Government Subsidy and Scheme Factors: The study identifies government schemes and subsidies as another important component influencing housing choices. EWS households often rely on government programs for affordable housing and basic services, especially during times of economic hardship or in the wake of policy changes, such as the Affordable Rental Housing Complexes (ARHCs) introduced post-COVID-19. The role of such schemes in facilitating access to affordable housing highlights the importance of effective policy interventions that target the specific needs of low-income populations. This finding underscores the critical role of public policy in shaping housing outcomes for the urban poor (Yates et al., 2004; Kundu et al., 2012).

In summary, the findings of the study emphasize the complexity of housing choices among the EWS and highlight the interdependence of multiple factors, including social networks, housing characteristics, neighborhood amenities, utility services, basic expenditure needs, location considerations, and government policies. The study contributes to the literature by identifying unique social factors that influence the housing choices of the EWS, offering new insights for urban planners and policymakers to design more inclusive and equitable housing policies.

5. Conclusions

This study provides a detailed analysis of the factors influencing rental housing choices among the EWS in Delhi, highlighting the nuanced decision-making processes that are often overlooked in policy discussions. The findings demonstrate that housing is a multifaceted commodity, encompassing a

range of attributes that cannot be considered in isolation. The study identifies seven key components—social factors, housing characteristics, neighborhood attributes, utility access, expenditure on basic needs, location, and government subsidies—that collectively shape the housing choices of EWS households.

One of the significant contributions of this study is the identification of social factors as a critical determinant of housing choices among EWS households. This finding reveals the reliance on social networks, such as relatives and local community members, for both financial and emotional support, particularly for newly migrated individuals. This aspect, largely absent in existing literature, provides a novel perspective on the housing decisions of low-income groups, emphasizing the need for policies that recognize and leverage these social dynamics.

The study also underscores the importance of housing characteristics and neighborhood attributes, including the availability of essential services and amenities, which are crucial for maintaining a decent quality of life. Utility provisions, expenditure patterns, location relative to employment, and public transportation access further influence housing choices, reflecting the diverse needs and constraints faced by EWS households. These findings align with existing literature, reinforcing the importance of these factors in the housing decisions of low-income populations.

The results highlight a critical gap in current policy frameworks, which often fail to address the specific needs of the EWS. Housing policies tend to focus on the provision of basic housing units without considering the broader socio-economic and cultural context within which these households make their decisions. The study suggests that a more holistic approach, considering factors such as household size, work type, and affordability, is necessary for designing effective housing policies that cater to the diverse needs of EWS households.

In conclusion, this study opens up a discussion on the importance of choice factors for the EWS, providing an opportunity for further research into each of the identified components. As global housing shortages continue to pose challenges, especially for EWS, understanding the unique characteristics and needs of these populations becomes increasingly important. This understanding can inform the development of more inclusive, context-specific housing policies that improve access to affordable and adequate housing, contributing to broader social and economic goals such as poverty reduction, social integration, and urban sustainability. Future research should focus on examining the individual components more deeply to enhance our understanding of the complexities involved in the housing decisions of the urban poor.

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The Authors declare that there is no conflict of interest.

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The data that support the findings of this study are available from the corresponding author, [Ekta], upon reasonable request.

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Integrating Metro Stations with the Adjacent Urban Fabric Using TOD Principles: A Case of Agargaon Metro Station, Dhaka

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ABSTRACT

Transit-Oriented Development (TOD) principles offer a promising framework for integrating metro stations with their surrounding urban fabric, promoting sustainable urbanization and efficient transportation systems. Dhaka, one of the fastest-growing cities globally, faces significant challenges in traffic congestion, air pollution, and urban sprawl. Introducing metro systems offers a promising solution to alleviate these issues and enhance urban mobility. This study presents a case study of Agargaon Metro Station in Dhaka City, examining its integration with the adjacent urban fabric using TOD principles. Through a combination of field observations, spatial analysis, and stakeholder interviews, the study evaluates the current state of Agargaon Metro Station. On-site assessments examined the station's physical infrastructure, accessibility, and connectivity with nearby areas, while Geographic Information Systems (GIS) analyzed spatial data, including land use patterns and transportation networks. Semi-structured interviews with urban planners, government officials, and community members provided insights into the challenges and opportunities for implementing TOD at Agargaon. The findings reveal that the station is underutilized as a TOD hub, with inadequate pedestrian infrastructure and mixed-use developments, leading to poor connectivity and accessibility. The study highlights the necessity of improved land use planning, policy support, and community engagement to enhance the station's role in fostering TOD. These recommendations, if implemented, could alleviate traffic congestion, improve air quality, and create more livable urban spaces, thereby enhancing Dhaka's overall quality of life. Additionally, the research contributes to the social and economic dimensions of urbanization by offering a framework that can be adapted to similar metro stations in Dhaka and other rapidly urbanizing cities.

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Highlights:

- Agargaon Metro Station is a key part of Dhaka's MRT system, addressing traffic congestion and urban mobility.
- The study applies TOD principles like density, mixed land use, and walkability to better integrate the station with its fragmented surroundings.
- Recommendations include improving pedestrian pathways, public spaces, and mixed-use zoning within a 1 km radius, and enhancing coordination with other public transport modes.
- The findings propose design guidelines to improve the urban environment using TOD principles.

Contribution to the field statement:

This study contributes significantly to the field of urban design by offering an evaluative framework for assessing the compliance of station areas with TOD principles. By providing a structured approach, helps stakeholders understand the essential components of TOD and guides them in making decision making process. Continued research is essential to address the identified limitations and explore additional aspects of TOD design and implementation. This work advances the understanding of how TOD principles can address the socio-economic challenges posed by unplanned urbanization, with broader applications for enhancing public transit infrastructure in developing cities.

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1. Introduction

The urban form of Dhaka has created significant challenges for city planners and designers, primarily attributable to the fragmented land utilization and inadequate amalgamation of transportation amenities, services, and infrastructure. The urban area is distinguished by a notable dependence on individual modes of transportation and insufficient provision of public transit, leading to significant traffic congestion. In 2024, the city's population exceeded 21 million, with an estimated influx of 1,000 new people daily. The transportation infrastructure has faced challenges to keep pace, leading to significant traffic congestion, with average travel speeds in central areas dropping to less than 7 km/h during peak hours. Non-motorized and informal transport modes, such as rickshaws and CNG-run auto-rickshaws, account for over 75% of daily travel, while only 6% use formal public transport systems. In response to these issues, the Government of Bangladesh has initiated the construction of a metro rail system to improve urban mobility and reduce reliance on private vehicles. The Dhaka Metro is intended to provide a reliable, efficient, and environmentally friendly alternative to the congested road network. Nevertheless, the effectiveness of metro systems relies not alone on their technological proficiency, but also on their integration with the surrounding urban environment. Upon its implementation, it is anticipated that the project will effectively decrease the number of privately owned vehicles on the roads of Dhaka. Further, the implementation of Dhaka Metro is anticipated to be supplemented by other transportation modes such as Feeder buses, Intermediate Public Transport (CNG, Rickshaws), etc. This will establish the foundation of the multimodal urban public transport system of Dhaka. Given the present pace of development, Dhaka and its surrounding areas will likely need to strategize transit-oriented developments (TODs) to enhance the quality of life in its urban localities. Despite the development of the Dhaka Metro, there is a lack of research on integrating metro stations with the existing urban fabric, particularly through Transit-Oriented Development (TOD) principles. An increasing number of cities have adopted transit-oriented development (TOD) as a strategy to enhance the urban structure of cities. TOD, or Transit-Oriented Development, has been utilized as a comprehensive approach to combine land-use and transportation systems, improve dense urban structures, and encourage the use of public transit by minimizing reliance on private automobiles (Calthorpe, 1993). This study addresses the gap in understanding how TOD can be applied to Dhaka's unique urban challenges and socio-economic conditions.

Transit-Oriented Development model is a comprehensive approach that combines land-use and transport systems to create sustainable and pedestrian-friendly neighborhoods. These will result in a convenient, safe, and enjoyable space for people to move around. The area’s diverse functions provide public open space, high-density housing, offices, and commercial centers, resulting in shorter and more rapid trips. By reducing auto-oriented activities, TOD integrates locals, especially those with restricted access to private vehicles because of their financial situation, their age, or the age of children or the elderly nevertheless have access to many facilities and may meet their needs, and provide access to many facilities. The execution of the Dhaka metro system, comprising numerous stations situated along primary routes, presents a prospect to implement a comprehensive approach that advocates for the revitalization of the city’s main transit areas.

Thus, this paper aims to incorporate the Dhaka Metro into the city's urban fabric while adhering to the principles of transit-oriented development. This entails evaluating several facets of station area design to enhance the comfort and convenience of users. The inclusion of station amenities, such as physical infrastructure including parking areas, transfer areas, pedestrian networks, cycling facilities, feeder shelters, taxi stands, etc., is essential for enabling smooth transfers within a multimodal transit system. The study used qualitative as well as quantitative approaches. The methods employed in this study encompass a comprehensive theoretical evaluation of several topics, on-site observation, and the collection of data from pertinent authorities. The literature review focuses on the concept and principles of transit-oriented development. Additionally, a comprehensive inventory of the station area is conducted to evaluate the current situation. In addition, the analytical and applied study involves the use of site observation and analysis, as well as the collection of images and field notes. An analysis is conducted on several design factors to enhance the premises of the station area. This

research analyses to identify effective practices and provides recommendations to enhance the performance of the current system. The research suggests a method for enhancing the urban environment of the area under investigation by implementing a series of design guidelines and principles based on Transit-Oriented Development (TOD).

2. Literature Review

2.1 Concept of Transit-Oriented Development

Transit-oriented development (TOD) has become a prominent focus in urban planning and urban mobility research since the mid-1990s (Al-malki et al., 2022; Ibraeva et al., 2020). Several studies have investigated the relationship between the physical infrastructure and the various means of mobility that were prevalent in the early 20th century, before the widespread ownership of cars (Knowles, 2006). A crucial aspect of urban planning is comprehending the relationship between the built environment and urban mobility and the ability to plan for it.

Calthorpe (1993), argues that the American dream of suburban living with its emphasis on single-family homes, private cars, and low-density development is unsustainable and detrimental to the environment and social fabric of communities. He proposes an alternative vision of urban development that is centered on transit-oriented development (TOD) and compact, walkable mixed-use communities. His ideas have been very influential in shaping urban planning and design in the United States and beyond. He is considered one of the pioneers of new urbanism a movement that promotes walkable mixed-use neighborhoods with a focus on community and sustainability. He further argued that TOD can catalyze new investment in urban areas. Also mentioned, "TOD can generate new development by attracting investment to areas previously overlooked by developers because of their lack of access to transportation or other amenities."

TOD is a Land-use strategy that emphasizes accessibility improvement by encouraging the development of compact, high-density, and mixed-use nearby transit stations. However, the majority of abstract conceptions contain many shared TOD components like mixed design, height, pedestrian access, and good mobility (Belzer & Autler, 2002; National Academies of Sciences, 2004). "Transit-Oriented Development in the United States: Experience, Challenges, and Prospects" Cervero & Kockelman (1997), do not propose a single theory of Transit-oriented development. Rather they provide a comprehensive analysis of the United States, drawing on a range of theoretical perspectives. They evaluate the history of TOD, tracing its roots to the early streetcar suburbs of the late 19th century and early 20th century. They discuss TOD's benefits, including reducing automobile dependency, increased mobility, and improved access to jobs and services. They also analyze the challenges of implementing TOD, such as financing, land use regulations, and community resistance. Arrington & Cervero (2008), define TODs as areas that have excellent pedestrian access and are planned to be compact, incorporating a mix of commercial and residential land uses. Similarly, TOD is a development pattern that revolves around transit hubs and promotes a combination of different types of land use in a well-connected and secure urban setting. Hence, the term TOD typically suggests that a specific location is easily accessible by foot and effectively connected to its environment. The area should accommodate numerous commercial establishments and provide a range of housing choices and job prospects.

TOD has been touted as a way to address a variety of issues related to transportation, urban sprawl, and sustainability. Some proponents argue that TOD can help reduce greenhouse gas emissions by reducing the need for car travel, while others believe that it can help revitalize urban areas by attracting new development and investments. Despite the potential benefits of TOD, it is important to note that it is not a one-size-fits-all solution. Different communities have different transportation needs and the success of TOD depends on a variety of factors, including the availability and quality of public transportation, the local land use context, and the preferences and behavior of residents. Nevertheless, TOD is an important theory in the field of transportation and development and it's likely to continue to be an important topic of research and discussion in the coming years.

2.2 Influence of TOD

The TOD idea has had a significant influence on the literature related to transportation and urban development. Peter Calthorpe, the prominent figure in the New Urbanism movement, provides a brief overview of a Transit-Oriented Development (TOD) as a diverse community situated within a 2000 feet (or 10-minute) radius of both a core commercial center and a transit station. TOD integrates many elements such as shops, housing, workplaces, public spaces, and green spaces, to create a pedestrian-friendly setting. This design facilitates the use of public transit, walking, cycling, or driving for both employers and residents (Furlan et al., 2021). The half-mile measure, which is about 800 meters, aligns with the Livable Neighborhoods Community Design Code of the Western Australian Planning Commission (WAPC) has also been widely utilized in other research studies (Dittmar & Ohland, 2003; Reid Ewing, 1999). The reason for using an 800m walkable catchment radius is because distances above 800m are considered "formal destinations" where individuals are more inclined to use transportation other than walking. Calthorpe differentiates between a "TOD district" (situated near local bus routes that connect to railway lines) and an "urban TOD" (situated right next to a railway line). Originally, several forms of Transit-Oriented Development (TOD) were primarily designed to urbanize suburban areas. Figure 1 illustrates that Calthorpe envisioned urban TODs to prioritize job hubs rather than housing- areas (Carlton, 2009).

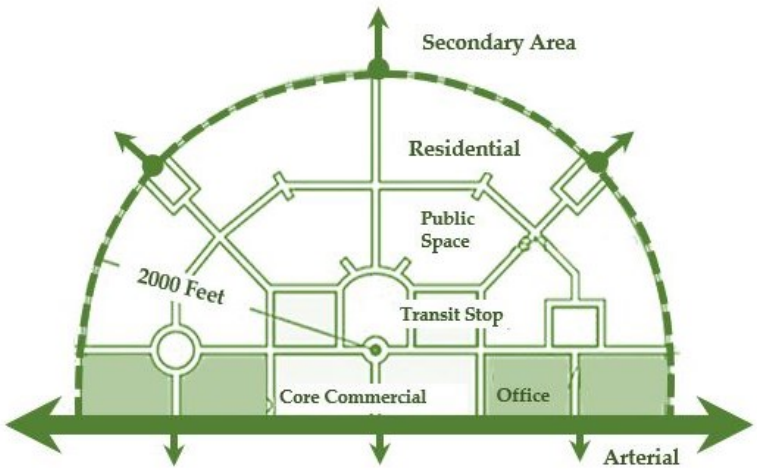

Figure 1. Concept of transit-oriented development (TOD) (Calthorpe, 1993).

TOD advocates for the development of urban areas that incorporate a variety of land uses, such as housing, recreation, commerce, and employment. This development is planned with a focus on pedestrians, ensuring that the scale of the area is suitable for walking while also accommodating cars. A compact city plan can provide proximity to transit terminals. This facilitates commuters to reach their desired locations more conveniently, hence fostering increased usage of public transportation by improving accessibility. TOD refers to the revitalization of an existing neighborhood or the creation of new structures that are designed to promote the use of sustainable and convenient modes of transportation, such as walking, cycling, and public transit (Lamour et al., 2019; Marthya et al., 2021). Figure 2 depicts a notion of a compact node for TOD (Transit-Oriented Development).

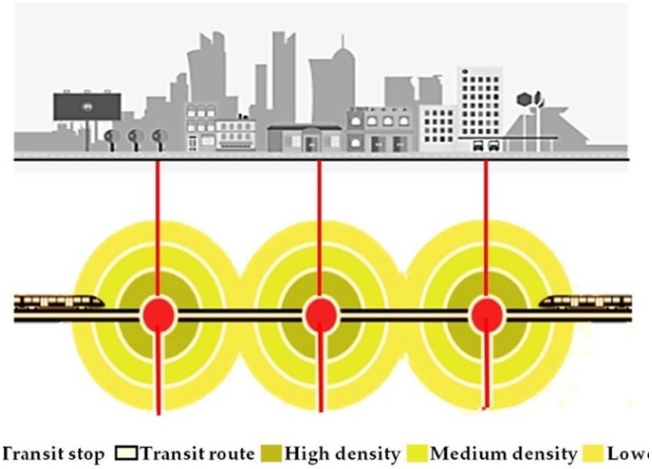

Figure 2. TOD nodes are interconnected with a public transit system (Nafi et al., 2021).

According to the US state of Florida, TODs are considered as specific places that include a combination of several types of land use, are compact, have a moderate to high population density, are connected to other land uses, are favorable to pedestrians and cyclists and are intended to support frequent transportation services that operate either independently or together (Pal, 2018). Many definitions agree that a well-executed Transit-Oriented Development (TOD) improves the transportation system of a specific area and boosts economic opportunities for its customers. These advantages arise from a variety of causes, namely the creation of mixed-use facilities that are conveniently located in a small area. These facilities cater to the demands of users and allow for beneficial and active activities throughout the day and night (Alwehab et al., 2016).

TOD rules must encompass both transportation and development, as well as urban form. The objective is to establish a condensed, top-notch, diverse development that is conducive to walking and incorporates effective public transportation alternatives. Introducing a novel kind of development into a thriving urban area with a high density of existing construction and a well-established transit system is a complex task. However, in the case of a large city, it might be advantageous to create transit systems before or concurrently with the establishment of the urban infrastructure, as this can have positive implications for future growth plans. Refer to Figure 3 (Loo et al., 2010) for further details.

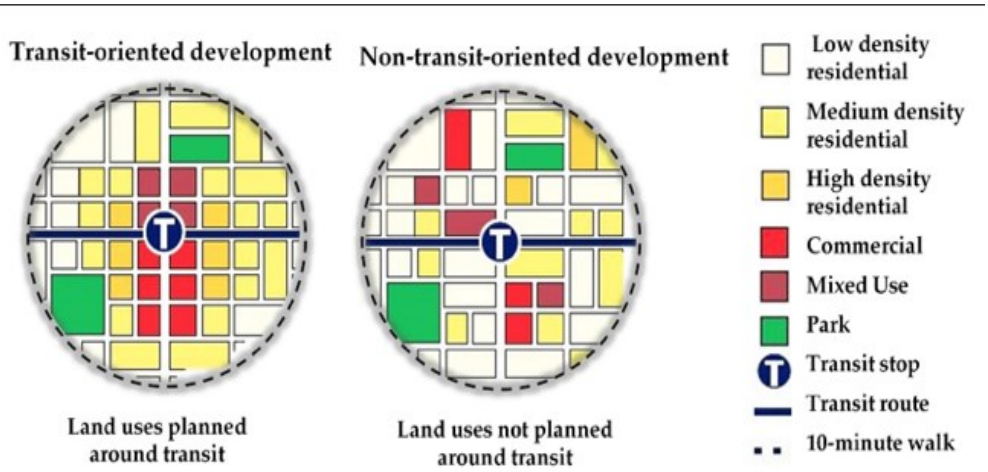

Figure 3. The ideal design of cities.

Transit-oriented development is characterized as a concentrated combination of pedestrian-friendly, moderately compact construction centered around transit stations. Its purpose is to promote the usage of public transportation, improve the quality of walking and cycling, and provide alternatives to private automobile usage. An ideal neighborhood should have bicycle and pedestrian networks within

a radius of approximately 400 m, along with tram and/or bus stations located at the periphery. Tram, metro, and/or bus stops should be situated at the outer edges of neighborhoods with a radius of approximately 800 m to facilitate simple access (Ann et al., 2019).

TOD is a planning approach that emphasizes compact, mixed-use development close to transit nodes to encourage walking, cycling, and the use of public transportation. Key principles of TOD include density, diversity, and design. Density refers to the concentration of development around transit stations, encouraging higher land use intensity and reducing the need for car travel. Diversity is the integration of various land uses, including residential, commercial, and recreational, within a short walking distance of transit stations, thereby fostering livable, vibrant communities. The primary objective of design principles is to establish pedestrian-friendly environments that are equipped with amenities that facilitate social interaction and active transportation, as well as well-connected streets and public spaces.

2.3 Integration of Metro Stations with the Urban Fabric considering TOD concept

Integration of transit-oriented design (TOD) and pedestrian-oriented design can create a convenient, safe, and suitable walkable environment in the station area (Wey & Chiu, 2013). Shorter and faster trips result from the combination of different roles and activities. These land uses include public open spaces, medium-to-high-density regions of population, offices, retail stores, services, and commercial hubs (Wey, 2015). The integration of metro stations with the urban fabric, particularly with a focus on Transit-Oriented Development (TOD), is crucial for creating sustainable, accessible, and vibrant cities. Different literature discussed how such integration can be achieved. Some are discussed below:

a) Mixed-Use Development: Encourage the development of mixed-use buildings around metro stations. This includes a combination of residential, commercial, and retail spaces. Mixed-use development optimizes land use and fosters a vibrant urban setting where individuals may reside, work, and engage in recreational activities close to the station.
b) Pedestrian Connectivity: Design pedestrian-friendly pathways and plazas to connect metro stations with surrounding neighborhoods seamlessly. Safe and attractive walkways enhance accessibility and encourage walking as a mode of transportation, reducing reliance on cars.
c) Transit Plaza Design: Create well-designed transit plazas around metro stations as focal points for community gatherings and activities. These plazas can serve as vibrant public spaces with seating, greenery, public art, and amenities such as bike-sharing stations and outdoor cafes.
d) Bicycle Infrastructure: Implement bicycle lanes, racks, and storage facilities near metro stations to promote cycling as a sustainable mode of transport. Integrating bike-sharing systems with metro stations encourages multi-modal commuting and provides convenient first and last-mile connectivity.
e) Affordable Housing: Ensure the availability of affordable housing options near metro stations to accommodate a diverse range of residents. TOD should prioritize inclusivity and prevent displacement of existing communities by offering a mix of housing types and income levels.
f) Transit-Oriented Zoning: Establish zoning regulations that support TOD principles, such as higher density near metro stations and reduced parking requirements. TOD zoning encourages compact, walkable development patterns that minimize sprawl and maximize transit accessibility.
g) Public Spaces and Green Infrastructure: Integrate parks, plazas, and green spaces into the design of metro station areas to improve the quality of life for both residents and visitors. Green infrastructure offers recreational opportunities, enhances air quality, and reduces the urban heat island effect.
h) Transit-Oriented Design Guidelines: Develop design guidelines that promote transit-oriented principles and ensure compatibility with the surrounding urban fabric. These guidelines should address building setbacks, façade articulation, street-level activation, and other factors that contribute to a cohesive and pedestrian-friendly environment.

i) Community Engagement: Involve local communities, stakeholders, and transit users in the planning and design process of metro station integration. Community input ensures that TOD projects reflect the needs and aspirations of residents and fosters a sense of ownership and pride in the development.

TOD around existing transit stations is complicated because it implies certain types of development in qualitatively different forms of structure it replaces (Rayle, 2015). Nevertheless, additional research has also regarded the Ds model as a more precise method for determining the potential performance of Transit-Oriented Development (TOD) in station areas. Destination, density, diversity, distance, design, and demand management are all factors this model considers (Dittmar & Ohland, 2003). After analyzing the literature and the preceding discussion, Table 01 has highlighted key indicators essential for evaluating station areas. These components are crucial for attaining the study's goals and assessing a possible Transit-Oriented Development (TOD) station.

The density context in Table 1 is represented by the population surrounding the station area and the total number of passengers at each operational station. Additionally, the contexts provide a comprehensive overview of various land use patterns, such as the number of businesses and employment within the catchment area of transportation stations. The design contexts delineate the attributes related to accessing transport services at the station. These encompass the station's connectivity with other transportation modalities, essential amenities, safety, and pedestrian accessibility in the streetscape.

By implementing these strategies, cities can effectively integrate metro stations with the urban fabric and realize the full potential of Transit-Oriented Development as a catalyst for sustainable and inclusive growth.

Table 1: TOD Indicators to integrate station area with the urban fabric.

Indicators	Employment influences on station area assessment	Related context
Population density	Number of the population within a catchment area	Density
Total ridership	Number of commuters for each active station	Density
Employment around transit	Number of jobs within a catchment area	Diversity of land use
Commerce around transit	Number of businesses in a catchment area	Diversity of land use
Walkability	Availability of walkable foot-paths around the station area	Design
Distance to transit station	distance between an origin to the station	Design
Built environment design	Quality of street crossing improved for pedestrian accessibility to station, including ped-shed, lighting around the station area	Design
Station accessibility	Basic amenities, commuter safety at the transit station	Design
Station Capacity	Accessibility of the station for intermodal connections	Design
Parking lots	Availability of car parking in the area of a transit station	Design

2.4 Study area: Metro line 6 and Agargaon Station

The Dhaka Metro Rail is a high-level mass rapid transit (MRT) system that is part of the 20-year Strategic Transport Plan (STP) established by the Dhaka Transport Coordination Authority (DTCA), a governmental organization. Line 6 (Figure 4) comprises a total of 16 elevated stations, with each station being 180 meters in length. Additionally, the line spans a distance of 20.1 kilometers and is powered by electricity, utilizing light rail tracks. The entirety of Line 6, except for the depot, is constructed at an elevated level over existing highways, namely above the medians, to facilitate the smooth flow of traffic beneath it. The stations are likewise built at a raised height. Therefore, it serves the purpose of designating regions for investment and coordinating policies to facilitate compact growth. The Agargaon station on MRT line 6 has been selected as an empirical case for this study. It is already constructed and mostly exhibits administrative and mixed-use features, as seen in Figure 5. The TOD precinct has been selected based on a radius of 800 meters, which aligns with the theoretical definition of TOD as a 10-minute walking distance according to Calthorpe (Calthorpe, 1993).

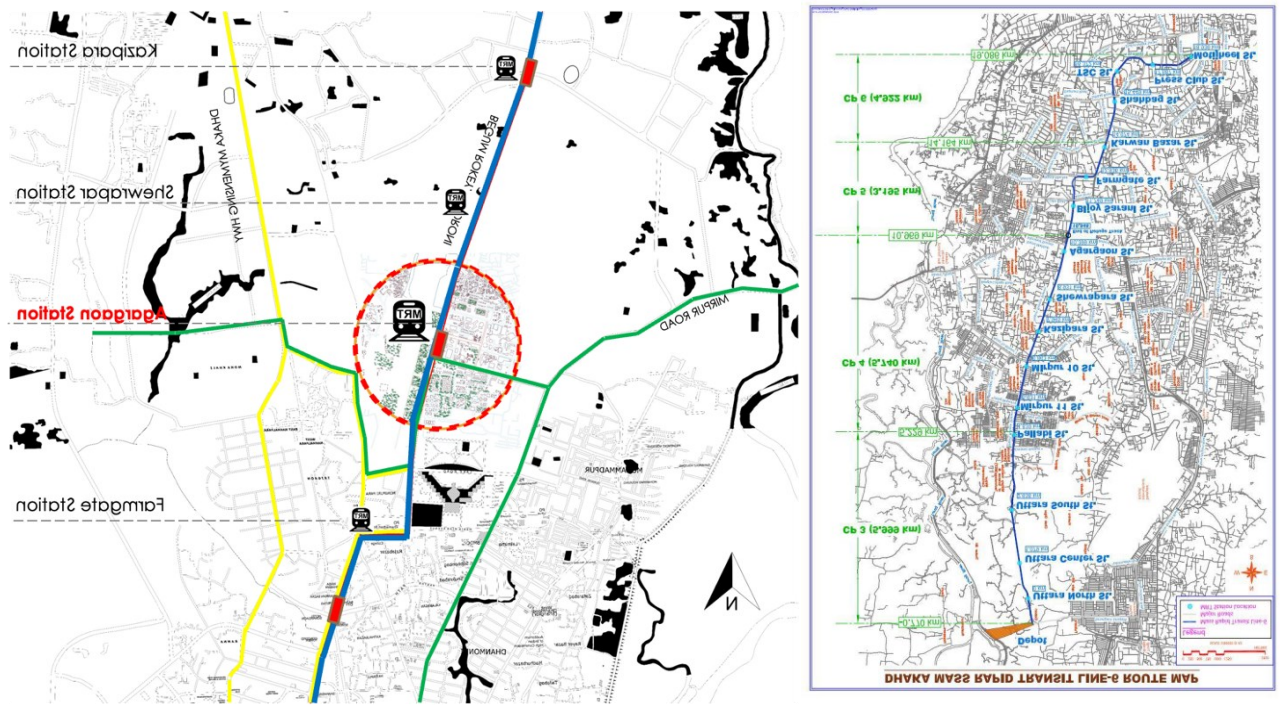

Figure 4. Line 6 and location of Agargaon Metro Station.

Figure 5. Image of its surrounding area.

Dhaka Metro within the city's urban framework by upholding the principles of transit-oriented development. This effort involves the comprehensive exploration of diverse aspects of station area design, aimed at elevating user comfort and convenience. This integration required improvements of station amenities, incorporating tangible features like parking facilities, transfer modes, metro ridership data, pedestrian pathways, bicycle provisions, feeder shelters, and taxi stands, all vital for enabling smooth transitions within a multifaceted transportation network.

3. Materials and Methods

To accomplish the goals of this study, a mixed-method approach was employed, integrating both qualitative and quantitative methods. This comprehensive methodology was executed through the following key steps (Figure 6):

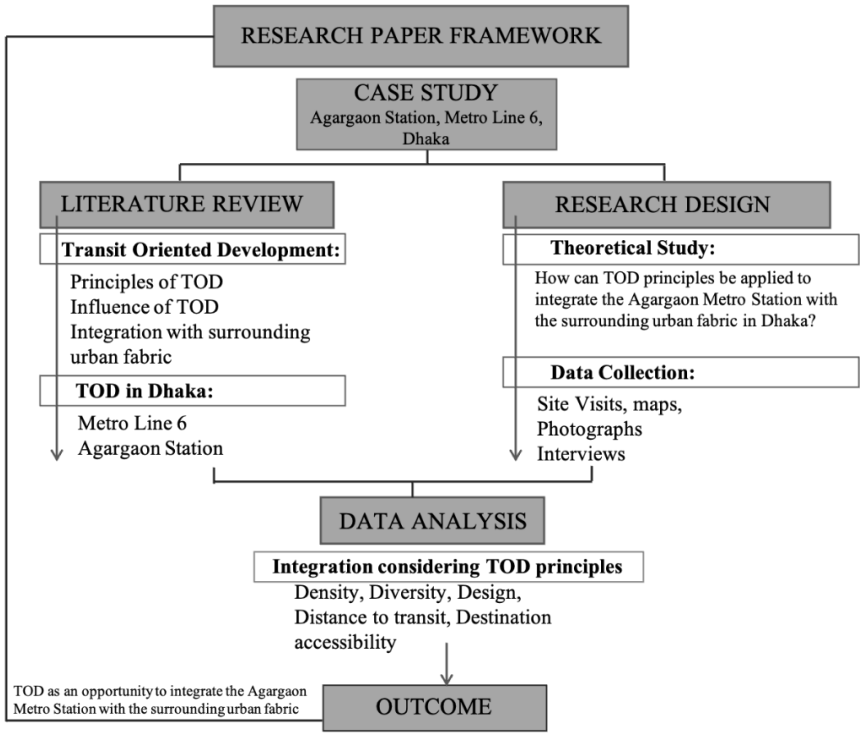

Figure 6. Research Methodology.

3.1 Literature Review

The literature review served as the foundational phase, encompassing an extensive array of sources related to Transit-Oriented Development (TOD) in both international and local contexts. This review included academic articles, policy documents, and case studies, focusing on the principles of TOD, its relationship with sustainability, and concepts of smart growth. The review aimed to identify critical elements for effective TOD implementation, such as pedestrian-friendly areas, public accessibility, mixed-use development, connectivity, walkability, and a comprehensive public transportation system. The findings from this literature review informed the theoretical framework and conceptual model used in the study, providing a basis for understanding how TOD principles could be applied to the specific context of Dhaka.

3.2 Data Collection

Data collection involved both qualitative and quantitative approaches, gathering a range of verbal and graphic information. This phase included:

3.2.1.Field Observations

Multiple site visits were conducted to the Agargaon Metro Station area to assess the current physical and social conditions. The selection criteria for these observations focused on key TOD factors such as pedestrian flow, infrastructure quality, land use diversity, and public space utilization. Observations were systematically recorded through detailed field notes and photographs, capturing the area's dynamics and identifying potential for TOD interventions.

3.2.2. Stakeholder Interviews

Key stakeholders were selected for interviews based on their relevance and expertise in urban planning, local governance, transportation, and community engagement. These interviews provided qualitative data on the perceptions, challenges, and opportunities related to the integration of the

metro system with the urban environment. The interviews were semi-structured, allowing for flexibility in exploring various aspects of TOD while ensuring coverage of essential topics.

3.2.3. Quantitative Data Collection

Quantitative data were gathered on demographic trends, land use patterns, transportation modes, and infrastructure features in the study area. This data provided a statistical basis for analyzing the current urban dynamics and assessing the potential impact of TOD.

3.3 Data Analysis

Data analysis involved a detailed examination of both qualitative and quantitative data. The qualitative data from field observations and interviews were analyzed using thematic analysis, identifying key themes and patterns related to TOD elements and urban integration challenges. This analysis helped in understanding stakeholder perspectives and the practical implications of TOD implementation.

Quantitative data were analyzed using statistical methods to identify trends and correlations between different urban factors, such as population density, land use diversity, and transportation accessibility. GIS (Geographic Information System) tools were also employed to visualize spatial relationships and highlight areas of potential improvement.

4. Findings

The results section of this study is split into three distinct parts. The first section provides a comprehensive examination of the study area, which is further classified as follows: (1) population density and ridership, (2) land use, (3) Road Network, (4) pedestrian accessibility, (5) Traffic movement, (6) Existing building condition, and (7) urban fabric. The subsequent section presents a detailed analysis of the valuable information obtained from the interviews conducted with experts. The third section comprises the recommendations and guidelines that primarily address the examination of mixed-use spaces, community and public spaces, public realms and pedestrian-oriented development, connectivity and walkability, and an integrated public transit system.

4.1 Site Analysis

This section provides a comprehensive overview of the study area considering the following factors: (1) population density and ridership, (2) land use, (3) Road Network, (4) pedestrian accessibility, (5) Traffic movement, (6) Existing building condition, and (7) urban fabric.

4.1.1. Population Density and Total Ridership

The Agargaon area falls within the administrative zones of Ward 27 and Ward 28 of Dhaka city. It is located in the Sher-E-Bangla Nagar Thana, which, as of the 2022 census, has a population of approximately 142,640, a total area of 4.911 square kilometers, and a population density of 29,046 persons per square kilometer. This station is targeted to serve several neighborhoods, including Ward 28 Agargaon Staff Quarter, West Agargaon, Kafrul, Taal Tola Staff Quarter, Shamoli Road No. 1, the Space Science Building, and the G Type area. The Ministry of Communication (MOC) authorized the Strategic Transport Plan (STP) developed by the Dhaka Transport Coordination Board (DTCB) in December 2006, which identified MRT Line 6 as a high-priority project in its Phase 1 Study. The proposed MRT Line 6 is expected to attract a substantial number of passengers due to the high demand for trips along this corridor, which surpasses that of other corridors both presently and in the future.

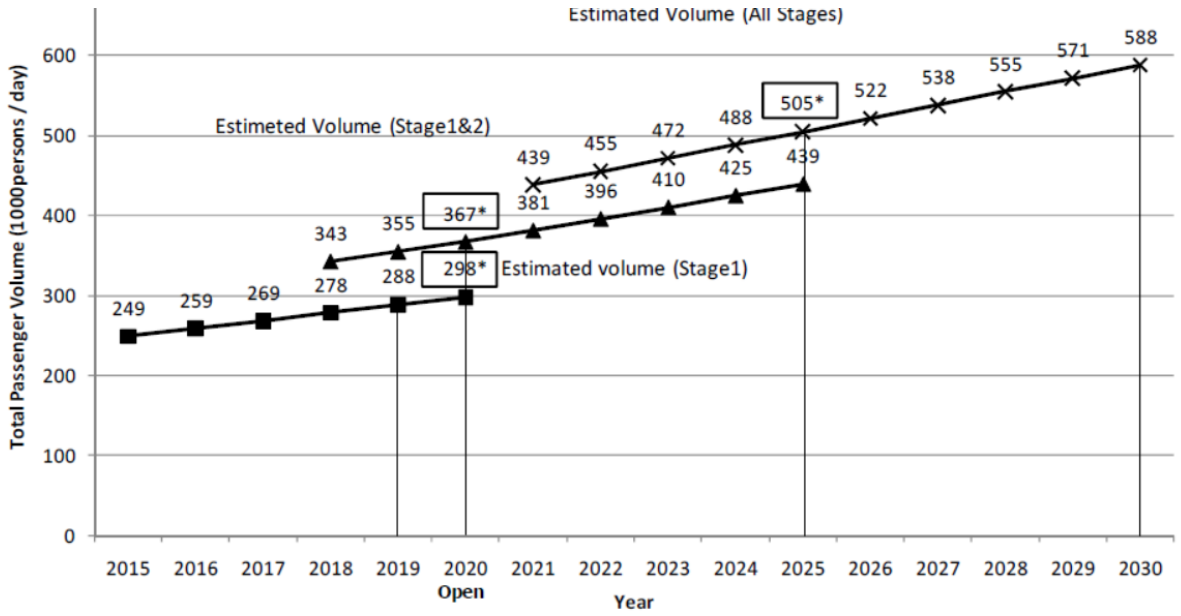

Figure 7. Population density and ridership.

The survey report published by the metro rail construction authority prior to the construction of the metro rail in 2014 presents the comparative findings of traffic count, as displayed in Table 2. This outcome is the mean synopsis of the traffic count conducted over a period of one week. The vehicle has been classified into two categories: Motorized Traffic (MT), which includes vehicles such as Jeeps, cars, motorcycles, auto-rickshaws, microbuses, buses, and trucks, and Non-Motorized Traffic (NMT), which includes vehicles like rickshaws and vans. The survey findings were multiplied by the Passenger Car Unit (PCU), and the gross total was represented by G. Total. Two methods have been used to conduct the traffic count at each point.

Table 2: Traffic Count at Various Points From Mirpur 12 to Agargaon Road

Traffic Count at Various Points From Mirpur 12 to Agargaon Road								
Location: Mirpur-12, Mirpur-10, Agargaon								
Survey Location	Direction	Total MT (PCU)		Total NMT (PCU)		G. Total (PCU)		Remarks
Mirpur10	Mirpur 10 To Agargaon	1653	742	970	242	2622	983	62.50% Less than before
	Agargaon to Mirpur 10	1497	710	992	289	2489	1000	59.82% Less than before
Agargaon	Agargaon To Farmgate	1765	1223	1037	876	2802	2099	25.10% Less than before
	Farmgate To Agargaon	1558.67	1102	850.5	700	2409	1802	25.20% Less than before

4.1.2. Land Use

The current land use of the site is predominantly characterized by a varied combination of development, encompassing residential structures, a hospital, commercial establishments, public institutions, and a recreational space. The commercial uses encompass shopping complexes and office space, whilst the residential uses comprise low-income housing and staff quarters. Public institutions include IDB Bhabhan, governmental offices, and several educational establishments. During the site visit and observation, it was observed that the Agargaon area lacks accessible green areas and public places, which hampers social inclusion and interaction. Furthermore, at present, outdoor areas that are intended to foster social engagement among persons have typically been disregarded. Figures 8 depict the notable characteristics of the study area.

Figure 8. Land use of the study area and accessible and non-accessible green areas.

4.1.3. Road Network

The road network surrounding the Agargaon MRT station area exhibits a mix and coexistence of the grid layout and spontaneous, organic development. The road network surrounding the new MRT station has a more natural and harmonious layout. Based on the physical assessment, the road design may be categorized as a

- Primary Arterial Road, namely the Agargaon Road, which serves as a connection for major offices and commercial buildings.
- Secondary roads refer to distributary roads that provide access to major roadways.
- Local road tertiary - Provides access to specific properties or structures.

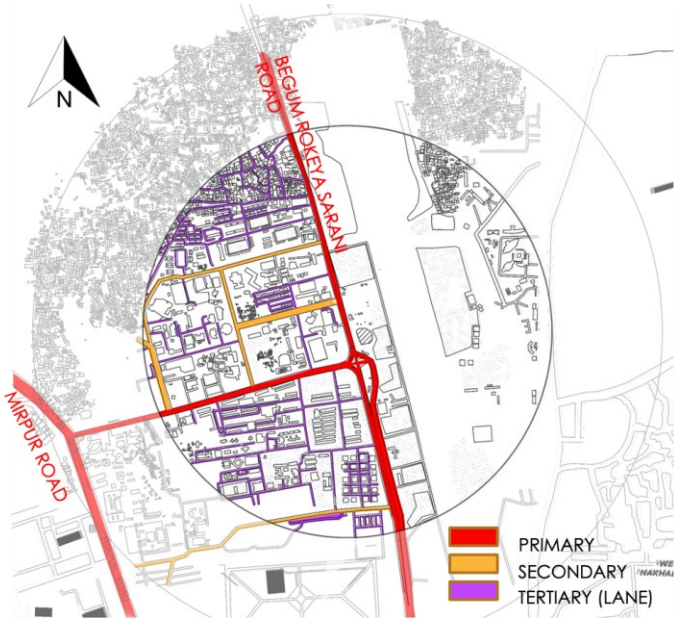

Figure 9. The road network of the study area.

4.1.4. Pedestrian accessibility

The Agargaon station features extensive pedestrian pathways on either side of the station, which transition into comparatively narrower pathways on secondary roads. The station lacks dedicated bicycle stands and parking facilities, although it provides universal access to and from the station. Commuters predominantly rely on rickshaws, which do not have designated stands, resulting in traffic congestion on the feeder roads. Additionally, due to the proximity of the old airport site on the

opposite side of the station, commuters primarily utilize the pedestrian pathways on the IDB building side. Additionally, squatters and street sellers have encroached on the feeder pedestrian way, making it difficult for pedestrians to walk freely and safely.

Figure 10. Pedestrian frequency of surrounding roads.

Figure 11. Pedestrian accessibility of surrounding roads.

4.1.5. Traffic movement

Agargaon experiences moderate average daily traffic relative to the rest of the city. The commuter demographic is primarily composed of office employees, workers, and residents of staff quarters. Additionally, due to the area's designation as an institutional zone, individuals from various regions visit for a range of purposes, including academic, administrative, and professional engagements. Traffic congestion typically occurs between 9:00 and 11:00 am, coinciding with the arrival of commuters, primarily from the Mirpur area. This congestion is most pronounced at major nodes where bus stops and transit hubs are located. After 7:00 pm, traffic volumes decline significantly as office hours conclude and workers depart for their homes (Figure 12). This daily pattern underscores the critical influence of work schedules and institutional activities on traffic dynamics in Agargaon.

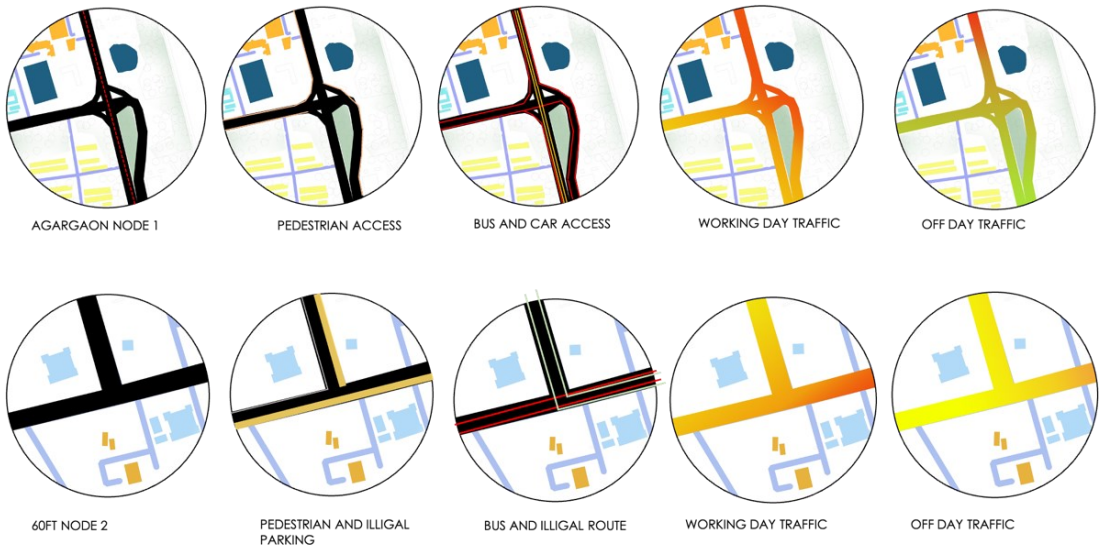

Figure 12. Traffic movement of different modes of surrounding roads of the station area.

4.1.6. Condition of Buildings in the Area

The Agargaon area, within an approximate 800-meter radius, presents a complex and evolving urban landscape characterized by a blend of modern and traditional structures. This region has undergone significant development, particularly in the last decade, transforming into a major administrative and healthcare hub in Dhaka.

Table 3: TOD Indicators to integrate station area with the urban fabric.

Institution	Building Condition
Administrative structure	The Administrative structure of Agargaon exemplifies substantial advancements in urban planning and development. National Board of Revenue (NBR) Headquarters - A modern 12-story building with automated building management systems and fire safety measures. Bangladesh Election Commission - Plays a crucial role in overseeing elections throughout the country. Bangladesh Public Service Commission - Responsible for recruiting civil servants. Bangladesh Bureau of Statistics (BBS) - The principal government agency for statistical data. Bangladesh Atomic Energy Commission - Focuses on research and development in nuclear science and technology. Bangladesh Institute of Governance and Management (BIGM) - Provides postgraduate education in governance and management, and Institute of Architects Bangladesh (IAB) - A professional organization for architects that also engages in educational and advocacy activities.
Healthcare Institutions	Agargaon is a critical healthcare hub in Dhaka, hosting key medical institutions such as the National Institute of Cardiovascular Diseases, the National Institute of Kidney Diseases & Urology, and Shaheed Suhrawardy Medical College and Hospital. These facilities not only provide essential healthcare services but also boost the local economy by attracting patients, healthcare professionals, and ancillary services. The concentration of these institutions underscores Agargaon's strategic importance in the national healthcare infrastructure.
Residential and Educational Facilities	The residential landscape in Agargaon includes a mix of older government staff quarters and newer apartment complexes. This area is also notable for its educational institutions, such as the Sher-e-Bangla Agricultural University and several secondary schools, which cater to the local and surrounding communities. The presence of these institutions not only serves the educational needs of the population but also contributes to the socioeconomic vibrancy of the area.
Mixed Use and recreational amenities	20-storey BCS Computer City which is a commercial hub mainly for electronics and computer-related products. BICC building- used for conferences, exhibitions and trade fairs. Other than that there are a park (Chandrima Uddyan), a children's amusement center (Shishu Mela), and two museums- the Liberation War Museum and the National Museum of Science and Technology. These mixed-use buildings and recreational facilities highlight Agargaon's strategic importance in Dhaka's urban landscape, providing a blend of residential, commercial, institutional, and recreational spaces that cater to a diverse population.

4.1.7. Urban Fabric: Solid and Void

Figure 13 illustrates the proportionate allocation of "solid" and "void" spaces within the study area, together with the existence of both grid and organic street patterns in the urban layout. However, that there are good proportion of open and green areas exists in the study area but most of them are restricted.

Figure 13. Built area and open area of the study area.

4.2 Stakeholder interviews

To gain a comprehensive understanding of the challenges and opportunities in this integration process, feedback was collected from various stakeholders, including Architects and urban planners, local government officials, community members, and transportation experts. The primary subjects of discussions revolved around Transit-Oriented Development (TOD) as a concept and integration of the Agargaon station area with the surrounding urban fabric. This summary encapsulates the key points raised by these stakeholders.

4.2.1. Urban Planners and Designers

Urban planners emphasized the importance of enhancing pedestrian and bicycle infrastructure around the station. They noted that currently, the station lacks sufficient sidewalks, pedestrian crossings, and dedicated cycling paths, making it difficult for users to access the station safely. They suggested implementing wider sidewalks, pedestrian bridges, and secure bike parking facilities to encourage non-motorized transport modes. Also highlighted the potential for mixed-use developments around the station.

4.2.2. Local Government Officials

Local government officials focused on the need for improved coordination between different agencies involved in urban development and transportation planning. They pointed out that fragmented planning efforts have led to a lack of cohesive strategies for integrating metro stations with existing urban areas. Officials stressed the importance of developing comprehensive land-use plans that align with the goals of Transit-Oriented Development (TOD). Additionally, they acknowledged the challenge of managing informal settlements and vendors around the station area. While these informal activities provide livelihoods for many residents, they often lead to congestion and hinder pedestrian movement. Officials suggested creating designated spaces for vendors and implementing regulations to manage informal activities effectively.

4.2.3. Community Members

Feedback from community members revealed concerns about accessibility and safety. Many residents noted that the current access points to the station are inconvenient and poorly maintained, particularly for the elderly and people with disabilities. Safety was another significant concern. Community members reported feeling unsafe due to inadequate lighting and a lack of security measures around the station, especially during early morning and late evening hours. They called for increased security personnel, better lighting, and CCTV surveillance to enhance safety and security.

4.2.4. Transportation Experts

Transportation experts emphasized the necessity of a multimodal transport network to complement the metro system. They recommended the development of feeder bus routes, shared transportation options (such as ride-sharing and auto-rickshaws), and well-designed drop-off/pick-up zones around the station. Experts also discussed the need for effective wayfinding and information systems to guide passengers smoothly between different modes of transport. They highlighted the potential for using digital technology, such as mobile apps and real-time information displays, to keep commuters informed about transit schedules and services.

The stakeholder feedback underscores the multifaceted challenges and opportunities involved in integrating Agargaon Metro Station with its surrounding urban fabric. Key recommendations include improving pedestrian and cycling infrastructure, enhancing safety and accessibility, promoting mixed-use developments, managing informal activities, and ensuring effective coordination between planning agencies. Addressing these concerns and leveraging the opportunities identified by stakeholders can significantly enhance the usability and appeal of the metro system, fostering a more connected, accessible, and vibrant urban environment around the Agargaon Metro Station.

5. Discussion

Analyzing the mode of transport and its impact on the urban fabric near Agargaon Metro Station requires the following issues that must be addressed such as infrastructure, connectivity, pedestrian access, and land use. This analysis will provide insights into how the transportation system interacts with the surrounding urban environment and influences its development.

a) Expand and improve footpaths: Work with the relevant authorities to expand and improve the footpaths underneath and around the stations. This could involve widening the existing footpaths or constructing new ones where necessary. The footpaths should be designed to accommodate the expected volume of pedestrians, ensuring safety and ease of movement.
b) Reorganize rickshaw stands: Properly organize and designate rickshaw stands in a way that minimizes their impact on traffic flow. Ensure that the stands are located in areas that do not obstruct the movement of vehicles and pedestrians. Consider the number of rickshaws that can be accommodated at each stand to avoid overcrowding.
c) Reorganize rickshaw stands: Properly organize and designate rickshaw stands in a way that minimizes their impact on traffic flow. Ensure that the stands are located in areas that do not obstruct the movement of vehicles and pedestrians. Consider the number of rickshaws that can be accommodated at each stand to avoid overcrowding
d) Integration with other modes: Enhance the connectivity between the metro station and other modes of transport, such as Bi-cycle, bus stops, and parking facilities. This will encourage commuters to use the metro as their primary mode of transport, reducing the reliance on rickshaws and private vehicles.
e) Dedicated pick-up and drop-off zones: Designate specific pick-up and drop-off zones for rickshaws near the metro station. This will help streamline the flow of rickshaws and reduce congestion caused by random stopping and parking. These zones should be clearly marked and easily accessible for both rickshaw drivers and passengers. Additionally, consider implementing dedicated pedestrian-only zones around the stations to further enhance safety.
f) Increased Economic Activity: Pedestrian-only zones have the potential to boost local businesses and economic activity. With more people walking in the area, there is a higher likelihood of

increased foot traffic and potential customers. This can lead to the revitalization of local businesses and the creation of new economic opportunities.

g) Implement traffic management measures: Work with local authorities to implement traffic management measures around these stations. This could include traffic signals, pedestrian crossings, and speed reduction measures to improve safety for pedestrians.
h) Environmental Benefits: By reducing vehicular traffic, pedestrian-only zones contribute to lower levels of air pollution and noise pollution. This helps improve the overall environmental quality of the area, making it more sustainable and enjoyable for everyone.
i) Improved Aesthetics: Pedestrian-only zones often incorporate elements of urban design, landscaping, and public art, enhancing the visual appeal of the area. This creates a more attractive and inviting space for pedestrians, contributing to the overall beautification of the station's surroundings.
j) Involve community participation: Engage with the local community and stakeholders to gather feedback and suggestions on improving the safety and functionality of the footpaths. This collaboration can help identify specific challenges and implement solutions that take into account the needs and concerns of commuters and city dwellers.
k) Raise awareness and educate: Conduct awareness campaigns to educate both commuters and city dwellers about the importance of pedestrian safety and responsible behavior. Encourage pedestrians to use designated footpaths, follow traffic rules, and be aware of their surroundings to minimize the risk of accidents.

6. Conclusion

The successful integration of metro stations with the adjacent urban fabric using Transit-Oriented Development (TOD) principles is essential for promoting sustainable urban development and enhancing the quality of life in Dhaka City. Dhaka can foster lively and pedestrian-friendly communities by prioritizing density, diversity, and design around transit hubs, ensuring that citizens have easy access to convenient, affordable, and environmentally friendly transportation options. However, achieving this vision requires concerted efforts from government agencies, private developers, and local communities to overcome various challenges and seize opportunities for positive change.

The findings of this study confirm the feasibility of implementing TOD in both the inner areas and new parts of the city. The analysis revealed that macro-scale urban structure traits—such as density, mixed land use, and connectivity—align more closely with TOD requirements compared to micro-scale traits like streetscape characteristics. This underscores the importance of considering macro-scale features in promoting sustainable modes of transportation, particularly in addressing critical issues such as traffic congestion and inefficient transportation systems, which pose significant barriers to economic productivity and social interaction.

Furthermore, the promotion of mixed-use developments has the potential to invigorate local economies and cultivate vibrant communities, thereby enhancing residents' overall quality of life. The integration of various modes of transportation, coupled with the establishment of pedestrian-friendly infrastructure, aims to connect diverse communities and foster equitable access to resources and opportunities. To address the car-oriented design practices prevalent in Dhaka, the study suggests modifications to design regulations and procedures. City officials and practitioners should move beyond cosmetic design projects and focus on broader aspects of the built environment, including physical, social, aesthetic, and functional dimensions.

Moreover, this research emphasizes the importance of engaging stakeholders—including urban planners, government officials, and community members—to gather insights and encourage community participation in the planning process. This participatory approach empowers local communities, ensuring that their needs and aspirations are effectively incorporated into urban development initiatives. Highlighting the economic advantages associated with TOD—such as

increased property values, enhanced opportunities for local businesses, and improved environmental conditions—this study seeks to influence policy decisions that advocate for sustainable urban growth. Despite its contributions, the study has limitations in terms of generalizability due to the lack of detailed digital data. Future research could further explore microscale challenges in TOD walkability, examine the reflection of urban forms in different contexts, and compare selected stations with examples from both developing and developed nations. Incorporating graph theory, space syntax, social network indices, and behavioral research would provide insights into the relationship between physical characteristics and mobility patterns.

Overall, this study contributes significantly to the field of urban design by offering an evaluative framework for assessing the compliance of station areas with TOD principles. By providing a structured approach, it helps stakeholders understand the essential components of TOD and guides them in making informed decisions. Continued research is essential to address the identified limitations and explore additional aspects of TOD design and implementation. Ultimately, this work aims to support the development of a more sustainable, accessible, and livable urban environment in Dhaka and similar rapidly growing cities, thereby enhancing both the social and economic dimensions of contemporary urbanization.

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Conflicts of Interest

The author(s) declare(s) no conflicts of interest.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

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Original scientific paper

Gender Disparity and Housing Development: Examining Socioeconomic Barriers and Policy Solutions in Nigeria

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ABSTRACT

Gender disparity (GD) significantly impacts housing development, especially in developing countries like Nigeria, where socioeconomic and cultural barriers constrain equitable housing access. This study investigates the features and effects of GD on housing development in Iwo Central Local Government Area, Osun State, Nigeria. Using a mixed-method approach, data were collected from 328 respondents through questionnaires and analyzed using descriptive and inferential statistics, including indices and ANOVA. Key findings highlight societal mindsets as the most influential feature of GD, followed by lack of bodily autonomy and employment equality, with respective relative significance indices (RSIs) of 4.23, 4.06, and 4.00. Denied access to housing and homelessness emerged as the most critical effects of GD, with effects indices (EGDIs) of 4.36 and 4.31. Regression analysis revealed a significant relationship between GD characteristics and housing development ($F = 99.964$, $p = 0.04$), emphasizing the pervasive impact of GD on housing equity. The study concludes that GD restricts women's access to adequate housing, perpetuating socioeconomic inequalities. Recommendations include promoting gender-responsive housing policies, enhancing women's access to affordable housing finance, and integrating gender equity into urban planning and housing design. Addressing GD is crucial for fostering inclusive, equitable, and sustainable housing development in Nigeria.

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Highlights:

- Gender disparity significantly impacts housing development in terms of availability, affordability, and quality.
Societal mindsets and cultural norms are significant predictors of women's access to housing.
- Lack of financial autonomy among women is positively correlated with higher homelessness rates.
- Unequal access to education significantly affects women's participation in housing development processes.
- Gender-responsive policies moderate the relationship between gender disparity and sustainable housing development.

Contribution to the field statement:

This study bridges a critical gap in understanding the interplay between gender disparity and housing development, particularly in Nigeria's Iwo region. By integrating a mixed-methods approach, it highlights the socioeconomic and cultural barriers affecting equitable housing access. The findings advocate for gender-responsive policies, offering innovative solutions to foster inclusive and sustainable housing development.

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1. Introduction

Gender disparity (GD) refers to the unequal sharing of opportunities, resources, wealth, and power between women and men. In the context of housing development, GD can be noticeable in several ways, for example, women have restricted access to capital, decision-making authority, and benefits from housing development projects (Rabia, et al 2019). For instance, women who have restricted access to capital and decision-making authority are less able to contribute to community development. This can lead to a lack of affordable housing, inadequate infrastructure and limited access to services such as healthcare and education (Qbal, et al. (2012). The concept of gender denotes to the socially built relationship between women and men. It refers to changeable and culturally variable rules and norms (Prudence, et al. 2007). Women represent almost sixty-eight percent of the world's total population (UN Habitat, 2014), yet they own less than 1% of the world's housing properties. This phenomenon has been observed in many Nigerian cities.

Housing has been defined by numerous scholars and authors, and the phase of these descriptions has two things in common. Housing is either a process or a product. In describing housing as a product, Chant (2012) defined housing as a completed object that can be touched and seen, while as a process, it encompasses all the interrelating entities and activities that must be in vogue and inclination to bring the product to completion. Conversely, Ezenagu (2000) argued that housing not only implies structure but also a host of comprehensive and complex participatory and evolutionary processes that consummate and result in giving shape to human settlements and housing needs. Housing has been understood as a male property and resource, with women having access only to its content and use. Thus, women are commonly not given instructions and brief information from and are not consulted during several housing development programs, although they play important roles and parts in building society. They are acknowledged as the main users, maintainers, and consumers of shelters, particularly in poor urban neighborhoods and rural areas.

Housing is an essential human need and a basic human right, yet access to adequate and affordable housing is unevenly distributed among different genders. Women, in particular, face numerous challenges in accessing safe and affordable housing due to discriminatory policies, social norms, and economic factors (Skaburskis, 1997). One major barrier to women's access to housing is the gender wage gap, which results in women having lower incomes than men on average (Makinde, 2016a). This income gap makes it more difficult for women to afford housing and puts them at risk of homelessness. A study by the National Women's Law Center found that in 2019, women working full-time, year-round, earned only 82% for every dollar earned by men, with even larger gaps for women of color (NWLC, 2021).

Another challenge faced by women in accessing housing is discrimination and disparity in the housing market. Women who are single or have children may face discrimination from landlords or real estate agents who assume they are less financially stable or responsible than their male counterparts (National Association of Realtors, 2022). Additionally, women may face sexual harassment or assault from landlords or other tenants, making them feel unsafe in their homes. Furthermore, women's domestic responsibilities also play a role in their access to housing. Women often have caregiving responsibilities for children, elderly parents, or other family members, which can limit their ability to work and earn income, making it harder to afford housing. Women may also be more likely to prioritize the safety and well-being of their families over their own housing needs, leading to their staying in unsafe or inadequate housing (Housing and Urban Development, 2022).

Although men undoubtedly dominate housing development, few women are involved in its construction and development. In contrast, most women do not participate in housing. Engagement and involvement in housing development might consequently be influenced by numerous factors, among which is gender, even though gender may interact singularly or in unpredictable blends with other socio-institutional occurrences, for instance, marital status, ethnicity, income, age, household structure, and educational level, in influencing the degree of women's and men's engagement and involvement in housing development. From the pilot survey, it was observed that an increase in the

Iwo Central Local Government population does not lead to a corresponding growth in housing development. Therefore, this study examines the effects of GD on housing development. Few studies have examined the relationship between housing and gender. Munir et al. (2021) examined the impact of GD on housing development in Pakistan. The study found that women faced significant barriers to accessing housing, including limited credit access, lack of property rights and discrimination in the housing market. These barriers were particularly pronounced for women who were unmarried or divorced. The study also found that GD in a wider society, including education and employment, was associated with lower levels of housing development overall.

The United Nations Human Settlements Program, (2012) examined the impact of GD on housing development. The study found that women faced similar barriers to housing access, including discrimination in the housing market and limited access to credit. The study also found that GD in education and employment was associated with lower overall housing development. Kabeer and Waddington (2015) examined the impact of GD on housing conditions in Bangladesh. The study found that women were more likely to live in homes with poor sanitation and inadequate water supply. This was partly due to gender-based discrimination in access to capital and services, in addition to gender norms that restricted women's mobility and involvement in decision-making.

Oluwumi et al. (2020) investigated GD and women's discrimination against real estate firms in Lagos. This study only examined women's discrimination in the real estate industry, not in housing development. The study did not examine housing development types. Henry (2000) examined housing development and gender in low-income outskirts of Jinja Municipality, Uganda. This research identified GD in housing development in Uganda. The study was conducted in Uganda and not in Nigeria. Adeoye, (2018) examined the factors determining gender differentials in contribution to urban informal housing development in southwestern Nigeria. This study analyzed the factors influencing women's and men's involvement in housing development in southwestern Nigeria. This study did not examine the features of GD. Asiyanbola (2010) examined gender and participation in housing development in Ibadan, Nigeria. This study investigated the differences in the overall perception of women's awareness, involvement, and actual participation in housing development. This study did not examine the effects of GD on housing development.

Parenthetically, the following research questions are stated to address the problem. What are the socioeconomic characteristics of respondents' housing development in Iwo? What are the types of housing developments in Iwo? what are the features of GD in the study area? what are the effects of GD on housing developments in the study area? GD on housing is a noteworthy problem that affects millions of people worldwide, and it is essential to understand the specific ways in which this problem manifests in different contexts. By investigating the effects of GD on housing development in Iwo, this study can contribute to the growing body of literature on this topic and identify strategies to address this problem in the Nigerian context. Iwo is a rapidly developing city that has undergone significant changes in recent years. Despite this progress, however, significant gaps remain in access to affordable and secure housing, particularly for women. This study can help inform policies and programs aimed at promoting gender equality and improving access to housing for all members of the public.

In addition, housing is a basic human need and plays a critical role in the overall well-being and quality of life of people (Makinde, 2016b). Adequate and affordable housing is essential for physical, emotional, and mental health, education, and economic mobility (Baker & Bentley, 2023). Gender is a key socioeconomic factor in housing development that cannot be overemphasized. This study has contributed by emphasizing and providing facts on the impacts of GD on housing development as one of the important socioeconomic attributes of housing that cannot be overstated. Therefore, understanding and addressing the ways in which GD affects housing development is important for promoting communities' overall well-being and development. Figure 1 shows the conceptual framework of the study, which was derived from a compressive literature review.

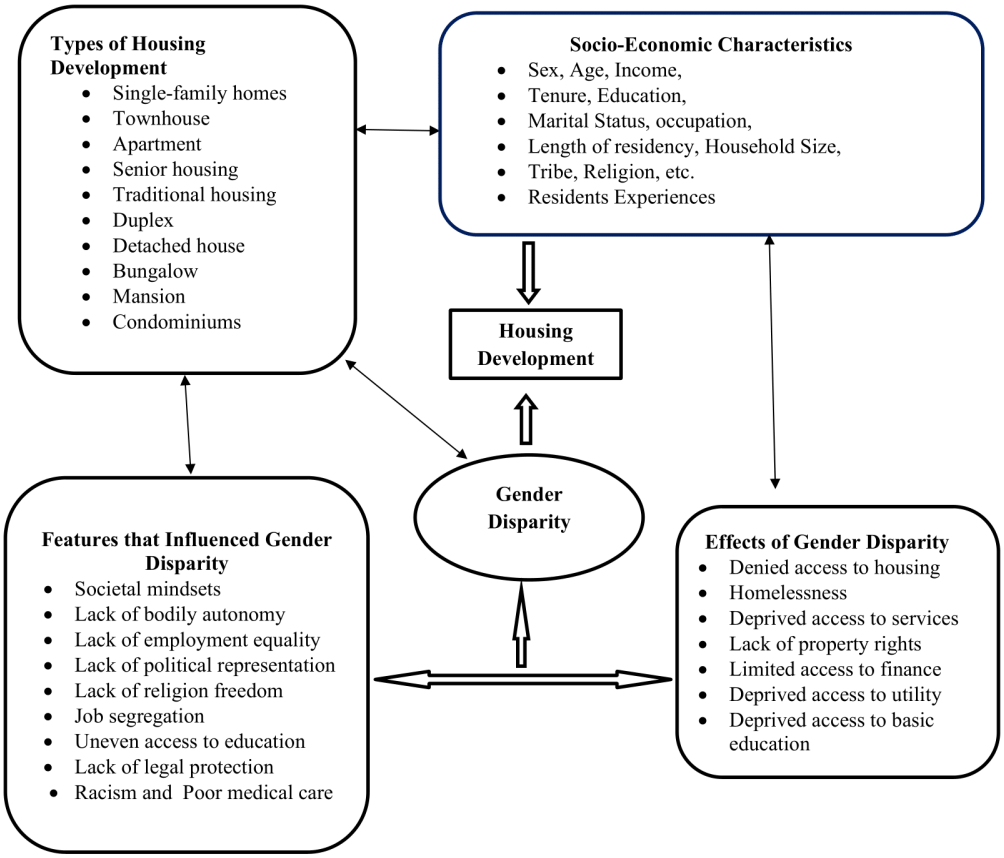

Figure 1. Conceptual framework of the study.

2. Literature Review

Gender disparity (GD) refers to the unequal distribution of resources, power, and opportunities between women and men. In the context of housing development, GD manifests as women having reduced access to resources such as land and financing, which significantly hinders their ability to secure adequate housing. Housing development encompasses the planning, designing, construction, and maintenance of housing units, including both new developments and the rehabilitation of existing housing stock. For this study, housing development focuses on the impact of GD on housing availability and quality in Iwo.

2.1 Housing

Housing refers to the provision of dwellings, shelters, or homes for people. It is a fundamental need for human beings because it provides shelter and security and a sense of belonging and identity. According to the United Nations (2019), housing is a basic human right and an essential constituent of the right to an acceptable standard of living. However, the availability and affordability of housing vary greatly across countries, regions, and social groups. In numerous parts of the world, there is a shortage of affordable housing, especially for low-income households. This is repeatedly due to a lack of investment in the development of new housing as well as inadequate provision of infrastructure, such as water and sanitation systems, which can make it problematic for people to live in certain areas (Mani, et al 2024).

According to Makinde, (2014a), "Housing development is the process of creating, preserving, and maintaining housing units and communities. This includes new construction, rehabilitation, and preservation of existing housing, as well as the delivery of essential services and infrastructure. Housing development also impacts the environment and sustainability. Housing development can protect natural resources, minimize environmental impacts, and improve residents' quality of life. An approach that highlights smart growth, sustainable design, and green building practices can help create healthier, more livable communities (Makinde, 2014b). A solution to challenges in housing

development is to ensure that new housing units are affordable for moderate and low-income households. The lack of affordable housing is an important concern and problem in Nigeria, with 7.2 million extremely low-income renter households facing a severe shortage of available and affordable housing**.** Another major solution to the challenge of housing development is the delivery of necessary services and infrastructure. This includes the construction of roads, sewage systems, water, and other public amenities, as well as the provision of healthcare facilities, schools, and other services essential for the well-being of communities (Olusola, 2020).

There are different types of housing development, each with its own unique characteristics and planned to meet the requirements of different groups of people (Devlin, 1994). Some of the most common types of housing development are as follows:

Single-family homes: These are standalone homes intended for one family. They are typically built on a single lot and have their own yards and gardens. Single-family homes account for the majority of new housing production in the United States.

Townhouses: Townhouses are multi-unit to one another, often sharing walls with neighboring units. These houses are typically smaller than single-family homes and are intended for denser forms of housing. Townhouses are a popular type of housing for first-time homebuyers, farmers, and people looking for low-maintenance housing.

Apartments: Apartment buildings are multi-unit structures that provide individual living spaces for renters. They are typically located in urban areas and are intended for denser forms of living. Apartments account for most U.S. rental housing.

Senior housing: Senior housing is intended for older adults and is designed to meet specific needs. It can take many forms, including independent living, assisted living, and skilled nursing facilities. Senior housing is an important component of long-term care and persistence and provides older adults with a range of housing options to meet their changing needs (Devlin, 1994).

Cohousing: A type of housing development intended to promote a sense of community among residents. Typically, it involves shared common spaces and a shared commitment to a sustainable lifestyle. According to the Cohousing Association of the United States (COHOUS), cohabitation is a type of deliberate community consisting of private homes complemented by communal facilities (CohoUS, 2021). Gulcimen et al. (2021) analyzed the environmental impacts of different housing types. The study found that multi-story apartment buildings had the lowest environmental impact because of their compactness and the ability to share resources such as heating and cooling systems. Wang, et al (2020) found that cohousing (cohabiting) can provide numerous benefits, including social connections, reduced living costs, and environmental sustainability. However, the study also identified challenges such as the need for consensus-based decision-making and potential conflicts among residents.

2.2 Gender and Influencing Factors

Gender is defined as the socially constructed behaviors, roles, and identities that society considers suitable for men and women. In relation to the World Health Organization (WHO), gender is defined as the socially constructed expressions, roles, identities, and behaviors of boys, girls, women, men, and gender-dissimilar people. It affects how people observe each other and themselves, how they interact and act, and the distribution of resources and power in society (World Health Organization, 2021). Gender is also an important factor in many areas of social life, including work, family, and politics. For example, gender stereotypes and biases can influence hiring decisions in the workplace and opportunities for promotion and advancement (Heilman & Eagly, 2008). In a family, gender roles can outline the division of responsibilities and labor, as well as attitudes toward parenting and childcare (Kimmel & Ferber, 2016). In politics, gender can have an emotional impact on the participation and representation of women in decision-making processes (Paxton, Hughes, & Green, 2006). In line with the World Economic Forum (WEF), GD is not only a pressing moral and social issue and a critical economic challenge. If not addressed, it perpetuates

the inefficient use of a country's human capital potential, leading to slower economic growth (World Economic Forum, 2020).

The social and cultural traits associated with being male or female are referred to as gender. It is a socially manufactured idea that includes various roles, actions, and standards that are accepted by women and men in a specific society (Healy and Zucca, 2004). Sex, which describes the biological and physiological traits that separate males and females, is not the same as gender (WHO, 2017). Health, education, employment, interpersonal connections, and housing development are just a few of the many facets of life that gender significantly influences. The options and possibilities available to people may be constrained by gender norms and stereotypes, which can also lead to disparity and discrimination. For instance, gender-based violence is a major problem that touches millions of people worldwide and is frequently caused by gender stereotypes and power disparities (WHO, 2021).

Being male or female is associated with various social, cultural, and psychological attributes (Nordiska, 1996). Gender is a complicated and multifaceted concept. Although people frequently think of gender as a simple idea, with people either identifying as male or female, there is actually a wide variety of gender identities (Saleemi and Kofol, 2022). These include:

Cisgender: Those who identify as gender that matches their biological sex are known as cisgender. One example of a cisgender person is someone who was born with male reproductive organs and who identified as a male. The most prevalent gender identity is this one (Richards, Bouman and Seal, 2016).

Transgender: Those who identify as transgender are those whose biological sex led them to be born with a gender that is different from the one they actually prefer (Small, 2024). The term "transgender" refers, for instance, to a person who was born a male but now identifies as a female. Discrimination, harassment, and limited access to healthcare are just a few of the difficulties that transgender people may encounter (James, Herman, Rankin, Keisling, Mottet, & Anafi, 2016**).**

Genderqueer: The word "genderqueer" is used to describe individuals who do not solely classify as female or male or who reject traditional biological gender categories. Those who identify as genderqueer may identify as a mix of female and male, as neither female nor male, or as a whole different gender (Lombardi, Wilchins, Priesing, & Malouf, 2001).

Nonbinary: The word 'nonbinary' is used to describe individuals who do not exclusively categorize as either male or female but rather as a gender that is not part of the binary system. Those who identify as non-binary may choose to identify as either male or female, neither male nor female, or as a completed other gender (Budge, Rossman, &Howard, 2014).

Agender: Those who do not identify with any gender or who do not feel a sense of gender are referred to as Agender. Agender people can identify in various ways, including as neither male nor female or as a blend of the two (Richardsetal, 2016).

2.3 Factors Influencing Gender Disparity in Housing Development

In terms of housing development, GD refers to the unequal distribution of resources, opportunities and access to services. GD in housing can occur in several ways, such as unequal access to affordable housing, inadequate living conditions, and a lack of housing opportunities (Nordiska, 1996). More so than men, women, particularly those with low incomes and women of color, are negatively impacted by this disparity, presenting serious social and economic problems for households. Persistent GD between men and women is a major aspect of GD in housing development. Because women typically earn less money and have less financial clout than males, they find it difficult to access quality, affordable housing. Women's access to housing is affected by this income disparity, particularly in locations with high housing costs. Therefore, women may be compelled to live in congested, inadequate, or unattractive environments (Stewart, and Cloutier 2021).

The higher parental duties that women endure are indeed crucial aspects of GD in housing development. In general, women are less able to work and earn an income because they spend more

time than males taking care of their children, ageing parents, and other family members. This regulation limits women's ability to access adequate housing or improve their living conditions, making it difficult for them to overcome poverty (Philippine Commission on Women, 2015). In addition, discrimination against women limits their capacity to own property and prevents them from obtaining housing finance such as loans and mortgages. Lenders and landlords may discriminate against women based on their gender or marital status, making it difficult for them to access credit or affordable housing (Center for American Progress, 2018). This discrimination can also limit women's ability to access property rights, leading to economic exclusion and poverty (Carol and Anjali 2011).

2.4 Features of Gender Disparity

GD is a persistent and pervasive concern that affects people around the world, particularly women and girls. This disparity manifests in different ways and has several negative consequences for respondents and society as a whole. One of the most significant features of GD is the gender pay gap, which discusses the disparity between the wages of women and men in the workforce. In line with the World Economic Forum, the worldwide gender pay gap is 16%, implying that women make an average of 85% of every dollar made by men (World Economic Forum, 2020). This gap is particularly pronounced in certain industries, such as finance and technology, and has been shown to persist even when factors such as education and experience are considered (Blau & Kahn, 2017).

Another key feature of GD is the under-representation of women in leadership positions. Women are considerably less likely than men to hold power and authority positions in both the private and public sectors (World Economic Forum, 2020). This lack of representation can limit women's ability to shape policies and decision-making processes, thus perpetuating gender inequality in various areas. A third feature of GD is the prevalence of gender-based violence, which includes domestic violence, sexual assault, and harassment. Women are disproportionately affected by gender-based violence, which can have serious physical and psychological consequences for victims (World Health Organization, 2021). This violence can also limit women's capacity to contribute fully to society and access resources and opportunities.

A fourth feature of GD is the limited access that women often have to healthcare, particularly reproductive healthcare. Women may face barriers in accessing contraception, maternal healthcare, and treatment for reproductive health issues (United Nations Population Fund, 2021). These barriers can cause severe concerns for women's well-being and health and perpetuate GD by limiting women's capability to contribute fully to society. Finally, GD is perpetuated by stereotypes and discrimination that affect women in various aspects of their lives. Women are frequently subject to gender-based inequality and discrimination in the workplace, education, and other areas, which can limit their opportunities and perpetuate GD (International Labor Organization, 2021). Additionally, gender stereotypes can contribute to a culture that undervalues women and limits their potential.

2.5 Effects of Gender Disparity on Housing Development

The development of housing is just one of many areas of life where GD has a significant effect. Housing is an essential human necessity and a component of welfare that has significant impacts on both social and economic growth (Santos and Klasen, 2021). GD affects housing availability, pricing, and quality, which poses serious problems, particularly for women (Adeosun, and Owolabi, 2021). The type of housing that women can obtain is also affected by GD (Marcus and Somji, 2024). Women are frequently forced to live in poor housing due to deficiencies in utilities such as water, electricity, and sanitary facilities. In certain instances, women are even denied access to housing, leaving them homeless and open to exploitation (Adeosun, and Owolabi, 2021). According to studies by the International Housing Coalition, (2021) women are significantly affected by poor housing conditions, including inadequate ventilation, poor lighting, and a lack of basic services, such as bathrooms and cooking facilities (IHC, 2021). The well-being and health of women and their relatives are significantly impacted by these issues (Marcus and Somji, 2024). A significant

factor in GD is housing ownership. Women encounter major obstacles to housing access in many nations, especially if they are single or do not have a male income (Santos and Klasen, 2021). "Women confront many disparities and violence while obtaining housing, including gender bias, age, region, income, tribe, and marital status, according to a study by UN Women (UN Women, 2021). Access to affordable and sustainable housing, essential to women's well-being and financial independence, is challenging because of these factors. Housing development for women is affected by GD. Women in many nations earn less than men, which prevents them from being able to afford appropriate housing. Women are more likely to be poor than men, and they are also less likely to have access to credit, which makes it difficult for them to develop good housing, according to a report from Habitat for Humanity (Habitat for Humanity, 2021). Women who want to increase their economic independence and security encounter significant obstacles because of disparities.

Chant, (2012) investigated the impact of GD on housing in urban areas. The study found that women often face significant barriers to accessing housing due to their low incomes and lack of control over their resources. Women also face discrimination in the housing market, with landlords and property managers preferring male tenants. This can lead to women being forced to live in inadequate and unsafe housing or relying on informal settlements with inadequate sanitation and water facilities. Meth et al. (2019) studied the impact of GD on housing formalization in India and South Africa. This study found that GD in India contributes to women's lack of access to housing. Women in South Africa and India often have lower incomes and educations than men, which limits their ability to access formal housing. Women also face cultural barriers that prevent them from owning property or inheriting land, which can make it difficult to access adequate housing. UN Women (2018) examined the impact of GD on housing in the Pacific Islands. The study found that women in the Pacific Islands face and experience significant challenges and problems in accessing adequate and affordable housing. Women have lower incomes than men, which limits their ability to access formal housing. Women also face cultural barriers, including discriminatory laws and social norms that prevent them from owning property or accessing credit. This can force women to rely on informal settlements or live in overcrowded and unsafe conditions.

2.6 Feminist Theory and the Concept of Intersectionality

The understanding of the effects of GD on housing development is rooted in feminist theory and the concept of intersectionality. Feminist theory posits that women's opportunities and experiences are molded by their gender, and this disparity is further compounded by other factors, for instance, sexuality, class, and race (Crenshaw, 1989). Intersectionality, a concept developed by Crenshaw, highlights the ways in which these different identities intersect and mutually construct one another, creating unique experiences of oppression and privilege. In the context of housing development, GD can manifest in several ways. For instance, women may have fewer accesses to resources and opportunities for home ownership, leading to a higher probability of renting or living in substandard or overcrowded housing (Vásquez-Vera, et al. 2023). Additionally, women may be more likely to experience housing discrimination, both in the rental market and in the process of procuring a mortgage (Sanders, & Scanlon, 2000; Turner, et al 2002). Furthermore, women are often responsible for the care and maintenance of the household, which can limit their ability to participate in the housing development process and make decisions about the design and location of their homes (Wacquant, 1996).

In addition, in many societies, men are typically the principal breadwinners, and women are in charge of caregiving and domestic tasks. This can lead to women being more likely to live in poverty and deficiency and less likely to have the financial resources to purchase a home or participate in housing development projects. Furthermore, women are frequently involved in housing development decision-making processes, such as urban planning, architecture, and real estate development. This lack of representation can lead to housing developments that are not designed with the preferences and needs of women in mind and considerations (Harcourt, and Escobar, 2002). GD can have a significant effect on housing development, both through direct

discrimination and through the ways in which women's roles and responsibilities shape their access to resources and opportunities.

2.7 Resident Socioeconomic Characteristics

Resident socioeconomic characteristics, including sex, age, income level, occupation, education, marital status, family size, ethnicity composition, and race, have a significant impact on housing development and have resulted in unequal access to affordable housing and adequate living conditions for different groups of people (Olusola, 2020). For example, the income level of people is a major factor in accessing affordable housing. The lack of affordable housing is a noteworthy issue and concern in the United States, with 7.2 million extremely low-income renter households facing a severe dearth of affordable housing and an available rental home environment. This finding indicates that respondents and families with low incomes are disproportionately affected by the affordable housing crisis and are more likely to experience housing insecurity and homelessness (Makinde, 2014a). Race and ethnicity also play a significant role in access to affordable housing (Kim, et al. 2019). Persons of color are more likely to experience discrimination in the housing market and to live in areas with limited access to opportunity and high concentrations of poverty. This can lead to a lack of access to decent, safe, and affordable housing, along with limited access to jobs, education, and other opportunities essential for upward mobility. In addition, education can influence access to affordable housing. Individuals with lower levels of educational and academic accomplishment are more likely to experience housing insecurity and homelessness. This is because persons with lower educational levels are more likely to have lower-paying jobs, which can make it harder for them to afford housing (Makinde, 2014b).

Policy and International Department, RCN (2012) examined the connection between health outcomes and respondents' socioeconomic characteristics. The study found that respondents with lower socioeconomic status were more likely to experience poor health consequences, including lower life expectancy, higher rates of chronic diseases, and higher mortality rates. Kim et al. (2019) studied the relationship between socioeconomic status and educational outcomes in Developing Countries. The study found that socioeconomic status was a significant predictor of education outcomes, with respondents from lower socioeconomic backgrounds having lower levels of education attainment. Emmanuel and Zucman, (2020) examined the relationship between socioeconomic characteristics and income disparity in the United States. The outcome of the study found that income disparity has increased significantly since the 1980s, with the top 2% of recipients experiencing the largest gains in income. The study also found that socioeconomic factors such as education and occupation were strong predictors of income disparity. Unterhalter, et al. (2022) examined the features of GD in education. Unterhalter, argued that GD in education is characterized by several features, including: gendered patterns of participation and achievement, curricula and pedagogy, hierarchies of knowledge, and patterns of employment and career opportunities. Unterhalter, argued that these features of GD in education are shaped by broader social, economic, and political structures and are reinforced by gendered norms and values.

2.8 Working definition of gender disparity

GD refers to unequal and unsatisfactory treatment, perceptions of respondents because of gender. It occurs when one gender (usually women) is disadvantaged and discriminated against compared with the other gender (usually men. GD can occur in numerous aspects of life, including employment, education, access to resources and services, and politics. Some examples of GD include unequal pay, limited access to education or job opportunities, discrimination and harassment, limited reproductive rights, and restricted roles and expectations based on gender discrimination. GD can have negative consequences for respondents and society as a whole, including limiting opportunities and potential, perpetuating poverty, and increasing social and economic inequalities.

2.9 The Research Gap, Necessity, and Objectives of the Study

The study of the effects of gender disparity on housing development is important for several reasons. Gender disparity in housing is a significant problem that affects millions of people worldwide, and it is essential to understand the specific ways in which this problem manifests in different contexts. By investigating the effects of gender inequality on housing development in the study area, this study contributes to the growing body of literature in this area and identifies strategies to address this problem in the global context. Iwo is a rapidly developing city that has experienced significant changes in recent years. Despite this progress, significant gaps remain in access to affordable and secure housing, particularly for women. This study will help inform policies and programs aimed at promoting gender equality and improving access to housing for all community members. Housing is a basic human need and plays a critical role in the overall well-being and quality of life of many families. Adequate and affordable housing is essential for physical, emotional, and mental health, education, and economic mobility. Therefore, understanding and addressing the ways in which gender disparity affects housing development is important for promoting communities' overall well-being and development.

3. The Study Area

The general intent of this study is to examine the effects of GD on housing development in the Iwo local government area of Osun State, Nigeria. Iwo is a rapidly developing city; however, it faces significant challenges related to GD in housing. This study explores the specific ways in which GD affects housing development in Iwo and identifies strategies to promote gender equality and improve access to housing for all members of the community. Iwo has four local government areas because of its large population. This study focused only on the Iwo Central Local Government where GD had been noticed.

Iwo has been observing the disparity of gender in housing development, and it is obvious that the disparity continues to grow because of gender inequality. These inequalities are very noticeable in the Iwo central local government. Therefore, the experience of Iwo regarding GD in housing development is a critical and important aspect that has brought the need for the study. Iwo city has over 30 prehistoric and influential kings all lower than the Oluwo of Iwo land, the only paramount ruler and consenting authority. Iwo city has an area of 245km^2 and a population of 343,913 according to 1.6% annual population change (2006 – 2022) from Nigerian National Census Figures. The city migrated from Ile-Ife in the 14th century and is located in Osun State, Western Nigeria. The headquarters of the three local government areas are Iwo, centrally located in Iwo, Ola-Oluwa in Bode-Osi. Furthermore, Ayedire in Ile-Ogbo. Iwo now has four additional local governments: Iwo West, Iwo East, Ayedire southeast, and Ola-Oluwa southeast. The city is located between the latitudes 7^{0}38^{1}N and longitude 4^{0}11^{1}E. Figure 2. Map of Iwo City.

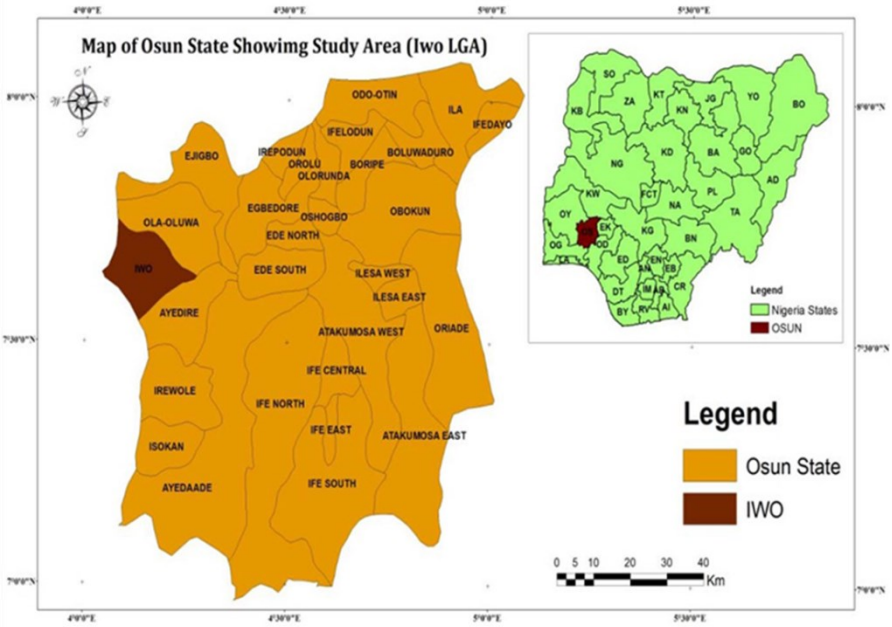

Figure 2. Maps of Osun and the location of Iwo city and Nigeria Map.

4. Research Methodology

The sources of data for this study were secondary and primary data. Primary data were obtained mainly through the administration of questionnaires to residents (landlords or tenants) in the study area. The questionnaires were administered to the targeted residents (landlord or tenants). The questionnaire focused on the effects of GD on housing development. The study area, the Iwo Central LGA, comprises 15 political wards. The estimated population of Iwo LGA is 191,348, consisting of 96,419 males and 94,929 females, according to 1.6% annual population change (2006 – 2022) from Nigerian National Population Census figures. Data were collected from 15 ward areas in Iwo Central LGA. The sample size selected for the study was 50% of the targeted population residents (landlord or tenant), which is believed to have a statistically significant effect on the results outcome and is large enough to prevent erroneous inference, also due to resource limitations and constraints. The study population comprised either landlords or tenants. This study first adopted a systematic sampling method to identify residential buildings. A systematic random sampling technique was used to select dwelling units in the study area. After the first building was selected randomly, every other 5th building in the study area was selected for questionnaire administration. The rationale behind the selection of a systematic random sampling procedure is that it is necessary to understand the whole population's characteristics. The aim is to produce a sample that best represents the target population in the study area. Systematic sampling was adopted because it is a convenient and simple way of establishing a sample population that is free from bias or favouritism. In addition, there is no need to number each member of the sample. The sampling procedure is fast and simple.

Based on a preliminary survey, this study focused on selected areas that seem to have high GD in housing development. Data collection was based on three (3) areas in Iwo Central LGA, concentrating on residential buildings in these areas due to the high prevalence of GD. The areas selected included Feesu, Isale-Oba, and Adeeke, comprising 408, 146, and 102 properties, respectively. Based on Table 1, approximately 50% of the total number of residents was selected for the assessment. A total of three hundred and twenty-eight (328) questionnaires were distributed to the residents (landlords or tenants) in the study area.

To obtain information from residents (landlord or tenant), systematic sampling techniques were used. Starting with a random start, after which the first building is chosen. This is because of the large size of the population and the homogenous nature of the population. Table 2 presents the percentage of the area selected for the sample in the selected areas.

Table 1: Summary of the study population, sampling frame, size, and sampling technique.

S/N	Study Population	Sampling Frame	Sampling Size 50%	Sampling Technique
1	Residential Buildings	656	328	Systematic sampling technique

Table 2: Population of residents selected as a sample in the study area.

Selected Areas	Total number of properties in the selected areas	50% Sample Units
Feesu	408	204
Isale-Oba	146	73
Adeeke	102	51
Total	656	328

The respondents were given a questionnaire to use as a schedule for interviews. The respondents in the study area were selected using a systematic sample technique. After the first (1st) was randomly selected, every other odd building was selected for questionnaire administration in the study area. In each of the selected areas, the landlords or tenants were interviewed.

5. Discussion of the Findings

In total, 53% retrieval rate was attained. This was sufficient to generalize the effect of GD on housing development. Table 3 presents the response rate and questionnaire distribution.

Table 3: Questionnaire distribution and response rate.

Respondents (Building Occupiers)	Number Distributed	Number Retrieved	Percentage (%)
Feesu	204	78	38(%)
Isale Oba	73	36	49 (%)
Adeeke	51	39	76 (%)
Total	328	153	53 (%)

5.1 Socioeconomic Characteristics of Respondents

The socioeconomic characteristics of the respondents consisted of educational qualification, gender, age, marital status, level of education, occupation, income level, household size, household position, average monthly income level, tenancy, length of residency and ethnicity, as revealed in Table 4.

Table 4: Socioeconomic Characteristics of Respondents.

1	Gender	Number of respondents	Percentage (%)	7	Househol, d Position	Number of respondents	Percentage (%)
	Male	71	46.4		Father	55	35.9
	Female	82	52.9		Mother	34	22.2
	Total	153	100		Child	41	26.8
					Relatives/Dependent	23	15.0
2	Age	Number of respondents	Percentage (%)		Total	153	100.0
	18-30	80	52.3				
	31-40	36	23.5	8	Average monthly income level	Number of respondents	Percentage (%)
	41–50	31	20.3		LESS THAN N18,000	81	52.9
	51-60	6	3.9		N18,000–N50,000	23	15.0

	Total	153	100.0		N51,000–N150,000	25	16.3
					N151,000–N300,000	18	11.8
3	**Marital Status**	Number of respondents	Percentage (%)		Above N 300,000	6	3.9
	SINGLE	76	49.7		Total	153	100.0
	MARRIED	64	41.8				
	DIVORCED	11	7.2	9	**Tenancy**	Number of respondents	Percentage (%)
	SEPARATED	2	1.3		Owner	69	45.1
	Total	153	100.0		Rented	71	46.4
					Others, specify	13	8.5
4	**Level of Education**	Number of respondents	Percentage (%)		Total	153	100
	PRIMARY	4	2.6				
	SECONDARY	68	44.4	10	**Length of Residency**	Number of respondents	Percentage (%)
	OND/NCE	30	19.6		1 year	37	24.2
	HND	28	18.3		1-5 years	37	24.2
	B.SC/B.A	23	15.0		6-10 years	26	17.0
	Total	153	100.0		11-15 years	28	18.3
					Over 15 years	25	16.3
5	**Occupation**	Number of respondents	Percentage (%)		Total	153	100
	STUDENT	59	38.6				
	CIVIL SERVICE	52	34.0	11	**Ethnicity**	Number of respondents	Percentage (%)
	TRADING	21	13.7		Igbo	11	7.2
	SELF-EMPLOYED	15	9.8		Hausa	16	10.5
	UNEMPLOYED	6	3.9		Yoruba	105	68.6
	Total	153	100.0		Urhobo	16	10.5
					Itsekiri	3	2.0
6	**Household Size**	Number of respondents	Percentage (%)		Other, specify	2	1.3
	1-2	34	22.2		Total	153	100.0
	3-4	43	28.1				
	5-6	50	32.7				
	7-8	26	17.0				
	Total	153	100.0				

Table 4 presents the socioeconomic characteristics of the respondents, encompassing data from 153 individuals. Of these respondents, 71 (46.4%) were male and 82 (52.9%) were female. The percentages indicate the relative distribution of each gender within the population and highlight a slightly higher proportion of females (52.9%) compared to males (46.4%).

Table 4 also illustrates the age-group distribution of the 153 respondents. The data reveal that the "18 to 30" age group is the largest, with 80 respondents (52.3%), indicating that a substantial segment of the population falls within this youthful demographic. The "31 to 40" age group comprises 36 respondents (23.5%), while the proportion of respondents in older age categories continues to decline. Overall, a significant majority of the population belongs to the "18 to 30" age group (52.3%), followed by a gradual decrease in representation among older age cohorts.

Furthermore, Table 4 includes data on the marital status of the 153 respondents. Four categories were utilized—single, married, divorced, and separated. The largest group was the "Single" category, with 76 respondents (49.7%), followed by the "Married" category, which included 64 respondents (41.8%). The "Divorced" category comprised 11 respondents (7.2%), and the "Separated" category represented 2 respondents (1.3%). The combined proportion of respondents who were single or married amounted to 91.5%, indicating that most participants fell into these two categories.

Educational qualifications of the respondents are also depicted in Table 4. Of the 153 respondents, the majority attained a secondary-level education (68 respondents, 44.4%). Other notable categories included OND/NCE (30 respondents, 19.6%), HND (28 respondents, 18.3%), and B.Sc./B.A. degrees (23 respondents, 15.0%). A small proportion (4 respondents, 2.6%) had only primary-level education. These data underscore the prominence of secondary education as the highest qualification for a substantial segment of the sample.

Occupational distribution, as shown in Table 4, indicates that students constituted the largest occupational category (59 respondents, 38.6%), followed closely by those employed in civil service positions (52 respondents, 34.0%). Other occupational groups included trading (21 respondents, 13.7%), self-employment (15 respondents, 9.8%), and unemployment (6 respondents, 3.9%). Overall, a significant proportion of the population comprised students and civil servants, with smaller segments engaged in trading or self-employment and a very modest group unemployed.

Household size distribution is also reported in Table 4. Among the 153 households, the "5 to 6" members category was the largest (50 households, 32.7%), reflecting a preference or prevalence of moderately large households. Households with "3 to 4" members followed (43 households, 28.1%), while smaller households with "1 to 2" members (34 households, 22.2%) and larger households with "7 to 8" members (26 households, 17.0%) were comparatively less common.

Table 4 further elucidates the roles of respondents within their households. Fathers represented the largest category (55 respondents, 35.9%), followed by children (41 respondents, 26.8%), mothers (34 respondents, 22.2%), and relatives/dependents (23 respondents, 15.0%). This distribution suggests that a substantial portion of the respondents were either heads of households or children, with a smaller yet notable representation of mothers and dependents.

With regard to income levels, Table 4 reveals that 81 respondents (52.9%) reported earning less than N18,000, suggesting that a majority of the population fell into a lower income bracket. The next largest income groups were N51,000 to N150,000 (25 respondents, 16.3%) and N18,000 to N50,000 (23 respondents, 15.0%). Higher-income categories included N151,000 to N300,000 (18 respondents, 11.8%) and above N300,000 (6 respondents, 3.9%). Thus, the data point to a pronounced concentration of respondents in lower-income brackets, supporting prior findings that socioeconomic factors—such as education and occupation—play a vital role in shaping income disparities (Emmanuel and Zucman, 2020).

Housing tenure and ownership status, as detailed in Table 4, indicate that 62 respondents (40.5%) owned their homes, while 71 respondents (46.4%) rented their accommodations. Thirteen respondents (8.5%) reported other forms of tenure requiring further specification. These figures highlight that most respondents either owned or rented their housing, with a smaller proportion falling into other categories.

Regarding the length of time spent in a given situation or context, the respondents' duration is relatively evenly distributed among those who spent "less than a year" (37 respondents, 24.2%), "1 to 5 years" (37 respondents, 24.2%), and "6 to 10 years" (26 respondents, 17.0%). Those who spent "11 to 15 years" accounted for 28 respondents (18.3%), and the "over 15 years" group comprised 21 respondents (13.7%). These data suggest a fairly balanced temporal distribution of the respondents' experience levels or durations.

Ethnic distribution, presented in Table 4, shows that Yoruba respondents comprised the majority of the population (105 respondents, 68.6%). The other major ethnic groups included Hausa and Urhobo (16 respondents each, 10.5%), and Igbo (11 respondents, 7.2%). Smaller ethnic categories were Itsekiri (3 respondents, 2.0%) and others requiring specification (2 respondents, 1.3%). This ethnic composition indicates a predominance of Yoruba respondents, with other ethnic groups represented to a lesser extent.

These findings align with the scholarship of Emmanuel and Zucman (2020), reinforcing the notion that socioeconomic factors, such as education and occupation, serve as significant predictors of income inequality within populations. The patterns observed in Table 4 corroborate this linkage,

emphasizing how variations in education, income, and occupational status contribute to the broader socioeconomic dynamics of the study area.

5.2 Housing Development Types

This data shows the type of house each respondent lives in, including single-family homes, apartments, townhouses, senior housing, mansions, traditional housing, duplexes, detached houses, and so on, as listed below.

Table 5: Types of Houses Lived in.

House's type	Number of respondents	Percentage (%)
Single-family homes	48	31.4
Townhouse	17	11.1
Apartment	51	33.3
Senior housing	12	7.8
Traditional housing	8	5.2
Duplex	8	5.2
Detached house	3	2.0
Bungalow	2	1.3
Mansion	2	1.3
Condominiums	2	1.3
Total	153	100.0

Table 5 presents the types of houses in which the respondents live. The data included information on 153 respondents, and the types of houses were categorized into multiple groups. The "Single Family Homes" category consists of 48 respondents, representing 31.4% of the total population. This category includes respondents living in standalone houses designed for single families. The "Townhouses" category includes 17 respondents, accounting for 11.1% of the population. This category includes respondents living in houses that are part of a connected row or terrace. The "Apartment" category comprises 51 respondents, making up 33.3% of the population. This category includes respondents living in apartments in large residential buildings. The "Senior Housing" category consists of 12 respondents representing 7.8% of the population. This category includes respondents living in housing specifically designed for senior citizens. The "Traditional Housing" category includes 8 respondents, accounting for 5.2% of the population. This category includes respondents living in houses that adhere to traditional architectural styles and cultural norms. The "Duplex" category consists of 8 respondents, representing 5.2% of the population. This category includes respondents who live in houses divided into two separate units. The "Detached House" category includes 3 respondents, accounting for 2.0% of the population. This category includes respondents living in standalone houses that are not connected to other structures.

The "Bungalow" category consists of 2 respondents, representing 1.3% of the population. This category includes respondents living in small, single-story houses. The "Mansion" category includes 2 respondents, accounting for 1.3% of the population. This category includes respondents living in large, luxurious residences. The "Condominiums" category consists of 2 respondents, representing 1.3% of the population. This category includes respondents living in units within a larger residential building, typically with shared amenities. The majority of respondents lived in single-family homes (31.4%), followed by apartments (33.3%). There was also a notable presence of townhouses (11.1%) and senior housing (7.8%). The remaining categories, such as traditional housing, duplexes, detached houses, bungalows, mansions, and condominiums, comprised smaller proportions of the total population. In summary, the data show that respondents mostly live in apartment-type housing. The findings of this study agree with Stromann-Andersen et al. (2014). This study found that multi-story apartment/buildings had the lowest environmental impact due to their compactness and ability to share resources, such as heating and cooling systems.

5.3 Features Influencing Gender Disparity in the Study Area

These data represent the features that influence GD according to the respondents' perspectives. The results presented in Table 6 indicate the features that contributed to and influenced gender disparity in the study area. The relative significant index (RSI) of factors influencing gender disparity in the study area indicates that 5 variables out of 10 identified variables had an RSI above average of 3.90, which were considered major significant factors influencing gender disparity in the study area. These include societal mindsets, lack of bodily autonomy, lack of employment equality, lack of political representation, and lack of religious freedom, with positive deviations and RSIs of 4.23, 4.06, 4.00, 3.99, and 3.99. The study revealed that among all factors, job segregation, uneven access to education, lack of legal protection, racism, and poor medical care were with negative deviations and RSI of 3.86, 3.80, 3.77, 3.73, and 3.58, respectively, which were considered less significant factors influencing gender disparity in the study area.

Table 6: Features Influencing Gender Disparity in the Study Area.

Feature of gender disparity	SD	D	NAND	A	SA	TNR	SWV	Mean
Societal mindsets	18	0	4	56	75	153	647	4.23
Lack of bodily autonomy	7	20	5	46	75	153	621	4.06
Lack of employment equality	12	11	5	62	63	153	612	4.00
Lack of political representation	6	16	4	75	52	153	610	3.99
Lack of religious freedom	6	16	4	75	52	153	610	3.99
Job segregation	18	15	3	51	66	153	591	3.86
Uneven access to education	13	21	2	65	52	153	581	3.80
Lack of legal protection	22	6	3	76	46	153	577	3.77
Racism	14	14	6	84	35	153	571	3.73
Poor medical care	17	17	11	76	32	153	548	3.58
Average								**39.01/10=3.90**

Note: SD= Strongly Disagree D= Disagree NAND= Neither Agree nor Disagree A=Agree SA= Strongly Agree, Sum of Weighted Value = SWV, Total Number of Respondents = TNR

Table 6 presents the responses regarding features that influence GD in a specific area. The data include information from 153 respondents who were asked to indicate their level of disagreement or agreement with the statement on the influence of uneven access to education on gender inequalities. The responses were categorized into several options. The "Disagree" category consists of 17 respondents representing 11.1% of the total population. This category represents respondents who disagree with the statement that uneven access to education influences gender inequalities in their area. The "Strongly Disagree" category includes 17 respondents, accounting for 11.1% of the population. This category includes respondents who strongly disagree with the statement. The "Neither Agree or Disagree" category comprises 11 respondents, representing 7.2% of the population. This category represents respondents who neither agree nor disagree with the statement. The "Agree" category consists of 76 respondents representing 49.7% of the population. This category represents respondents who agree with the statement.

The "Strongly Agree" category includes 30 respondents, accounting for 19.6% of the population. This category includes respondents who strongly agree with the statement. For (Uneven Access to Education), most respondents expressed agreement with the statement, with 54.9% agreeing and 21.6% strongly agreeing. A smaller proportion disagreed (9.2%) or strongly disagreed (9.2%) with the statement. Some respondents did not agree or disagree (3.9%), and a few respondents selected other response options (1.3%). The result obtained on Lack of Legal Protections shows that a significant number of respondents strongly agreed (30.1%) that the lack of legal protections influences gender inequalities. The majority agreed (49.7%), whereas a smaller proportion disagreed (14.4%) or strongly disagreed (3.9%). Some respondents did not agree or disagree (2.0%). For (Job Segregation), the highest percentage of respondents strongly agreed (41.2%) that job segregation contributes to gender inequalities. A significant number of respondents agreed (33.3%), whereas a smaller proportion disagreed (11.8%) or strongly disagreed (9.8%). Some respondents did not agree or disagree (2.0%), and a few selected other response options (2.0%). Regarding lack of bodily autonomy, most respondents strongly agreed (49.0%) that lack of bodily autonomy is a factor influencing gender inequalities. Some respondents agreed (30.1%), whereas a smaller proportion disagreed (4.6%) or strongly disagreed (13.1%). Some respondents did not agree or disagree (3.3%). For (Poor Medical Care), the highest percentage of respondents strongly agreed (34.0%) that poor medical care contributes to gender inequalities.

A significant number agreed (42.5%), whereas a smaller proportion disagreed (8.5%) or strongly disagreed (13.7%). Some respondents did not agree or disagree (1.3%). Regarding the lack of political representation, most respondents strongly agreed (34.0%) that a lack of political representation influences gender inequalities. Some respondents agreed (49.0%), whereas a smaller proportion disagreed (3.9%) or strongly disagreed (10.5%). Some respondents did not agree or disagree (2.6%). Finally, for (Societal Mindsets), the highest percentage of respondents strongly agreed (49.0%) that societal mindsets contribute to gender inequalities. Some respondents agreed (36.6%), whereas a smaller proportion did not agree or disagree (2.6%). A small percentage disagreed (11.8%). In summary, the data revealed different perceptions regarding the factors influencing gender disparity. Uneven access to education, job segregation, lack of bodily autonomy, and poor medical care are commonly acknowledged as influential factors by most respondents. The lack of legal protection and political representation has also received significant attention. Societal mindsets were considered influential by most respondents. These insights highlight the complex nature of gender inequalities and the various factors that contribute to them. This finding agrees with Unterhalter et al. (2022), which recognized that features of GD in education are shaped by broader social, economic and political structures and reinforced by gender norms and values.

5.3.1 The Relationship between Gender Disparity Characteristics and Housing Development in the Study Area.

Table 7 shows the regression analysis results for the relationship between the variables of gender disparity characteristics and housing development in the study area. The dependent variables suitable for multiple regression analysis, they were summarized into one composite variable. This was done and variables of the features of Gender Disparity were statistically obtained. The dependent variable, housing development, was regressed (multiple regression) on the nine identified independent Gender Disparity characteristic variables. It is useful to mention here that the variables used for this analysis were mostly obtained as either nominal or ranking data (scale of measurement) percentages, and mean were thereafter computed to obtain tertiary data (as ratio scale) to make them amenable to parametric test (multiple regression). This was made possible by computing the means of variables related to spatial units. The results showed F–value of 99.964 and P–value of 0.04, which is significant at the 0.05 level. The relationship between gender disparity features and housing development was found to be significant. This indicates a strong relationship between the dependent and independent variables. The following variables with P-values that were significant at 0.05 levels comprised: Lack of employment equality, Lack of political representation,

Job segregation, uneven access to education, Lack of legal protection, and Poor medical care (P-values of 0.014, 0.000, 0.000, 0.050, 0.010, 0.003, 0.041and 0.002 respectively.

Table 7: Multiple Regression Analysis of the Relationship Between Gender Disparity and Housing Development in the Study Area.

Model Summary

Model	R	R Square	Adjusted R-squared value	Std. Error in Estimate
1	.996[a]	.992	.982	.04854

a. Predictors: (Constant), Societal mindsets, Lack of bodily autonomy, Lack of employment equality, Lack of political representation, Lack of religion freedom, Job segregation, Uneven access to education, Lack of legal protection, Racism, Poor medical care

ANOVA [b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	**Regression**	**3.062**	**13**	**.236**	**99.964**	**.004**[a]
	Residual	**.026**	**11**	**.002**		
	Total	**3.088**	**24**			

a. Predictors: (Constant), Societal mindsets, Lack of bodily autonomy, Lack of employment equality, Lack of political representation, Lack of religion freedom, Job segregation, Uneven access to education, Lack of legal protection, Racism, Poor medical care.

b. Dependent Variable: Housing Development

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients		
Model		**B**	**Std. Error**	**Beta**	**T**	**Sig.**
1	(Constant)	-1.531	1.655		-.925	.375
	Societal mindsets	.363	.124	.521	2.937	.014
	Lack of bodily autonomy	1.464	.156	1.382	9.379	.000
	Lack of employment equality	1.149	.201	1.287	5.718	.000
	Lack of political representation	-1.244	.573	-1.253	-2.170	.050
	Lack of religious freedom	.493	.407	.481	1.211	.251
	Job segregation	-1.291	.414	-.848	-3.122	.010
	Uneven access to education	.109	.146	.142	.749	.003
	Lack of legal protection	-.564	.271	-.444	-2.084	.041
	Racism	.143	.191	.330	.748	.470
	Poor medical care	.205	.052	.211	3.899	.002

a. Dependent Variable: Housing Development

Note: *P-values significant at 0.05 levels*

Table 8 shows the computed Pearson's correlation coefficient (r) among pairs of the nine (9) identified relevant features of Gender Disparity variables in the study area. The study indicated that housing development had positive and no significant correlations (0.017 and 0.731) with variable societal mindsets (A) and Racism (I), respectively. It has positive and significant correlations with Lack of bodily autonomy (B), Lack of employment equality (C), Lack of political representation (D), Lack of religious freedom (E), Job segregation (F), Lack of legal protection (H), and poor medical care (J), with coefficients of 0.699, 0.378, 0.616, 0.754, 0.333, 0.838, and 0.537, respectively. It had negative and significant correlations (0.277) with uneven access to education (G). The correlation was significant at the 0.01 and 0.05 levels.

Table 8: Correlation Coefficients among Features of Gender Disparity and Housing Development Using Pearson's Correlation Coefficient (r) for the Study Area.

S/No	Variables	A (i)	B (ii)	C (iii)	D (iv)	E (v)	F (vi)	G (vii)	H (viii)	I (ix)	J (x)	K (xi)
(i)	Societal mindsets (A)	1										
(ii)	Lack of bodily autonomy (B)	-.218	1									
(iii)	Lack of employment equality (C)	.323	.464*	1								
(iv)	Lack of political representation (D)	-.005	.714**	.835**	1							
(v)	Lack of religious freedom (E)	-.343	.955**	.367	.679**	1						
(vi)	Job segregation (F)	.134	.557**	.179	.297	.521**	1					
(vii)	Uneven access to education (G)	.266	.102	.435*	.277	-.018	-.217	1				
(viii)	Lack of legal protection (H)	-.218	.893**	.468*	.726**	.912**	.539**	-.087	1			
(ix)	Racism (I)	.126	.454*	-.163	.037	.530**	.547**	-.489*	.554**	1		
(x)	Poor medical care (J)	-.146	.213	.118	.300	.138	.585**	-.358	.305	.019	1	
(xi)	Housing Development (K)	.017	.699**	.378*	.616**	.754**	.333**	-.277*	.838**	.731	.537**	1

***Correlation is significant at the 0.01 level (2-tailed).*

** Correlation was significant at the 0.05 level (2-tailed).*

5.4 Effects of Gender Disparity Indices (EGDI) on Housing Development in the Study Area

Table 9 presents the results of the level of effects of gender disparity Indices on housing development in the study area according to the respondents' perspectives. The result indicates that 3 variables out of 7 identified had an EGDI above average of 4.17, which are considered to have significant effects of gender disparity on housing development in the study area. These include: Denied access to housing, Homelessness, and Deprived access to services with positive deviation and EGDI of 4.36, 4.31, and 4.28, respectively. The study revealed that among all the 7 variables, Lack of property rights, Limited access to finance, deprived access to utility, and deprived access to basic education had negative deviations and EGDI of 4.13, 4.11, 4.09, and 3.95, respectively, which were considered significant but with unconventional effects of gender disparity on housing development in the study area.

Table 9: Effects of Gender Disparity Indices (EGDI) on Housing Development in the Study Area.

Effects of gender disparity	SD	D	NAND	A	SA	TNR	SWV	Mean
Denied access to housing	4	5	5	57	82	153	667	4.36
Homelessness	2	6	3	73	69	153	660	4.31
Deprived access to services	5	7	2	65	74	153	655	4.28
Lack of property rights	7	7	2	79	58	153	633	4.13
Limited access to finance	9	2	5	84	53	153	629	4.11
Deprived of utility access	1	3	2	122	25	153	626	4.09
Deprived of basic education	4	3	5	125	16	153	605	3.95
Average								29.23/7 = 4.17

The results obtained on types of housing development in the study area show that apartment buildings had the highest percentage of housing development, at 33.3%, followed by single-family homes at 31.4%. Other types of housing development include townhouses, senior housing, traditional housing, duplexes, bungalows, mansions, and condominiums, which are in the minority. Table 9 presents responses related to the effects of GD on various aspects. For (Deprived access to basic education), most respondents agreed (81.7%) that GD affects access to basic education. A significant number strongly agreed (10.5%), whereas a smaller proportion disagreed (2.6%) followed by strongly disagreed (2.0%). Some respondents did not agree or disagree (3.3%), with an average of 3.9281. For (access to utility), the highest percentage of respondents strongly agreed (16.3%) that GD leads to inaccessibility to utility services. A significant number of respondents agreed (79.7%), whereas a smaller proportion disagreed (0.7%) or strongly disagreed (2.0%). Some respondents did not agree (1.3%) 4.2418. For (Inadequate Access to Services), most respondents strongly agreed (48.4%) that GD results in inadequate access to services. Some respondents agreed (42.5%), whereas a smaller proportion disagreed (3.3%) or strongly disagreed (4.6%). Some respondents did not agree (1.3%) 4.2810. For (Denied Access to Housing), a significant number of respondents strongly agreed (51.6%) that GD leads to denied access to housing. Some respondents agreed (37.3%), whereas a smaller proportion disagreed (2.6%) or strongly disagreed (3.3%). Some respondents did not agree (3.3%) 5.3203.

For (Homelessness), most respondents strongly agreed (45.1%) that GD contributes to homelessness. Some respondents agreed (47.7%), whereas a smaller proportion disagreed (1.3%) or strongly disagreed (3.9%). Some respondents neither agreed nor disagreed (2.0%) 4.3137. For lack of property rights, the highest percentage of respondents strongly agreed (37.9%) that GD results in a lack of property rights. Some respondents agreed (51.6%), whereas a smaller proportion disagreed (4.6%) or strongly disagreed (4.6%). Some respondents did not agree (1.3%) 4.1373. Finally, regarding limited access to financing, most respondents agreed (54.9%) that GD leads to limited access. Some respondents strongly agreed (34.6%), whereas a smaller proportion disagreed (5.9%) or strongly disagreed (1.3%). Some respondents did not agree (3.3%) 4.1111. In summary, the data reveal that respondents perceive GD to have significant effects in various areas. Inaccessibility to basic education, utility services, and adequate services is recognized as a key consequence of GD. Denied access to housing, homelessness, lack of property rights, and limited access to financing are also highlighted as negative effects. These insights emphasize the broad impact of GD on different aspects of respondents' lives in a given area. This finding agrees with the study of Chant, (2012), which established that women often face more significant barriers to accessing housing due to their lower incomes and lack of employment disparities.

5.5 Relationship between the Effects of Gender Disparity and Housing Development

To determine the relationship between the effects of gender disparity and housing development in the study area, a regression analysis was conducted. Seven independent variables were identified; which comprised: Denied access to housing, homelessness, deprived access to services, lack of property rights, limited access to finance, deprived access to utility, and deprived access to basic education. Table 10 presents the results of the regression analysis of the relationship between variables of the effects of gender disparity and housing development in the study area. The results showed an F–value of 1.082E4 and a P–value of 0.003 which is significant at the 0.05 level. The relationship between the effects of gender disparity and housing development in the study area is significant. This indicates a strong relationship between the dependent and independent variables. The following variables with P-values that were significant at 0.05 levels comprised: denied access to housing, homelessness, deprived access to services, lack of property rights, limited access to finance, deprived access to utility, and deprived access to basic education (P-values of 0.032, 0.003, 0.004, 0.001, 0.002, 0.002, and 0.004 respectively.

Table 10: Multiple Regression Analysis of the Relationship between the Effects of Gender Disparity and Housing Development in the Study Area.

Model Summary

Model	R	R Square	Adjusted R-squared value	Std. Error in Estimate
1	0.815[a]	0.798	0.755	.00332

a. Predictors: (Constant), Denied access to housing, homeless, deprived access to services, Lack of property rights, Limited access to finance, Deprived access to utility, and basic education

ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1.548	13	.119	1.082E4	.003[a]
	Residual	.000	11	.000		
	Total	1.548	24			

a. Predictors: (Constant), Denied access to housing, homeless, deprived access to services, Lack of property rights, Limited access to finance, Deprived access to utility, and basic education

b. Dependent Variable: Housing Development

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.651	.175		3.725	.003
	Denied access to housing	-.105	.043	-.165	-2.448	.032
	Homelessness	.165	.043	.217	3.863	.003
	Deprived access to services	.252	.069	.361	3.663	.004
	Lack of property rights	.177	.041	.235	4.344	.001
	Limited access to finance	-.303	.074	-.257	-4.083	.002
	Deprived of utility access	.047	.024	.070	1.954	.077
	Deprived of basic education	.205	.052	.211	3.899	.002

a. Dependent Variable: Housing Development

P-values significant at 0.05 levels

Table 11 shows the results of the computed Pearson's correlation coefficient (r) among pairs of the seven (7) identified relevant Gender Disparity characteristics variables and Housing Development in the study area. The study indicated that housing development has negative and significant correlations (0.602) with variable denied access to housing (A). It has positive and significant correlations with homelessness (B), deprived access to services (C), lack of property rights (D), limited access to finance (E), and deprived access to utility (F), with coefficients of 0.939, 0.912, 0.943, 0.939, and 0.446, respectively. The correlation was significant at the 0.01 and 0.05 levels. Furthermore, the study revealed that housing development has positive and no significant correlations with Deprived access to basic education (G), with a coefficient of 0.261.

Table 11: Correlation Coefficients among the Effects of Gender Disparity and Housing Development in the Study Area Using Pearson's Correlation Co-efficient (r).

S/No	Variables	A (i)	B (ii)	C (iii)	D (iv)	E (v)	F (vi)	G (vii)	H (viii)
(i)	Denied access to housing (A)	1							
(ii)	Homelessness (B)	-.713**	1						
(iii)	Deprived access to services (C)	-.475*	.782**	1					
(iv)	Lack of property rights (D)	-.468*	.817**	.963**	1				
(v)	Limited access to finance (E)	-.728**	.992**	.793**	.826**	1			
(vi)	Deprived access to utility (F)	-.128	.382	.244	.242	.363	1		
(vii)	Deprived of basic education (G)	.140	.411*	.178	.221	.397*	-.068	1	
(viii)	Housing Development (H)	-.602**	.939**	.912**	.943**	.939**	.446*	.261	1

***Correlation is significant at the 0.01 level (2-tailed).*
** Correlation was significant at the 0.05 level (2-tailed).*

6. Study Findings in Relation to Existing Literature

The findings of this study corroborate those of Munir et al. (2021), who investigated the impact of gender inequality on housing development in Pakistan. Munir et al. observed that women confronted substantial obstacles in accessing housing, including barriers such as denied access, homelessness, restricted access to services, limited property rights, reduced access to finance, utilities, and basic education, as well as discrimination in the housing market. These challenges were particularly acute for women who were unmarried or divorced, underscoring the multifaceted dimensions of gender-based disadvantage. Furthermore, Munir et al. identified a broader association between gender disparities in societal contexts—such as education and employment—and lower levels of overall housing development.

The present study's alignment with Crenshaw's (1989) feminist theory is particularly noteworthy. Crenshaw's intersectional framework suggests that women's experiences and opportunities, including those related to housing, are not only shaped by gender but are also compounded by additional axes of inequality. Our findings highlight societal mindsets, lack of bodily autonomy, limited employment equality, insufficient political representation, restricted religious freedom, occupational segregation, uneven educational access, and inadequate legal protections, all of which converge to reinforce gender-based disparities in housing.

In addition, these findings support the United Nations Human Settlements Program (2012), which similarly identified significant barriers to women's access to housing. According to the UN-Habitat report, women frequently encounter discrimination in the housing market and face limited access to credit, highlighting the structural nature of these inequalities. This body of evidence further indicates that gender disparities in education and employment adversely affect housing development outcomes.

Our results are also consistent with Kabeer and Waddington (2015), who examined gender disparities in housing conditions in Bangladesh. Their study found that women were more likely to reside in homes with poor sanitation and inadequate water supply, conditions partially rooted in gender-based discrimination in resource allocation and the enforcement of restrictive gender norms that limit women's mobility and decision-making power.

This research is in agreement with Henry (2000), who explored gender and housing development in low-income suburbs of Jinja Municipality, Uganda. Henry's findings regarding the features and effects of gender disparity on housing closely parallel those observed in the current study.

Furthermore, Adeoye (2018) examined factors influencing gender differentials in urban informal housing development in southwestern Nigeria and identified similar forms of inequality, including homelessness and reduced access to essential services, utilities, and education.

This study further endorses earlier work by Asiyanbola (2010; 2011), who explored gender and involvement in housing development in Ibadan, Nigeria. Their analysis of variations in women's perceived involvement, awareness, and actual engagement in housing projects resonates with the conclusions drawn here. Similarly, Bengtsson et al. (2011) conducted a field experiment investigating the gender gap in rental housing, while Blau and Kahn (2017) examined the gender wage gap and its implications for housing development, both studies complementing the patterns identified in the present research.

Additionally, our findings affirm those of Meth et al. (2019), who compared gender inequality and housing development in South Africa and India, uncovering parallel issues of gender-based inequity. The current study's outcomes also support the work of the International Labor Organization (2021), Sanders and Scanlon (2000), and Harcourt and Escobar (2002), which have addressed the politics of place, culture, and gender in mortgage lending discrimination, further illustrating that gender is a critical lens through which to understand and address disparities in housing and related development arenas.

7. Summary of the Findings

The findings of this study demonstrate that gender disparity (GD) significantly hinders women's access to housing in the examined area. In particular, prevailing inheritance laws and sociocultural norms frequently favor male family members, thereby limiting women's rights to inherit property or secure legal ownership. The study further establishes that entrenched cultural conventions and discriminatory practices constrain women's ability to independently own or rent housing units.

Economic factors also emerged as critical determinants of housing development outcomes. The study found that GD amplifies economic inequalities, restricting women's financial resources and, in turn, their capacity to secure adequate housing. As a consequence of persistent gender wage gaps and occupational segregation, women often have lower incomes and fewer employment prospects, resulting in financial instability and reduced access to affordable, safe, and decent housing options.

The research confirmed that GD contributes to substandard living conditions for women. Compared to men, women are more likely to reside in overcrowded, unsafe, and inferior-quality housing. Moreover, they frequently encounter discriminatory practices—such as elevated rental prices, restricted property rights, and limited housing choices—when attempting to secure living arrangements. In marginalized communities, women bear the brunt of inadequate basic amenities, including access to clean water, electricity, and proper sanitation facilities, further exacerbating their vulnerability.

In addition, the study reveals that GD diminishes women's decision-making power and participation in housing-related matters. Women often possess limited control over household resources and remain excluded from critical housing decisions. Domestic violence, insecurity of tenure, and patriarchal norms further erode women's agency, impeding their active involvement in planning and decision-making processes within the housing development landscape.

7.1 Policy implications of the findings

The findings of this study will aid in the formulation of relevant policies with the aim of providing information that will enhance gender balance in housing development. This policy seeks to promote gender equality and ensure equitable access to safe, affordable, and adequate housing for all residents, regardless of gender.

8. Conclusion and Recommendations

The study concluded that gender disparity (GD) in the study area significantly affects women's access to housing development. Women are often subjected to discriminatory practices when

seeking housing, such as higher rental rates, limited options, and restricted property ownership rights. This study highlights the urgent need for comprehensive and targeted interventions to address GD in housing development by creating an inclusive housing environment that ensures equal rights, opportunities, and access for all genders.

The identified predictors of GD that inhibit housing development include societal mindsets, lack of bodily autonomy, lack of employment equality, lack of political representation, lack of religious freedom, job segregation, uneven access to education, lack of legal protection, racism, and poor medical care. These predictors should be considered in the development of policy frameworks for housing development. Additionally, the identified effects of GD, such as lack of access to housing, utilities, and services; homelessness; lack of property rights; limited access to finance; and deprived access to basic education, must be addressed through legislation designed to mitigate these issues.

The study aligns with Intersectionality and feminist theory, concepts developed by Crenshaw, which highlight the ways different identities intersect and mutually construct one another, creating unique experiences of oppression and privilege. Understanding and addressing how GD affects housing development is crucial for promoting the overall well-being and development of communities.

This study provides valuable insights into the impacts of GD on housing development as a key socioeconomic attribute. The findings emphasize the need for informed policy frameworks that enhance housing development and address gender disparities effectively. To address these disparities, enhancing women's access to housing finance through gender-responsive loan programs, microfinance schemes, and subsidies is crucial. Affordable housing options targeted toward low-income women and vulnerable groups must be provided, along with housing subsidies or rental assistance programs to alleviate financial burdens and ensure women's access to safe and adequate housing. Strengthening women's legal protection is essential by improving mechanisms to guard against domestic violence, eviction, and discrimination in the housing sector and establishing specialized courts or dispute resolution systems for prompt action on housing-related gender issues.

Fostering gender-responsive urban planning and design is vital to ensure safe and accessible housing infrastructure for women, incorporating women's perspectives in project designs and addressing their specific needs, such as childcare facilities and proximity to essential services. Investments in gender-sensitive social infrastructure, including community centers, childcare facilities, and healthcare services, must be prioritized, along with ensuring equal provision of basic amenities such as water, sanitation, and electricity. Strengthening data collection and research on gender-disaggregated housing indicators will inform evidence-based policy formulation and effective interventions. Collaborating with women's organizations and gender-focused NGOs will further address gender-specific housing concerns and advocate for equality in housing policies. Key actions include enacting gender-sensitive legislation, promoting women's property rights, and engaging civil society organizations in collective efforts to ensure gender equality in housing. Addressing these disparities is not only a matter of social justice but a prerequisite for sustainable and inclusive development. By prioritizing gender equality, we can pave the way for a more equitable and prosperous future where everyone has access to safe, affordable, and dignified housing, regardless of gender.

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Conflicts of Interest
The authors declare no conflicts of interest related to this research.

Data availability statement
The data supporting this study are available from the corresponding author upon reasonable request.

Institutional Review Board Statement
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Original scientific paper

Urban Morphology and Energy Performance: Spatial-Simulation Assessment from Hebron, Palestine

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ABSTRACT

Urban morphology critically governs residential energy demand, yet empirical evidence from semi-arid, geopolitically constrained cities remains scarce. This study quantifies the influence of neighbourhood form on heating and cooling loads in Hebron, Palestine. Three morphologically distinct districts—Old City (compact), Zeitoun (semi-structured) and Al Sheikh (unplanned sprawl)—were mapped in ArcGIS Pro to derive Floor Space Index, Ground Space Index and Open Space Ratio. Prototype mid-rise dwellings were modelled in DesignBuilder and simulated with EnergyPlus under identical boundary conditions. Pearson correlations and ANOVA assessed relationships between morphological variables and annual loads. Results show cooling demand decreases by 34 % as FSI rises from 0.7 to 1.2, whereas heating demand doubles under the same densification. The moderately dense Zeitoun configuration (FSI≈1.0, OSR≈1.6) achieved the lowest combined energy use, outperforming both extreme forms. Findings demonstrate that mid-rise, medium-density layouts balance summer shading with winter solar access, offering a viable pathway for energy-aware expansion in semi-arid contexts. The integrated spatial-simulation framework provides planners with transferable metrics for zoning and retrofit prioritisation, supporting climate-responsive urban policy across the Middle East. Future research should incorporate behavioural patterns and multiple building typologies to refine these benchmarks under climate-change scenarios.

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Highlights:

- Investigates energy efficiency across diverse urban morphologies in Hebron using GIS.
- Demonstrates that moderate-density mid-rise configurations optimize thermal performance.
- Provides evidence that traditional dense urban forms reduce summer cooling demand.
- Quantifies trade-offs between heating and cooling across spatial configurations.
- Informs urban policy on sustainable development in energy-challenged environments.

Contribution to the field statement:

This research provides quantitative evidence on how urban morphology influences energy performance in residential buildings in Hebron. Using GIS and energy simulation, the study identifies optimal urban configurations that reduce cooling and heating demand, offering planning insights for climate-responsive urban development in semi-arid regions.

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1. Introduction

Urban morphology is a principal determinant of residential energy efficiency, especially in semi-arid cities that experience rapid, largely unregulated change and geopolitical constraints such as Hebron. Over centuries, social, political and topographical forces have produced a stratified urban fabric whose neighbourhoods now differ markedly in density, openness and orientation (Shaheen & Dweik, 2017). Recent population growth has intensified these contrasts, creating an ideal test-bed for examining how morphology governs energy demand and thermal comfort.

A substantial international literature confirms that geometric properties of urban form—block depth, height-to-width ratio, street orientation and greenspace distribution—shape operational energy use and indoor comfort. Large-sample econometric work links building morphology to city-scale energy demand (Zhou, Xia, & Zhou, 2025), while design-stage simulation studies show that planning parameters can raise or curb end-use intensity (Lin, Luo, Gu, Hao, & Wang, 2025). Block-level optimisation can simultaneously cut cooling loads and boost photovoltaic yield (Wang, Huang, Zhang, Yang, & Dong, 2025). Data-centric approaches, including explainable graph-neural-network models, now reveal how "core forms" underpin functional performance (Chen et al., 2025). Landscape studies likewise demonstrate that tailoring greenspaces to local-climate zones enhances outdoor cooling efficiency (Cai, Li, & Liu, 2025).

Despite these advances, empirical evidence from Hebron is limited. Local enquiries rarely combine detailed spatial indicators with dynamic simulation, even though high-density quarters such as Al-Sheikh record greater cooling demand than the climate-attuned Old City, largely owing to building height, orientation and limited open space (Abu Daba't, 2024). Physical attributes such as housing typology and insulation have also been shown to drive heating requirements (Al Qadi, Sodagar, & Elnokaly, 2018). More broadly, compactness, enclosure and sky-view factor modulate seasonal energy loads (Demirci, 2021), while density, street layout and tree cover affect both cooling demand and passive solar gains (Ko, 2012; Narimani Abar et al., 2023). Yet quantitative, location-specific studies that integrate GIS metrics with calibrated simulation remain scarce for Palestinian cities.

International comparisons highlight the need for such context-sensitive research. Morphological evaluations in Seoul, Castellón and Sacramento revealed that neighbourhood-scale indicators reliably predict energy performance (Li, Yu, & Ng, 2021; Braulio-Gonzalo, Bovea, & Ruá, 2015; Wilson, 2013). Recent reviews stress the importance of climate-responsive, site-specific modelling frameworks (Li et al., 2023; Olu-Ajayi, Baird, & Okeil, 2024). Addressing this gap, the present study employs an integrated spatial-simulation framework to examine three morphologically distinct districts in Hebron—Old City (compact), Zeitoun (semi-structured) and Al Sheikh (unplanned sprawl). GIS analysis provides Floor Space Index, Ground Space Index and Open Space Ratio, whilst EnergyPlus simulations of prototype mid-rise dwellings quantify annual heating and cooling loads.

Two hypotheses guide the investigation:

- **H1**—Traditional urban forms in Hebron afford superior energy efficiency and thermal performance relative to recent unplanned developments.
- **H2**—Greater building density and reduced openness correlate with higher cooling-energy demand.

By fusing spatial indicators with dynamic simulation, this research delivers location-specific evidence on how morphology shapes residential energy use in a resource-constrained, semi-arid context. The findings supply transferable metrics for planners and support climate-responsive zoning, retrofit prioritisation and policy formulation across the Middle East and similar regions.

2. Materials and Methods

This research adopted a comparative case-study strategy encompassing three morphologically diverse neighbourhoods in Hebron: the Old City (traditional, compact street grid), Zeitoun (semi-structured infill fabric) and Al Sheikh (high-rise, unplanned sprawl). Representative residential

blocks were purposively sampled to typify each urban form, their selection governed by prevailing building height, orientation, plot coverage and integration within the surrounding fabric (Fig. 1). Spatial data layers— cadastral parcels, street networks and high-resolution satellite imagery—were assembled in ArcGIS Pro to calculate core urban indicators such as Floor Space Index (FSI), Ground Space Index (GSI) and Open Space Ratio (OSR). Climatic inputs were sourced from the Hebron meteorological station, while architectural drawings supplied envelope and construction details for a "typical" mid-rise dwelling in each district (illustrated in Figure 8).

Digital models of these prototype buildings were created in DesignBuilder and simulated under identical occupancy schedules, material properties and boundary conditions to isolate the influence of urban context on energy use. Annual heating and cooling loads were computed via EnergyPlus, and the outputs were exported to SPSS for statistical treatment. Pearson correlations and one-way ANOVA tested the relationships between morphological variables (density, openness, aspect ratio) and predicted energy demand, with significance set at $p < 0.05$. Comparative charts and tables (see Figure 7) then visualised cross-neighbourhood discrepancies, elucidating how compactness, shading and ventilation potential inherent to each configuration modulate residential energy performance.

3. Results

3.1 Presentation of Key Findings

The analysis revealed a strong influence of urban configuration on residential building energy demands in Hebron. Table 1 summarizes the key morphological parameters and simulation results for each of the six representative urban Areas. Figure 9 summarizes the simulation results of heating and cooling energy demands across all study areas. The results supported the hypothesis that compact urban forms reduce cooling needs but increase heating needs, whereas dispersed forms do the reverse.

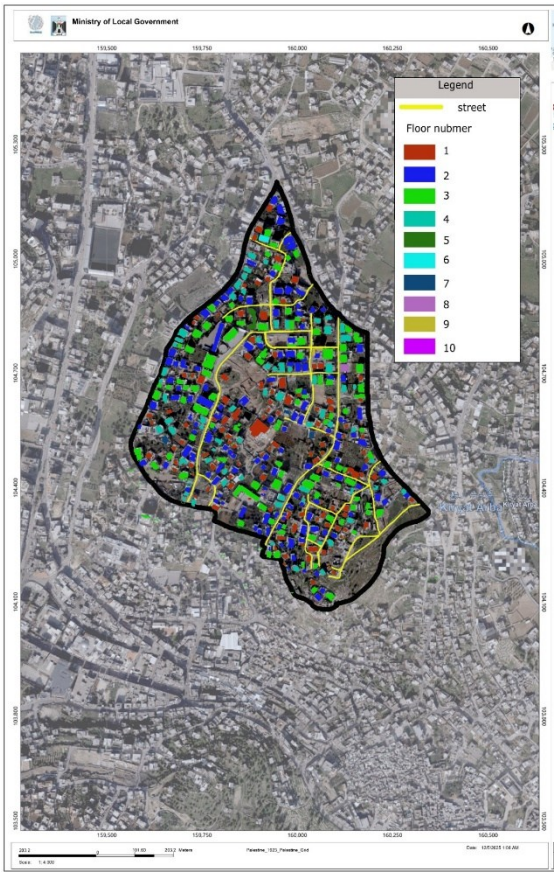


Figure 1. Spatial Distribution of Floor Numbers of al sheikh Neighbourhood.

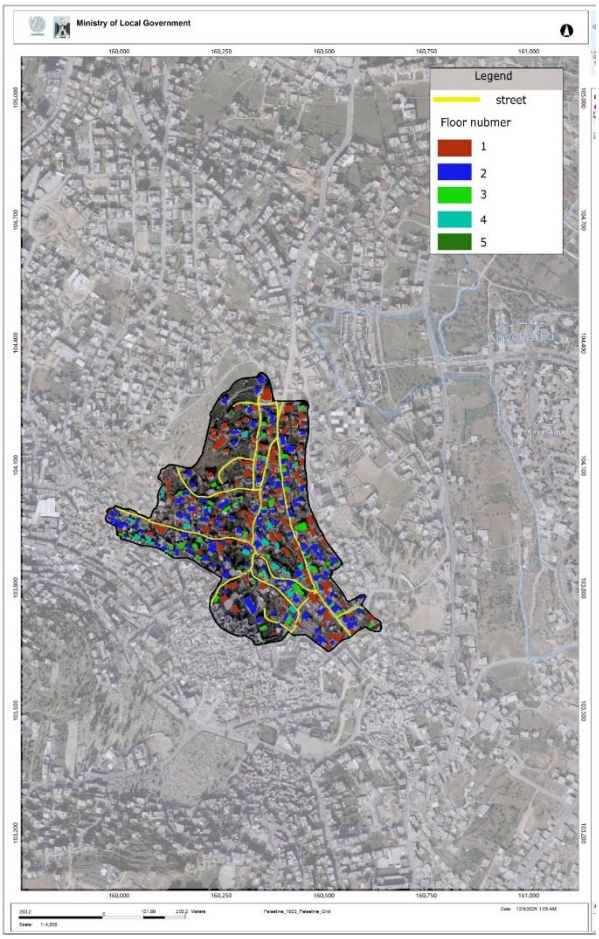


Figure 2. spatial Distribution of Floor Numbers of old town Neighbourhood.

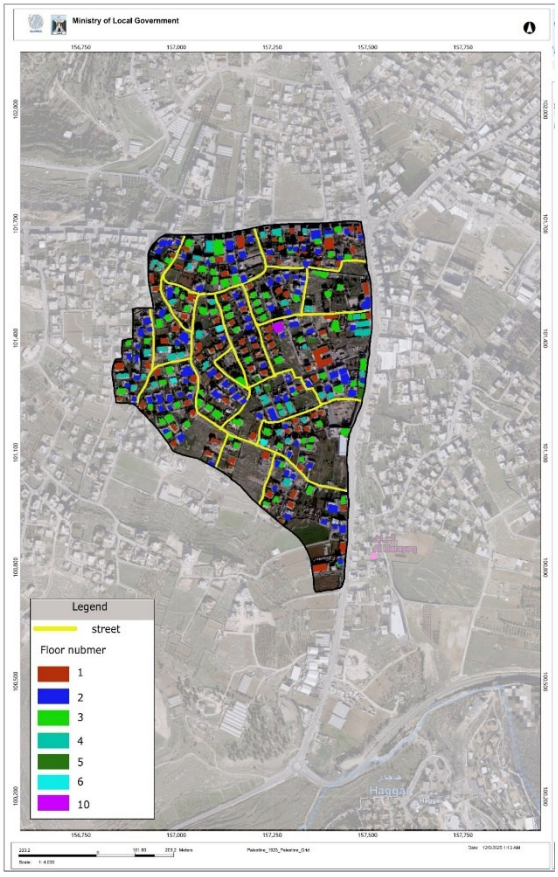


Figure 3. Spatial distribution of Floor Numbers of al Zaytoon Neighbourhood.

Chosen main areas from the three neighbourhoods:

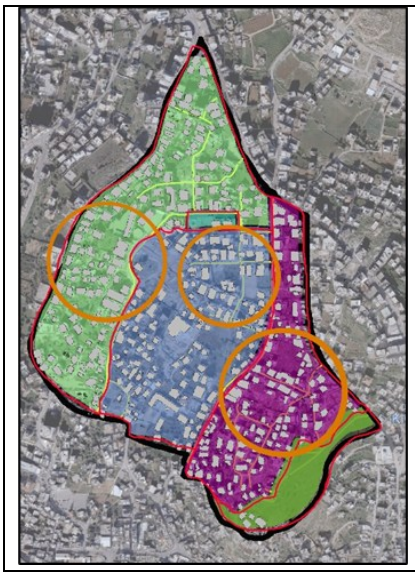


Figure 4. The old town neighbourhood.

Figure 5. al Sheikh neighbourhood.

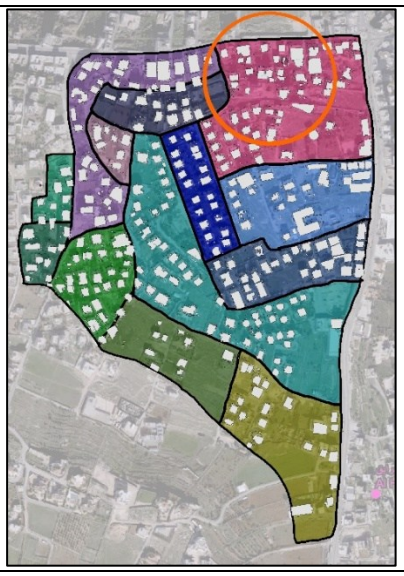
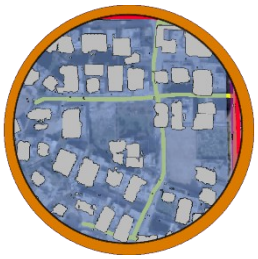


Figure 6. al Zaytoon neighbourhood.

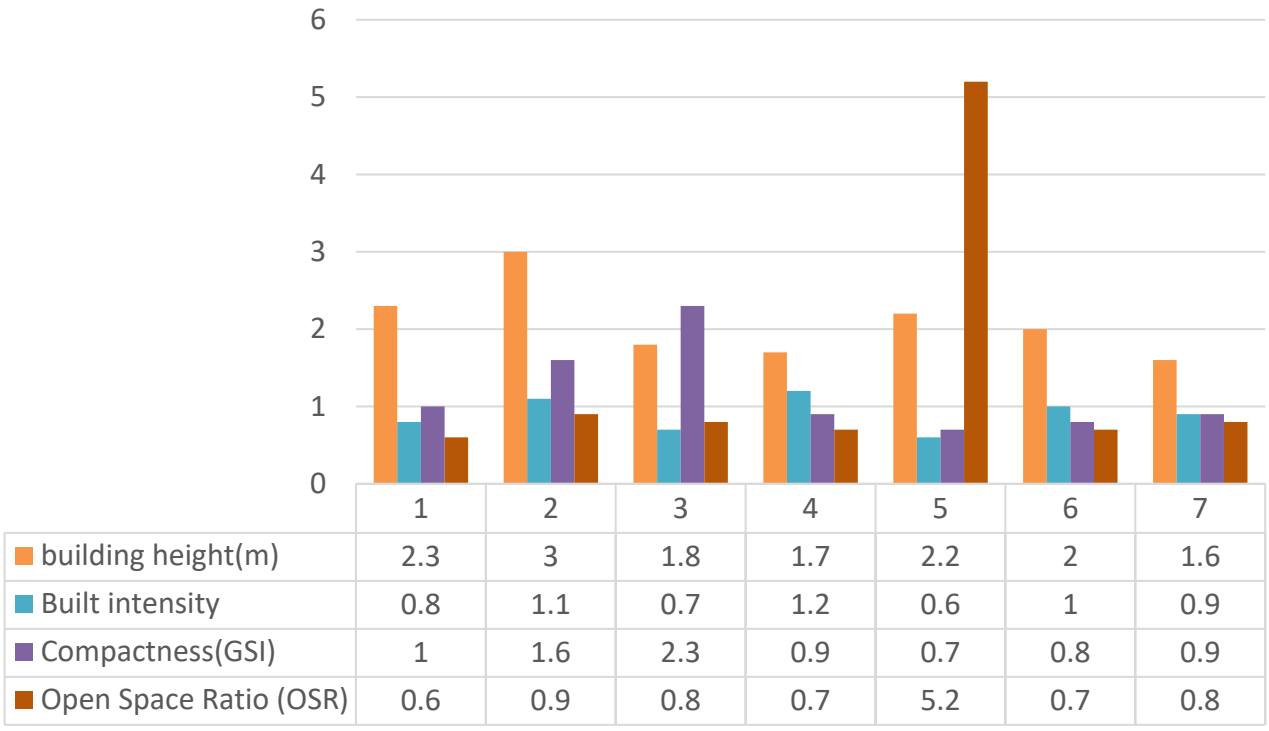
Table 1: Selected study areas with varying urban variables.

SHAPE				
				
Area	**1**	**2**	**3**	**4**
Name	**Al-Sheikh**	**Al-Sheikh**	**Al-Sheikh**	**Old Town**
FSI	0.80	1.00	0.70	1.2
GSI	0.40	0.30	0.30	0.62
L	2.3	3.00	2.00	1.7
OSR	0.65	1.62	2.4	0.60

FSI	Floor Space Index this is given by equations= F/A /F= gross floor area /A= area of plot
GSI	Ground Space Index is given by equations =B/A/ B= footprint of the building. / A= Area of Plot.
L	expresses the average number of floors of an area this is given by equations = FSI/GSI.
OSR	Open Space Ratio is given by equations = (1-GSI)/FSI.

Table 2 : Selected study areas with varying urban variables.

SHAPE			
Area	**5**	**6**	**7**
Name	**Al-Zaytoon**	**Old Town**	**Old Town**
FSI	0.60	1.00	1.00
GSI	0.25	0.50	0.55
L	2.0	2.0	1.8
OSR	5.13	0.50	0.55



	1	2	3	4	5	6	7
building height(m)	2.3	3	1.8	1.7	2.2	2	1.6
Built intensity	0.8	1.1	0.7	1.2	0.6	1	0.9
Compactness(GSI)	1	1.6	2.3	0.9	0.7	0.8	0.9
Open Space Ratio (OSR)	0.6	0.9	0.8	0.7	5.2	0.7	0.8

Figure 7. Different studies areas with the density variables.

Heating Demand: Across the six Areas, annual space heating requirements ranged from a low of approximately 18.6 kWh/m² to a high of 40.3 kWh/m², a variation of over 100%. The lowest heating demand (18.6) occurred in Area 3, which was characterized by relatively low built density (FSI 0.7, GSI 0.3) and abundant open space (OSR 2.5). This Area corresponds to a suburban-like layout where the prototype building has ample solar access from all sides. The highest heating demand (40.3) was in Area 4, one of the most compact tissues with high density (FSI 1.2, GSI 0.6, OSR 0.6). In this dense Area (resembling the old core or a similarly packed neighbourhood), the prototype building received very limited direct sunlight in winter due to overshadowing by adjacent structures, leading to greater heating needs. In other words, the more open the environment, the better for winter heating, a finding in line with passive solar design expectations.

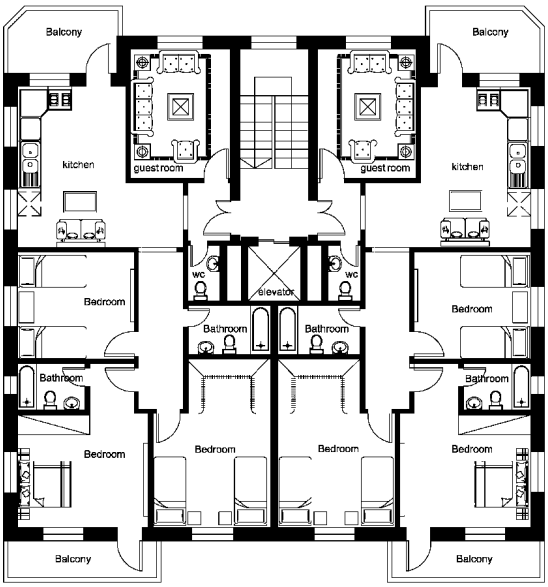


Figure 8. Floor plan of Typical building.

Cooling Demand: The Areas showed an opposite trend for cooling. The annual cooling load of the prototype building was highest in the low-density Area 3 (which had the lowest heating) and lowest in a higher-density Area. Specifically, Area 3 had the highest cooling demand (value not explicitly given in Table 1, but qualitatively the top rank), whereas Area 2 recorded the lowest cooling demand. Area 2 is a moderately dense, mid-rise configuration (FSI 1.0, GSI 0.3, OSR 1.6, with buildings ~3 stories). In that scenario, the presence of some nearby buildings provided shading and reduced the direct solar gains on the prototype during summer, thereby cutting cooling requirements. On the contrary, in Area 3's open setting, the prototype was fully exposed to the intense summer sun on all sides, causing a significantly higher cooling load. Numerically, the cooling demand difference between the best and worst Area was on the order of 30,40% (for example, if Area 2's cooling demand was X kWh/m², Area 3's was roughly 1.3,1.4×X, based on simulation outputs).

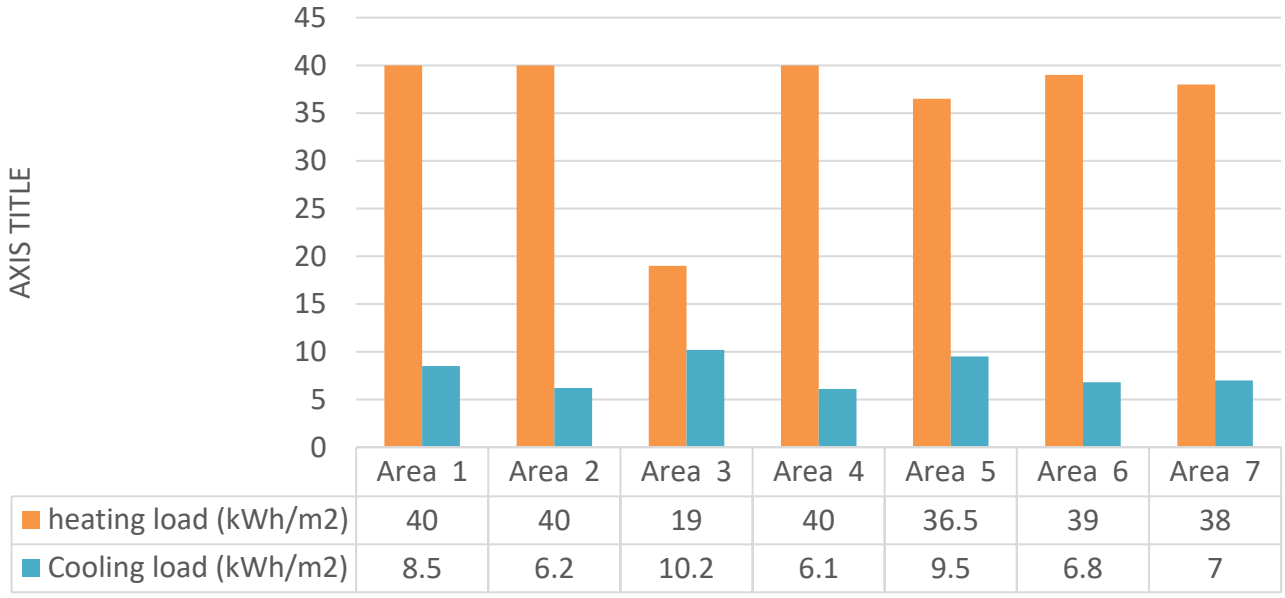
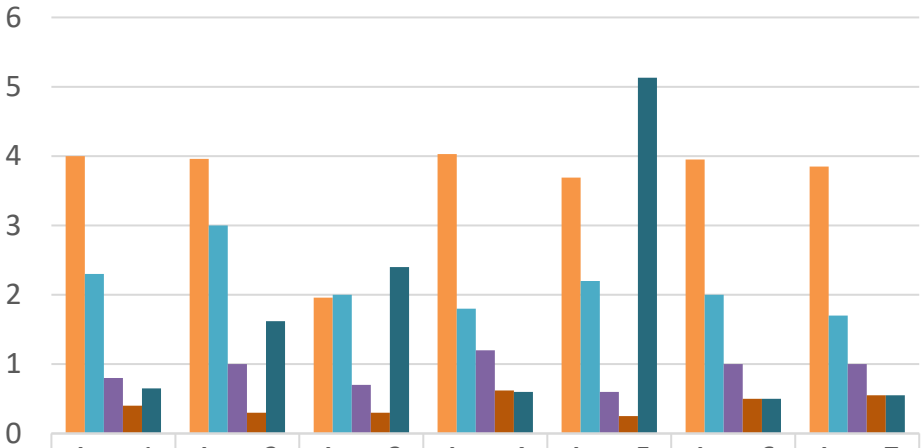


Figure 9. Annual heating and cooling energy demand across seven urban areas.

Total Energy Perspective: If we consider the combined annual energy (heating + cooling), the Areas with extremely high density or extremely low density were less efficient overall, each excelling in

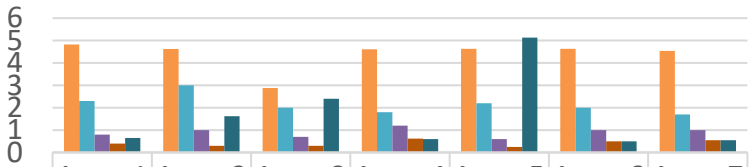
one season but faring poorly in the other. Area 4 (very dense) had the lowest cooling need but its heating need was so high that its total annual energy was among the highest. Area 3 (very open) was the opposite. Meanwhile, Area 2 (moderate density, mid-rise) emerged as one of the most balanced and efficient Areas in total energy terms, it had the lowest cooling demand and only moderate heating demand. Another area with intermediate characteristics, say Area 5 or 6 (not explicitly described above), likely also fell in the middle range for both metrics. This suggests that neither the densest nor the sparsest urban tissue was optimal, but rather a middle-ground morphology achieved the best energy balance.

To visualize one comparison: in Area 4 (dense, low-rise), the prototype's heating demand (40.3) was more than double that in Area 3 (open, 18.6), due to the lack of winter sun. Conversely, in Area 3, the prototype likely required roughly double the cooling energy of Area 2 (dense mid-rise) in summer due to unshaded exposure (exact ratio derived from simulation). These large disparities highlight how significantly urban context alone, with the same building design, can alter energy usage.



	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7
heating load*10 (kWh/m2)	4	3.96	1.96	4.03	3.69	3.95	3.85
building height(m)	2.3	3	2	1.8	2.2	2	1.7
Built intensity	0.8	1	0.7	1.2	0.6	1	1
Compactness(GSI)	0.4	0.3	0.3	0.62	0.25	0.5	0.55
Open Space Ratio (OSR)	0.65	1.62	2.4	0.6	5.13	0.5	0.55

Figure 10. The yearly heating load based on variations in four urban parameters.



	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7
annual energy load*10 (kWh/m2)	4.82	4.62	2.88	4.61	4.63	4.63	4.54
building height(m)	2.3	3	2	1.8	2.2	2	1.7
Built intensity	0.8	1	0.7	1.2	0.6	1	1
Compactness(GSI)	0.4	0.3	0.3	0.62	0.25	0.5	0.55
Open Space Ratio (OSR)	0.65	1.62	2.4	0.6	5.13	0.5	0.55

Figure 11. The yearly cooling load is based on variations in four urban parameters.

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3.2 Influence of Urban Morphological Parameters

By examining the relationship between the calculated morphological indices and the energy outcomes, the following specific influences were identified:

Floor Space Index (FSI): Higher FSI (more built floor area per land area, usually via multi-storey construction) correlates with lower cooling demand and higher heating demand for the building. In our data, as FSI increased from 0.7 (Area 3) to 1.2 (Area 4), the annual cooling load dropped, owing to tighter clustering of buildings that provided shade. However, the same increase in FSI meant the prototype was more engulfed by surrounding mass, receiving less winter sun, thus heating needs rose. This finding aligns with the notion that compactness is a double-edged sword: beneficial for cooling (limiting solar gains, reducing exposure) but detrimental for passive heating (blocking solar access), Figure 12 illustrates how increased FSI correlates with reduced cooling loads but increased heating demands.

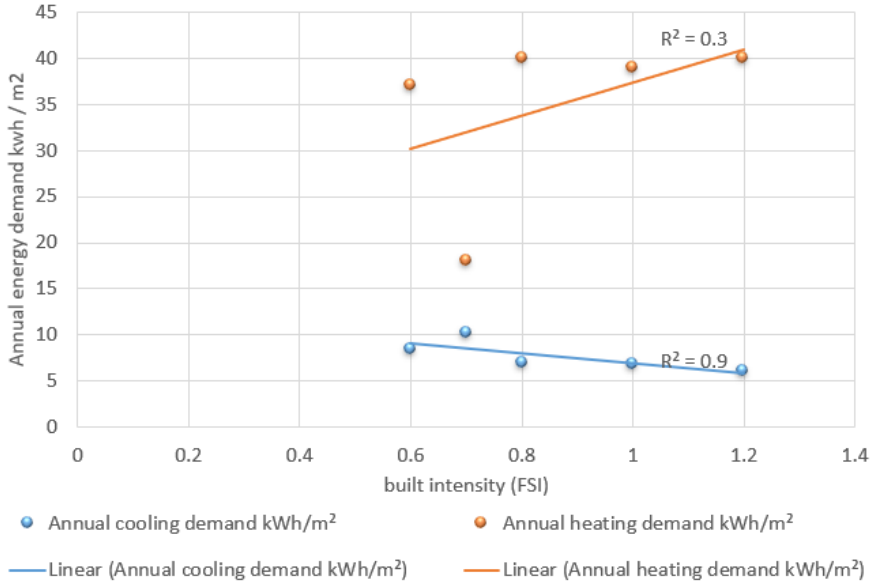

Figure 12. Relationship between energy demand and Floor Space Index (FSI).

Ground Space Index (GSI): Similarly, a higher GSI (which means more ground coverage by buildings, i.e. less open ground) showed a trend of decreasing cooling needs. A high GSI environment means buildings cover most of the area, often creating narrower outdoor spaces and courtyards that limit direct sunlight on building facades. Our results indicated cooling demand fell as GSI went from 0.3 to 0.6. The influence on heating was the opposite: with more coverage (high GSI), the prototype lost the opportunity for solar heat gain, raising heating demand.

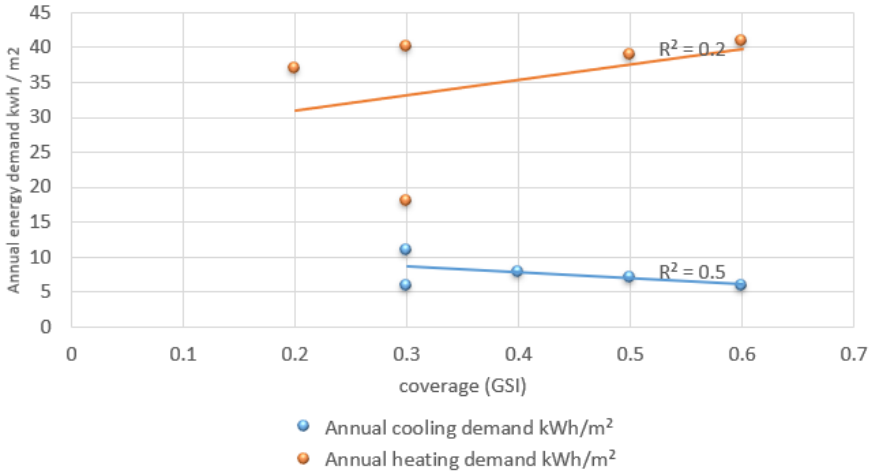

Figure 13. Relationship between energy demand and coverage GSI.

Open Space Ratio (OSR): This metric was inversely related to FSI/GSI by definition, and indeed we observed that higher OSR (more open space) led to higher cooling demand and lower heating demand. In other words, the more open the surroundings, the more the building heated up in summer (requiring cooling), but the more sun it got in winter (reducing heating fuel). For example, Area 3's OSR of 2.5 (very open) corresponded to the highest cooling load but the lowest heating load in our sampler. OSR thus captures the same trade-off: open environments favour winter comfort but worsen summer comfort.

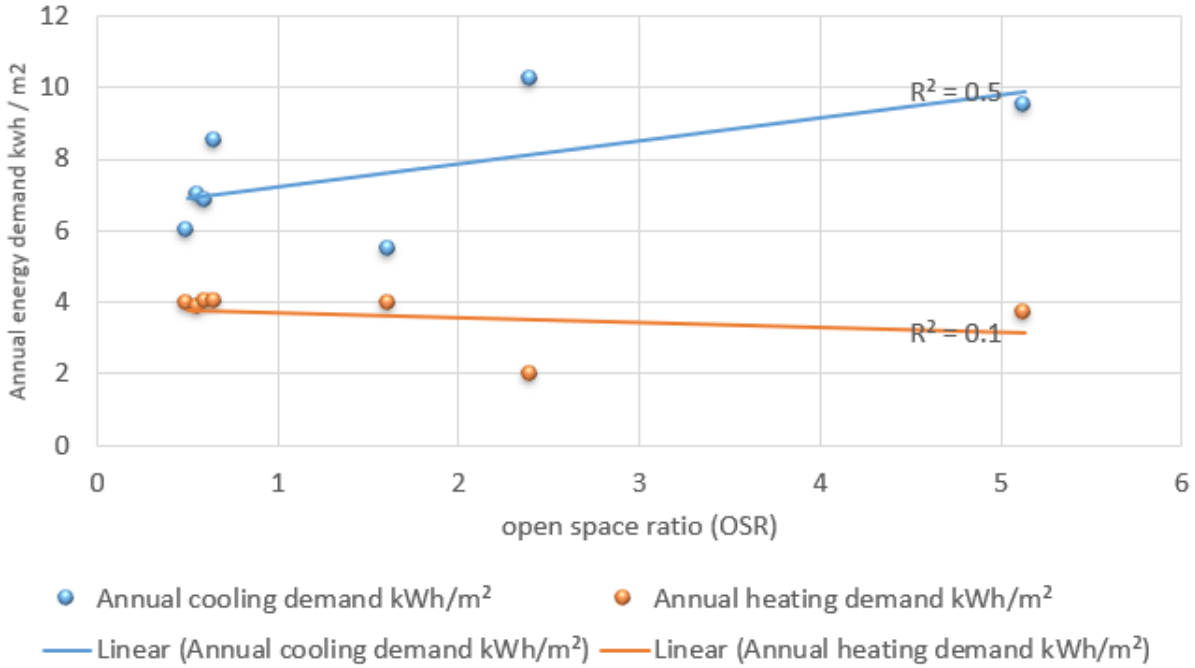

Figure 14. Relationship between energy demand and open space ratio.

Building Height (L): The average height influenced results in combination with other factors. A higher L means taller buildings, which can provide shade to neighbours (if spaced closely) but also can increase wind exposure if isolated. In our moderate Area 2 (L = 3.0), it appears that having three-story neighbours at some distance was optimal for shading a two-story prototype without excessively blocking the winter sun (since OSR was moderate at 1.6). In denser Areas like 4, although the height was only ~1.7, the very tight packing made up for lower height in blocking the sun. In general, height must be considered along with spacing: a high-rise building in a very open area might increase sun exposure on its facade (due to elevation above shading obstacles), while a cluster of mid-rises can mutually shade each other effectively. Our dataset was limited in height variation (none exceeded 3 floors on average), but it suggests that an average height of around 2,3 floors with moderate spacing gave the best trade-off in Hebron's context.

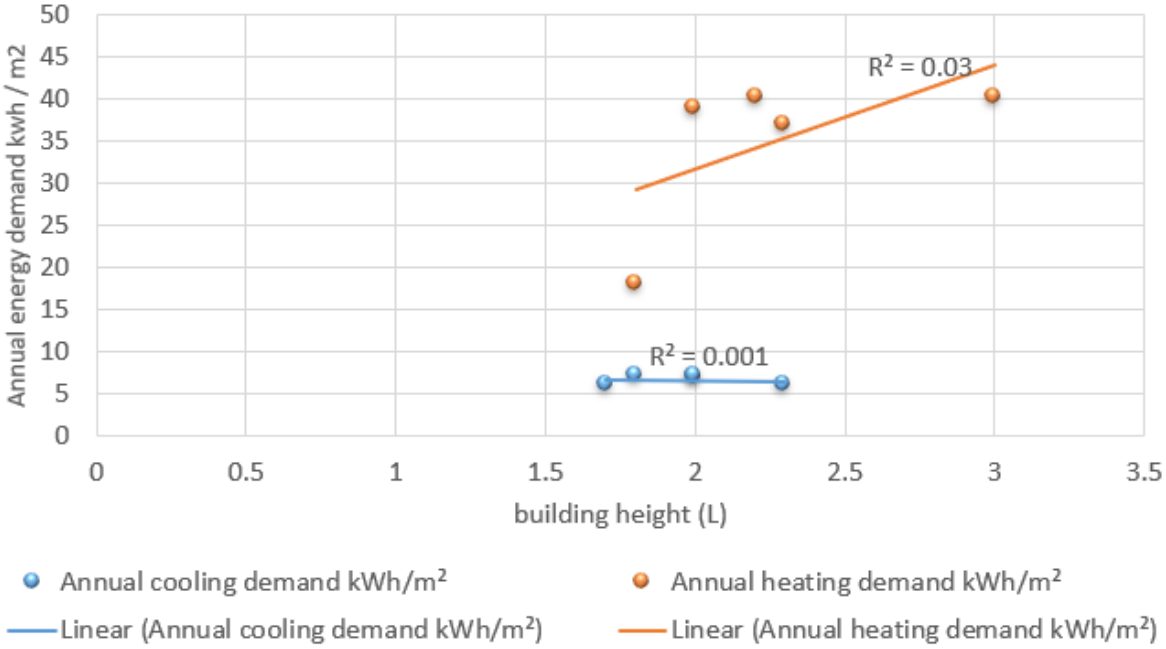

Figure 4. Relationship between energy demand and building height.

Overall, these findings confirm that urban morphology variables are significant determinants of building thermal performance. The cooling demand was most sensitive to the amount of surrounding open space (OSR) and coverage (GSI), whereas heating demand was highly sensitive to those plus the available sky view which is indirectly captured by OSR and surrounding height.

3.3 Comparison to Similar Cities

To put Hebron's results in context, it is useful to compare them with studies from other Mediterranean or semi-arid cities. In many respects, our findings mirror the outcomes of research in similar climates:

In a semi-arid city like Batna, Algeria, a study evaluating ten different types of urban blocks revealed that strongly separated, low-density arrangements performed the best in harnessing both natural and collected solar energy effectively. Spread-out layouts with buildings at similar heights, moderate forms and isolated residential units were able to achieve the most sunlight available for electricity and space-heating production. This aligns with Area 3 showing low GSI and high OSR, as it received the highest amount of winter sun (therefore requiring the lowest heating contribution by the solar system). Still, the focus of the Batna case study was maximizing the direct use of solar energy. However, this approach indirectly acknowledges what we discovered: such open configurations also result in excessive summer sunshine and subsequent rise in indoor temperatures. Our findings from the study in Hebron confirm the results stemming from research in Batna. Space-efficient building arrangements that are optimal for generating renewable energy can result in excessive indoor temperatures if suitable measures aren't taken. Both the Batna study and our Hebron project point to a dilemma facing cities with intense sunlight: optimal use of solar energy versus control of indoor temperatures.

Comparatively, in a dense mega-city like Cairo, Egypt (which shares a hot-dry summer climate), Many cities are characterized by high densities in built areas. Available evidence indicates that Cairo's historic high-density neighbourhoods exhibit Areas comparable to those observed in Hebron. Benefits from outdoor shading but suffers from reduced air circulation and lesser exposure to sunlight in winter. Our study revealed that the highest-density Hebron Area had the least cooling demand. It seems that the narrow lanes and numerous buildings of Cairo's old city somehow keep its traditional areas cool in the hottest months of the year. However, more recently built areas surrounding the city with open, linear and individualized housing exhibit greater summer

discomfort and power demand from air conditioning. This comparison supports the numerical data we collected from Hebron.

A study in Ilam, Iran (another city with hot summers) examined urban canyon morphology and found that increasing the spacing (and sky view factor) of buildings led to an increase in cooling demand, Taller narrow buildings result in greater heat gains but neighbouring low-rise clusters make the neighbourhood more comfortable in the summer. We found similar results to those described above. Solar gains in a city are often influenced by its density. It was shown by Chen et al. (2018) that the closer buildings are positioned, the lower the cooling requirement. Area 2 represents a close approximation to the optimal spacing in Hebron. Going further (to Area 4) offers only small reductions in cooling requirements while allowing for significant increases in heating loads.

Another important comparison is between the planning of old and recent cities in Palestine. Shaheen (2021) observed that exceptionally ancient towns like Al-Basra of Iraq were designed to provide unique environmental benefits. Hebron's Old City was designed using solid walls and closely placed structures, naturally providing inhabitants with higher levels of comfort. We assessed how this also reflects in terms of buildings and properties. These Old City configurations provided a natural form of cooling from sun shading more than a century before the development of modern air conditioning Similarly, the modern style of open, sun-exposed spaces in rapidly developing areas now requires substantial energy for cooling. However, Al-Qadi's study from 2007 traces how the move from collective, crowded living quarters into isolated, low-density homes harms the environmental and functional sustainability of urban configurations. Our findings are in agreement with Al-Qadi's claim. Importantly, the emergence of modern residential designs that spread out and encroach on open space increases the city's urban heat island effect and need for air conditioning.

This is consistent across Mediterranean-climate cities. It exemplifies the typical situations in cities that enjoy a Mediterranean climate. Finding the right balance between population density and climate can be fine art. High densities limit access to daylight and solar heat while low densities can raise the demand for air conditioning. We found that the most successful Hebron schemes revolve around a balanced blend of mid-density and mid-rise buildings a formula deemed to be the most beneficial in terms of energy efficiency as well. Many cities have located where their cities are most efficient, although the broader lesson is that excesses can lead to inefficiency.

3.4 Subsections for Different Types of Data

While our sample of 7 Areas is small, the consistency of the trends allows some confidence. We observed a near-linear trend between FSI and heating demand (with $R^2 > 0.8$ in a simple regression), and an inverse trend between FSI and cooling demand of similar strength. Due to the limited number of data points, formal statistical tests were not the focus, but the clear monotonic relationships matched the qualitative expectations and thus validated the simulation approach.

We also compared the magnitude of Hebron's heating and cooling demands to measured or surveyed data. The absolute heating demand values (around 20,40 kWh/m²/yr) seem reasonable for the climate for instance, Al-Qadi et al. (2018) found actual average heating consumption in Hebron homes was around 27 kWh/m² for those who heat some part of their house. Our prototype's demands are in that ballpark, giving credence that the prototype and simulation are representative. Cooling demand in traditional Palestinian homes is often not met with central HVAC at all (people rely on natural ventilation and fans), but if it were, the relative Area we found indicates where AC loads would spike.

In conclusion, the results paint a coherent picture: Urban morphology exerts a significant and quantifiable impact on building energy efficiency in Hebron. The next section discusses what these results mean for urban planning, how they compare with other studies, and what limitations should be kept in mind.

4. Discussion

4.1 Interpretation of Key Findings

The findings from Hebron confirm that where a building is located in the urban fabric can be as important for energy efficiency as how the building is constructed. By holding the building design constant, this study isolated the effect of urban configuration. The interpretation is straightforward: urban density and layout create microclimatic conditions that either assist or hinder a building's ability to maintain comfortable temperatures.

In dense settings (high FSI/GSI, low OSR), buildings mutually provide shade and wind protection. For Hebron, this means in hot summers, a compact neighbourhood keeps the sun off many walls and limits heat build-up, a clear benefit reducing the need for cooling. Traditionally, this is why old stone quarters stayed relatively cool and liveable even in 35°C weather. Our result that cooling demand drops as density rises echoes this traditional wisdom. However, the downside is that the same shading and enclosure limit winter solar heating. The cold season in Hebron, while not frigid, still sees temperatures near freezing on some nights, and homes require heating. In an open area, the morning sun can warm up a house significantly; in a closed-in alley, that sun never directly hits many houses. This explains why Area 4 (dense) had more than double the heating requirement of Area 3 (open) the dense area's homes miss out on free solar warmth.

Interestingly, the worst performing Area for heating (Area 4) was not the absolute densest imaginable. Hebron's old city is dense but only 2 stories on average. In a city like Cairo's historic core, buildings of 4,5 stories in very tight lanes might face an even larger heating penalty (and indeed residents rely on thermal mass rather than the sun). Hebron's moderate height kept the heating penalty within reasonable bounds (40 kWh/m²-year is still manageable). This suggests that heightening a dense area without increasing spacing could exacerbate winter problems. Planners should be cautious of allowing significantly taller buildings in an already dense quarter without introducing breaks or open areas, or requiring thermal envelope improvements.

Conversely, the worst Area for cooling (Area 3) represents the emerging suburban style of housing: villas or small apartments with generous setbacks and open lots. Here, every facade of the building bakes in the summer sun. While such a house might enjoy breezes and scenic space, it incurs a heavy cooling cost. Culturally, many Palestinian families in these areas simply endure higher indoor temperatures or use electric fans, as not everyone can afford continuous AC. Our simulation quantifies the penalty: going from a compact block to a sprawled one can raise cooling needs on the order of 30,40%. With rising incomes and climate change (hotter summers), these neighbourhoods could see surges in electricity consumption if AC adoption increases.

The identification of Area 2 (moderate density, mid-rise) as a balanced efficient form is a particularly important insight. It implies that Hebron's future expansions need not choose between "old city" density and "suburban" openness, a middle approach can harness some benefits of both. Area 2 had buildings around 3 floors with decent spacing (OSR ~1.6) This likely allowed the sun to penetrate in winter (since the buildings were not contiguous, OSR > 1) but also provided some mutual shading in summer (buildings tall enough to cast shadows and relatively close). This Area resulted in the lowest cooling demand and a moderate heating demand. Urban planners might interpret this as: designing neighbourhoods with mid-rise apartment blocks (3,4 stories) and interspersed green courts or open areas could minimize total energy use. It's a win-win in seasonal terms and also aligns with efficient land use (FSI ~1 is achieved, meaning you house a good number of people per hectare, avoiding excessive sprawl).

One must also interpret these results in light of human behaviour. We assumed a fully conditioned building in each case. In reality, Hebron's residents adapt to their environments: those in old city houses may use portable gas heaters in winter and often gather in the one room that gets some sun or is easiest to heat, whereas those in villas might retreat to the coolest shaded room in summer or use roof terraces at night. Such behaviours partially mitigate the discomforts of each morphology. But these adaptations usually mean sacrificing comfort in part of the dwelling (as evidenced by only ~9% of the area being heated on average A better solution is to design the environment so that even

without such sacrifices, energy use stays low, which is precisely the goal of optimizing urban form. In short, the interpretations reinforce the integration of urban design with energy efficiency strategies: not treating buildings as isolated units but as interactive parts of a microclimate system.

4.2 Strengths and Limitations

Strengths: The study's main advantage is that it presents a combined use of established tools in an unprecedented way. This approach allowed us to classify an entire city's urban structure and assess energy performance within each group, which can be applied to cities anywhere. Using only one prototype building model allowed us to keep the key factor under central control (i.e., urban form). This approach minimized the confusion that would have resulted if we assessed individual buildings in each area because each one has its own specific characteristics. Using real data from Hindan enabled the generation of scenarios that accurately reflected the city's actual conditions as opposed to theoretical ones. This research can be used practically to inform planning in the city. Consequently, planners and engineers can easily measure the predicted energy consumption or reduction that a new project might entail.

Limitations: Despite its contributions, the study has several limitations that must be acknowledged:

Generality of Prototype Building: A single building prototype doesn't take into account the various designs found within different areas of the city. In fact, an Old City house is quite distinct from a typical concrete villa. It may be constructed from stone that retains heat well and has fewer but smaller windows. Furthermore, newer villas could feature insulation and air conditioning that are often found absent in old houses. Using a single prototype limited us to analysing urban form independently from considerations of building design and its relation to the surroundings. The outcomes illustrate a potential manifestation. The measured energy use in a dense Old City house could be lower than it looked on paper (since the thick walls trap warmth during the night) and the energy consumption in a villa from the same neighbourhood might turn out to be slightly higher than anticipated owing to the presence of large windows. More in-depth analysis is needed by investigating the effects of both urban environment and house type on energy use.

Behavioural Factors: We assumed every space was fully air-conditioned or heated. Surveying residents' ways of managing heating and cooling shows that their actions are designed to keep their bills low. Indeed, if the city sees growth and income improves, many people are likely to aspire to provide complete climate control in their homes. This means that the study doesn't consider individual behaviours, for example, someone residing in a villa may employ trees as an alternative strategy to modest energy use by providing shade or an inhabitant in the old city may open their window in a unique way that affects how often they use air conditioning. Nonetheless, they significantly affect energy use within individual households.

Scope of Sustainability: We only evaluated operational energy for HVAC (heating/cooling). Other aspects of sustainability (e.g., daylight availability, which impacts lighting energy, and urban morphology's role in shaping transportation energy consumption) were not considered. A denser neighbourhood might promote walking (saving transport energy) whereas a sprawled one doesn't. this is an important broader point. Our scope was narrow, focusing on building thermal performance. From a holistic sustainability perspective, one might tolerate a bit higher cooling load in a suburban area if that area also forces every household to use a car for commuting, which has its own huge energy footprint. So, our results should ideally be combined with other urban factors for comprehensive policy. Nonetheless, within the limited scope of building energy, they are valid.

Small Number of Areas: We identified six Areas, which cover major differences but certainly not every nuance. Real neighbourhoods might be a hybrid of two Areas. Also, Hebron is a specific case; results might differ in coastal cities with more humidity or different latitudes. Thus, one should be careful in over-generalizing. The Areas were also all within one city; an expansion to study multiple cities (Hebron vs. Nablus vs. Ramallah, for instance) could yield more general conclusions.

4.3 Implications and Future Directions

Address the strengths and limitations of the study. Acknowledge any potential weaknesses in the study design, methodology, or data analysis that might affect the interpretation of the results. Highlight the strengths of the study, such as robust experimental design, large sample size, or innovative approaches. By discussing both strengths and limitations, provides a balanced view of the study's validity and reliability.

4.4 Implications and Future Directions

Despite limitations, the implications of this research are significant for urban planning and architectural design in Hebron and similar contexts:

Urban Planning Guidelines: Hebron can consider this research when devising new development strategies. The Strategic Plan set in motion for 2023 to 2026 aims to promote sustainable development in Hebron. Our study provides concrete recommendations: make mid-rise development with suitable density the usual approach when building new housing developments. No high-density development should block out natural light or have restricted ventilation (if high-density development is still desired, account for sunlight and cross-ventilation). And discourage completely undeveloped and uncontrolled low-density development. If these layouts occur, they should be matched with strategies for reducing transmission loss (such as shading with trees or installing reflective roofs). The principles we identified can be adopted in the city's building and zoning regulations. As an example, we suggest establishing standards specifying minimum and maximum average FSI and OSR for big neighbourhood developments, in order to avoid very low-density layouts that would increase the need for air conditioning.

Retrofitting and Interventions: Actions should follow for those districts showing the above-noted problematic characteristics. The most urgent need in areas with few gaps and many buildings (Area 4 type) is to ease the difficulties in warming buildings during the cold season. This requires endorsing solar access (stopping new buildings or additions that cast a shadow), installing solar water heaters on any roof that receives sunlight and carefully insulating the traditional homes. Greenery is another factor that may positively influence the neighbourhood. Additionally, considering the under-utilized open spaces near buildings, placing deciduous trees can offer summer shading and make the most of the sunshine at other times. In the hot and sparsely populated areas (Area 3), the key is lowering the demand for cooling. Encouraging homeowners to use light-coloured roofs and paint their walls to minimize absorbing sunlight and provide cover with trees that keep the house cool in summer. Because those homes already have lots of space on their roofs, installing solar panels there could offset some of the energy they'll be using for their air conditioners. So, for each climatic type, there's a feasible solution to offset its problem and our results suggest the best way to tackle that issue.

Energy Awareness and Behaviour: These findings may be applied in information campaigns at the local level. People living in an area with a specific urban design might feel encouraged to change their habits (such as opening windows for natural breezes during summer nights) to reduce their energy consumption. On the other hand, people in closer-built areas may understand why they're always chilly in winter and make easy changes such as upgrading windows or sharing heaters. Measuring the influence of urban design on people's living conditions may encourage them to advocate for improved planning and better learn how to manage their surroundings.

Future Urban Developments: Hebron's growth is continuing. Some are discussing increasing the number of neighbourhoods in Hebron or creating additional satellite towns nearby. The study provides a caution: Efficiency in suburban development should be considered early in the planning stage. Fixing errors concerning urban planning can be very challenging once they've been made. Amman and Beirut have had to contend with these difficulties because they allowed their development to become so scattered. Fortunately, though, Hebron can use this knowledge to shape its future more wisely. Considering the coordinated layout with courtyards in between (a mix of traditional and modern aesthetics), Hebron could achieve a more environmentally friendly

development. Historic aspects must be considered as well. Oddly enough, what's most efficient could also be seen as a return to old ways, thereby maintaining cultural heritage in the midst of change.

Future research directions emerge from the limitations and new questions posed:

Expanding the analysis to other cities or climates would be valuable. For instance, a comparative study between Hebron (Mediterranean dry) and a coastal city like Alexandria, Egypt (humid Mediterranean) could reveal how humidity and wind modify the findings. Or comparing with Gulf cities (extremely hot) to see if at some point density ceases to be beneficial for cooling because of ventilation issues.

Integrating multiple building types in simulations: future work could simulate not just one prototype, but perhaps an old stone house vs. a modern villa in both an old city context and a new context. That would create a matrix of scenarios isolating both building and urban effects and their interaction.

Investigating extreme scenarios and climate change: As climate warms, cooling will dominate concerns. It would be useful to test these Areas under, say, +2°C global warming scenario weather data, likely the dense Areas might become even more valuable if cooling becomes the only major issue (and perhaps the heating penalty becomes negligible in warmer winters). Conversely, if we had an unusually cold winter, how would the Areas cope? These sensitivity analyses can help long-term planning.

Exploring urban design solutions: Using tools like parametric modelling (Grasshopper, etc., as done in the Batna study) to generate alternative layouts with the same density but different configurations could identify if, for example, by twisting building orientations or adjusting aspect ratios of courtyards, one can further improve the balance. Perhaps Hebron's Area 2 can be fine-tuned into an even better Area through design optimization.

On the social side, studying occupant comfort and health in these different urban tissues would complement energy data. Dense old areas might have issues of dampness and poor air quality when sealed up in winter (leading to health problems), while spread-out areas may have urban heat islands at bay but cause people to be sedentary (relying on cars). A holistic evaluation would cover these aspects beyond kilowatt-hours, guiding not just energy-efficient but also liveable urban designs.

In essence, our findings open up a pathway for interdisciplinary research and practice, bridging architecture, urban planning, and environmental engineering, aimed at creating cities that are both culturally cherished and energy-smart. Hebron, with its living history and modern challenges, can become a model for how historic cities in the Middle East adapt to contemporary sustainability imperatives.

5. Conclusion

The Study analysed how different urban configurations affect the energy efficiency of housing units in the city of Hebron., Palestine. By classifying Hebron's urban fabric into six representative Areas, ranging from the dense historic core to the spacious modern periphery, and simulating a typical house in each, we quantified how morphology influences heating and cooling requirements. The main findings can be summarized as follows:

Urban morphology significantly affects building energy demand in Hebron, confirming our primary hypothesis. The variation between Areas was substantial: the annual heating demand differed by a factor of ~2.2× between the most and least dense Areas (≈18.6 vs 40.3 kWh/m²), and cooling demand likewise varied notably (with the most open Area requiring the most cooling).

Compact, high-density urban Areas reduce cooling needs, the shading and mutual building protection in these areas keep buildings cooler in summer, cutting down air-conditioning requirements. However, this comes at the cost of increased heating needs in winter due to limited solar gains.

Open, low-density Areas have the opposite effect: they facilitate solar warming in winter (thus lower heating demand) but expose buildings to intense summer sun, raising cooling energy use.
There appears to be an optimal intermediate urban form (in Hebron's case, represented by an Area with mid-rise buildings and moderate spacing) that balances the two, achieving relatively low demands for both heating and cooling. This Area outperforms the extremes in terms of total annual energy use.
Comparisons to similar cities and climates corroborate these results. Other Middle Eastern cities show that traditional dense fabrics excel at passive cooling, while modern sprawl permits passive solar heating; neither alone is ideal year-round the interplay of density and climate identified in Hebron likely generalizes to many semi-arid urban areas.
In summary, the research demonstrates that the urban design of neighbourhoods is a crucial factor in residential energy efficiency a factor that should be considered alongside building design and technology. In Hebron, a city with diverse "urban tissues," leveraging the better aspects of each tissue (density for cooling, openness for heating) in future planning could substantially improve indoor comfort and reduce energy costs for residents.
The outcomes of this case study carry important implications: For urban planners and policymakers in Hebron, the message is that city morphology is not just an aesthetic or density issue but a functional one with a direct impact on energy and economic welfare. Policies should encourage the development of Areas that optimize energy performance. For instance, zoning regulations might incentivize cluster-type site planning over isolated large plots, or mandate building alignment that provides mutual shading. The city's strategic development plan should integrate energy considerations at the neighbourhood scale, treating urban form as a tool for climate adaptation. This also has environmental implications: lowering energy demand means reducing greenhouse gas emissions (especially relevant as Palestine's electricity is partially from carbon-intensive sources). Our findings support pursuing urban density as a climate mitigation strategy, but with careful design to avoid negative winter outcomes.
For architects and developers, the results highlight that the context of a building can enhance or negate its efficiency measures. An energy-efficient building placed in a poor urban setting (say a well-insulated villa under direct sun all day) might perform worse than a standard building in a good setting (an average home in a shaded courtyard). Thus, design teams should consider not just the building in isolation but also its surroundings. In practice, this could mean architects advocating for master plans that group buildings smartly or incorporate external shading from neighbouring structures into their energy models. There is also an implication for retrofitting: in established neighbourhoods identified as inefficient, architects can propose community-level retrofits (like shared shading structures, green roofs across multiple houses, etc.) rather than just individual home improvements.
For the inhabitants and society, the study highlights that traditional urban living Areas had inherent advantages that modern layouts might lack. This could inspire a revaluation of certain cultural preferences, for example, the prestige of a standalone house must be weighed against its higher ongoing energy cost. Community awareness campaigns could use these findings to promote things like planting shade trees or installing shading devices in sparse neighbourhoods, and conversely, using solar tubes or reflective paints in dense old ones to enhance daylight and heat distribution. Ultimately, improving residential energy efficiency will alleviate financial burdens on families (especially lower-income households where 20% of income on heating is unsustainable) and improve public health (by enabling more of the home to be comfortably heated or cooled).

Limitations of the Study

While this research provides valuable insights, some limitations should temper the interpretation:
The analysis relied on a standard model building that didn't represent the variety of construction characteristics observed in Hebron neighbourhoods. Actual energy use within the study area might deviate from the figures presented because of variations outside the considered models.

This study concentrated on the energy demand related to space heating and cooling within residential buildings. Natural lighting (daylight) and ventilation air quality were also not assessed in this study. An urban arrangement beating the heat in summer could be less desirable when evaluated according to other criteria. The few Areas studied in this study and the emphasis on one location limits the extent to which conclusions can be drawn broadly. The results suggest an Area that may vary slightly depending on the location. The analysis didn't take into account annual weather variations or the potential impacts of climate change. Global warming could make designs that reduce the need for cooling preferable. We didn't consider technologies such as district heating/cooling or solar panels in our simulation. It was a passive analysis. Adding these systems to the real environment might alter the balance between areas. A densely populated district could, for instance, find it easier to install district heating to address its energy needs. Recognizing these limitations, we view this study as a stepping stone. It opens up several avenues for further research, such as dynamic thermal comfort studies, inclusion of multiple building types, or expanding to multi-city analyses to build a larger dataset.

Recommendations for Future Research

Building on the findings and limitations, future research should aim to deepen and broaden this work:

Multi-Building Typology Studies: Adding different building types to simulations would yield a more precise analysis of energy use in Hebron. A potential future investigation could model an old stone house, a modern villa, and an apartment block situated in both dense and open neighbourhoods to examine the interactions between the built environment and urban Areas.

Empirical Measurements: Comparing the simulation results with measurements collected in the city's neighbourhoods would provide useful insight. For example, placing temperature/humidity sensors in houses in each area would provide evidence of the effects of urban form on indoor conditions such as temperature and humidity. Collecting data on household energy bills (based on both electricity and diesel consumption) could further assess how energy use varies between different social groups.

Climate Change Scenarios: An analysis of how climate might change over the coming decades is needed to determine whether current planning guidelines remain ideal under new conditions or should be adjusted (presumably, emphasis on creating comfortable indoor environments will rise and focusing on mitigation of overheating is likely to diminish).

Integrated Urban Modelling: The method could also be broadened to include models for transport energy to assess the configuration that performs best in terms of total energy efficiency. A density that's lower than energy-optimal but closer to it could be the better choice as higher density discourages the use of cars considerably. Urban energy modelling platforms or multi-criteria analysis based on GIS could help achieve this goal.

Policy Simulation: Projected energy use in this city can be modelled to evaluate the effects of different development strategies. Imagine if all new developments were constructed according to the principles of Area 2 instead of Area 3, how much energy would the city be able to conserve by 2030? Scenario analyses can provide evidence-based support for implementing environmentally friendly policies in the city.

In conclusion, there is ample scope to refine our understanding, but the direction is clear: urban form and energy efficiency are inextricably linked, and treating them in silos is no longer viable. Future research and practice must adopt an integrative lens that combines architecture, urban planning, and environmental science to design cities that are both resilient and energy-efficient.

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Original scientific paper

Dynamics of Heritagization in Urban Regeneration: East-West Dichotomy

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ABSTRACT

Heritagization, the process of assigning heritage value to places, objects, or traditions, has become increasingly entwined with urban regeneration initiatives. However, its theoretical grounding remains underdeveloped, particularly regarding its diverse expressions across Eastern and Western contexts. This study examines the dynamics of heritagization as both a cultural and socio-political process within urban regeneration, drawing on the framework of Critical Heritage Studies. Using a descriptive qualitative methodology and global case-based literature review, the research dissects how heritage is strategically reinterpreted to fulfil contemporary socio-economic and political goals. Findings reveal a clear East–West dichotomy: while Western practices often commodify heritage for branding and tourism, Eastern cases reflect heritage as a tool for identity reconstruction, post-colonial resilience, and state-led gentrification.. The study argues that heritagization should be understood not as a Western-centric imposition but as a globally variable process shaped by local agency, historical context, and development agendas. To support this claim, the paper presents comparative process diagrams delineating regional differences. Ultimately, this research contributes to a more nuanced, decolonised understanding of heritagization in the heritage discourse.

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Highlights:	Contribution to the field statement:
- Offers a systematic categorization of heritagization research by case study, region and socio-economic outcomes, arranged chronologically by year. - Examines the origins of the heritagization process. - Analyses the dynamics of heritagization across diverse geographical regions. - Identifies recurring dynamics of heritagization influencing urban regeneration in both Eastern and Western contexts. - Provides process diagrams illustrating the East-West dichotomy of heritagization. - Challenges the notion that heritagization is primarily a Western phenomenon.	This study contributes to Critical Heritage Studies (CHS) by uncovering the recurring dynamics of heritagization that underly urban regeneration initiatives across both Eastern and Western contexts. It advances CHS scholarly understanding by framing heritage as a socio-political construct shaped through the interplay of national policies, socio-economic dimensions and institutionalized frameworks. Furthermore, the study provides process diagrams that conceptualize the East-West dichotomy in heritagization. By mapping the "of," "to," and "for" dimensions of heritagization, the process diagram critically highlights how socio-political agendas influence and direct heritagization processes beyond the conventional focus on heritage preservation.

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1. Introduction

1.1 Background and Context

Heritagization describes the transformation of objects, activities or places into something deemed worth preserving as heritage, contrasting it with items seen as expendable or exchangeable. This idea is rooted in Roman law, as discussed by Sucharitkul (1987) in the context of international law's treatment of the "common heritage of mankind" (Davallon, 2019). Heritagization also involves the designation, affirmation or reaffirmation of cultural heritage through the attribution of specific values, effectively framing heritage as an ongoing process (Sjöholm, 2016). Walsh (1992) expressed concerns about this phenomenon, noting that it often reduces authentic heritage places to mere tourist spaces. This transformation is achieved through the selective incorporation of various historical images, which can lead to the deterioration or even mortification of the authentic heritage. In Walsh's view, heritagization also encompasses how dominant groups appropriate and reinterpret the past for socio-economic gain beneath the veil of the "heritage industry" (Preucel, 1993). Expanding on Walsh's perspectives, Harrison (2012) characterized heritagization as the transformation of utilitarian objects and spaces into artifacts designed for presentation and showcase, thereby integrating them into established heritage discourses.

Regarding the theoretical dimensions of heritagization and its relation to scale, Harvey (2015) examined how concepts of scale, territory, and boundaries influence the creation of heritage. He emphasized the importance of understanding the interplay between local communities and heritage-making processes, noting that these dynamics significantly affect heritage production and practice. Kirshenblatt-Gimblett (1999) critiqued the impact of heritagization on local populations, arguing that it often transforms community members from proprietors of heritage sites into performers or cultural ambassadors. The process of heritagization is inherently selective, prompting critical inquiries into the socio-economic factors that shape and influence it. This selective nature needs critical exploration of how particular cultural objects are deliberately recognized as heritage, while others are excluded or disregarded (Mai Le, 2021).

Heritagization in this vein creates a separation between the everyday world and the realm of heritage objects, whether tangible or intangible. This separation can evoke a sense of continuity with the past or highlight a stark difference. It generates knowledge about the object and its origins, reflecting the present society’s socio-economic values and helping to contextualize the significance of designating it as heritage (Davallon, 2019). Due to this, Kock (2023) indicates that the process of heritagization is often critiqued for diminishing the significance, as heritage is reinterpreted through a historically romanticized and secular lens.

1.2 Problem Statement and Research Gap

In cultural heritage discourse, literature previously addressed two primary themes. The first examines how globalization and urbanization influence cultures, traditionally linked to sovereign nation-states, particularly regarding the spread of Western practices in heritage conservation and management (Harrison 2013; Labadi and Long 2010; Meskell 2015). The second theme explores the politics and ethics of intercultural postcolonial encounters, which globalization has intensified, prompting critical assessments of Westernized heritage practices among Indigenous and minority communities (Biehl *et al.* 2015). Winter (2014) stresses that there is a lack of comprehensive theorization of the emerging issues at a global scale within cultural heritage studies (Colomer,2017). Davallon (2019) extends on this by stating that the concept of "heritage" today is characterized by a degree of instability, as it encompasses conflicting realities. As a result, the effort to define the term precisely has shifted towards studying "heritagization," which refers to the process by which an object or a practice acquires the symbolic status of heritage. All these issues are intrinsically tied to the creation of heritage and bring attention to the foundational process of heritagization. This foundational process also involves the appropriation, construction, socio-economic influences societal representation of heritage (Margry 2011: 335, Milošević, 2017). This brings forward the novel idea of a "heritage

regime," which marks a significant shift from traditional interpretations of heritage towards the dynamic nature of heritagization (Gravari-Barbas,2022). In this view, heritagization has emerged as a central mechanism within cultural heritage discourse and often marks the unconscious starting point for any discussion related to heritage (Kajda, 2019).

1.3 Objectives and Hypotheses

Critical heritage[1] scholars have examined the heritagization process, emphasizing how heritage discourse initially employed by transnational organizations like UNESCO is subsequently adopted and modified at national, regional, and sub-regional levels to legitimize the selection, preservation and regeneration of both tangible and intangible cultural heritage. However, the term "heritagization" has increasingly become synonymous with urban regeneration, which involves the selective reinterpretation of the past to fulfil contemporary objectives (Zhu & Maags,2020; Mascaro, 2024). Existing research has repeatedly emphasized the insufficient conceptualization and vague comprehension of heritagization as a complex and evolving process within the framework of urban regeneration (Sjoholm, 2016; AlShaikh, 2017, Xue, *et al.,* 2019, Mai Le, 2021, Mascaro, 2024, Hanif & Riza, 2024). Despite its potential to frame heritage as a dynamic process instead of a static one, heritagization has faced criticism for lacking a robust theoretical foundation and for being predominantly associated with the Western world. This study, therefore, examines the dynamics of heritagization in the context of urban regeneration, with particular emphasis on how it shapes urban regeneration initiatives beyond the mere preservation of heritage. Its objectives are

I. To explore the origin of the heritagization process.
II. To investigate the dynamics of heritagization in different geographical contexts.
III. To draw a closer link between heritagization practices in the Eastern and Western parts of the globe.
IV. To debunk the belief that heritagization is dominantly a Westernized practice.

1.4 Significance and Structure of the Paper

The findings of this research will contribute to the growing yet limited literature on heritagization, which principally attends to World Heritage Sites witnessing transformations to cater to heritage tourism or the post-transformation experience of the local community. Furthermore, findings will draw a closer link between the heritage discourse of the Eastern side and the Western side of the world. The research is also anticipated to strengthen the ongoing discourse of Critical Heritage Studies (CHS) that advocates for adopting a more dynamic approach to heritage as highlighted by (Harvey, 2001; Hall, 2002; Muñoz Viñas, 2005; Smith, 2006; Di Giovine' 2009, Gravari-Barbas & Graburn, 2012, Harrison, 2013; McDonald, 2013, Harvey 2015; Colomer,2017; Gravari-Barbas, 2022; Boussaa & Madandola, 2024, Kasem *et al*, 2024).

[1] Critical Heritage Studies is an interdisciplinary field that examines the cultural, social, and political aspects of heritage. It challenges traditional understandings of heritage by questioning power relations, socio-economic influences, historical narratives, and the role of marginalized communities in heritage making and management. This approach emphasizes critical interpretation, redefinition, and engagement with heritage in the present, rather than simply preserving it as a remnant from the past.

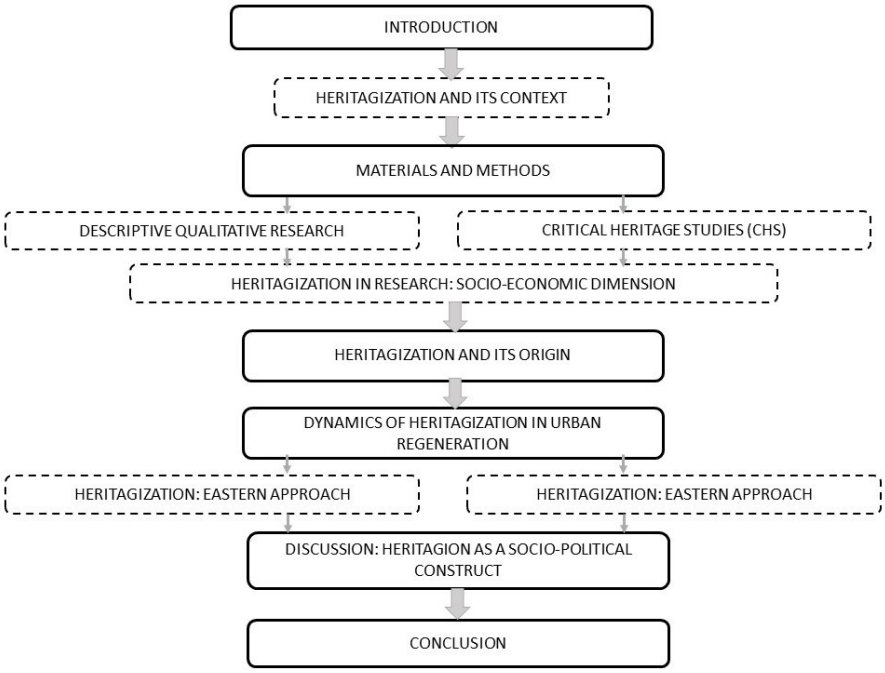

Figure 1. Conceptual Model of the Study.

2. Materials and Methods

2.1 Study Design and Setting

This study employs a descriptive qualitative research design underpinned by the theoretical perspectives of Critical Heritage Studies. The theory of Critical Heritage Studies (CHS) has garnered significant attention as it represents an evolving field of research. This theoretical perspective is supported by a growing body of scholarship that aims to transcend the conventional emphasis of heritage studies on technical aspects such as management and practice, shifting instead toward an exploration of cultural heritage as a multidimensional phenomenon encompassing socio-political, socio-cultural, and socio-economic dimensions.

2.2 Data Collection

Data was primarily gathered from the academic literature review of the term heritagization in the context of urban regeneration. The literature review encompassed a diverse array of scholarly sources, including peer-reviewed journal articles, book chapters, conference proceedings, as well as postgraduate theses at both the Master's and doctoral levels. This comprehensive selection of literature aimed to capture the breadth and depth of existing research pertinent to the study's focus. These studies were done in different geographical contexts and each reveals the process of heritagization adopted according to different dynamics. However, what was common between all these studies is the quest to select, preserve and display the heritage so it may acquire a symbolic status.

2.3 Data Analysis

The descriptive qualitative research design was structured into five analytical phases to systematically facilitate the identification and interpretation of the underlying dynamics of heritagization within the context of urban regeneration (Fig.2). This methodological approach enabled a comprehensive examination of the complex and multidimensional processes involved in heritagization, encompassing differing regions, specific case studies and socio-economic dimensions (Table.1). These phases facilitated the identification of emergent and relational dynamics that are fundamental to the phenomenon under investigation.

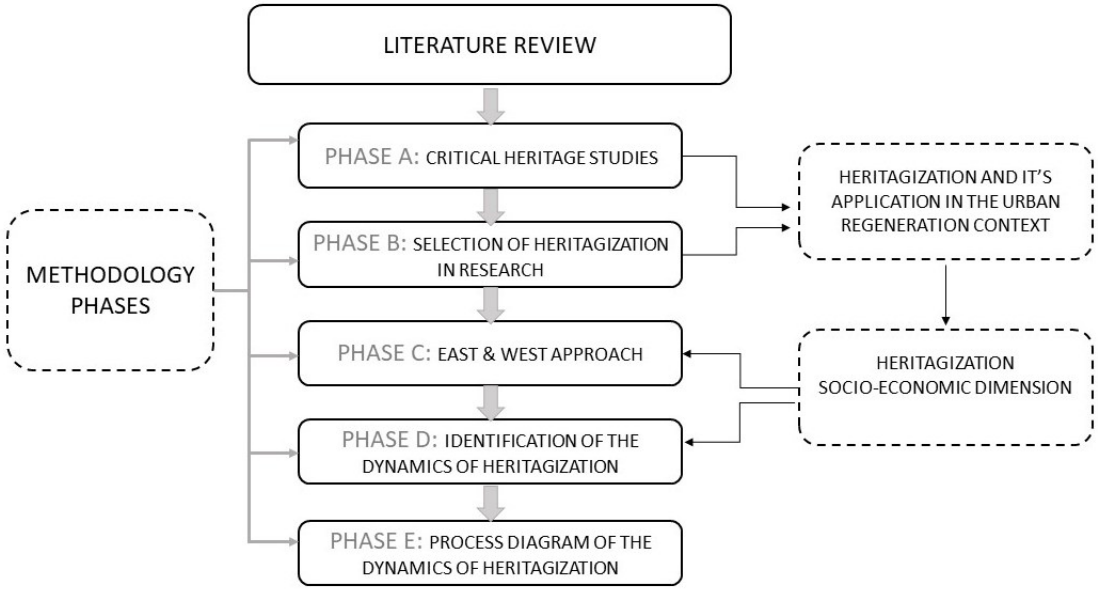

Figure 2. Methodology Phases.

Table 1: Chronological overview of heritagization literature, categorised by case study, region, and socio-economic dimension.

Work (title – citation)	Case study	Region	Socio-economic dimension
Grote Markt Groningen: The Re-Heritagization of the Public Realm (Ashworth, 2008)	Grote Markt, Groningen (NL)	Europe	Boosts city-centre commerce via heritage tourism.
The 'Heritagization' of Konso Cultural Landscape (Assoma, 2010)	Konso cultural landscape	Africa	Channels local economic optimism by creating opportunities for cultural tourism and global community networking.
Folk Architecture Heritagization in Rural Portugal (Silva, 2011)	Castelo Rodrigo	Europe	Preserves vernacular architecture, highlighting the top-down approach.
Memorising a Controversial Politician: The "Heritagization" of a Materialised Vox Populi (Margry, 2011)	Grass-roots memorials	Europe	Shape's civic identity while affecting the local cultural economy.
"Heritage-scape" or "Heritage-scapes"? (Gillot *et al.,* 2014)	Conceptual	Europe	Introduce heritage as a tool for cultural commodification, tourism development, and community livelihood enhancement within globalized markets.
Re-telling, Re-cognition, Re-stitution: Sikh Heritagization in Canada (Ashley, 2014)	Abbotsford Gurdwara	N. America	Supports diaspora cohesion and multi-cultural identity.
Heritagisation of the 'Ottoman/Turkish House' in the 1970s (Türeli, 2014)	Istanbul	Eur./Asia	Spurs conservation-led urban renewal that counters urbanization, tourism, local actors and international organizations
Heritagisation, Re-Heritagization, De-Heritagization… Kiruna, Sweden (Sjöholm, 2016)	Kiruna	Europe	Signify the importance of built heritage, its relevance in the community, and challenges in mining-town relocation.
Urban Revitalisation through Heritagization (Picard & Leite, 2016)	Various	Global	Leverages heritage for inclusive urban revitalization
Described, Inscribed, Written Off (Salemink, 2016)	Rural Vietnam	Asia	Highlights tensions between heritage conservation, local livelihoods, and the need for fair compensation in land-use.
Heritagization of Disaster Ruins… (Mentec & Zhang, 2017)	Beichuan & Wenchuan	E. Asia	Channels post-disaster recovery via heritage tourism.
The Value of Authenticity in Heritagization (AlShaikh, 2017)	Dubai Historic District	Gulf	Dissect the multiple layers of heritagization that underlie the reconstruction of heritage and its impact on the local community
Concrete Memories and Sensory Pasts (Low, 2017)	Singapore	Asia	Cultivates Sensory-based heritage to promote cultural tourism and place identity.
Historicising the Present: Brussels Attacks… (Milošević, 2017)	Brussels	Europe	Spurs' memorial tourism and security economies.

Heritagization & Institutionalisation of Taekkyeon (Park *et al.,* 2018)	Korea	Asia	Commercializes martial-arts heritage through an institutionalized approach.
Impact of Cultural Heritage on Tourists (Nilsson, 2018)	RO, PL, SE	Europe	Re-positioning of tourists' "authentic" experiences to support political impact and favorable narratives.
Heritagization of Post-industrial Redevelopment… Amsterdam (Kamp, 2019)	Amsterdam	Europe	Converts post-industrial heritage for social inclusion and economic recognition through cultural rights.
Touristification of Saint-Ouen Flea Market (Gravari-Barbas & Jacquot, 2019)	Paris	Europe	Formalises Tourism-led redevelopment and highlights tensions between economic investment, gentrification, and heritage preservation.
Simulacra Heritagization: Minyuan Stadium (Yue *et al.,* 2019)	Tianjin	Asia	State-led heritage simulations for cultural commodification and economic development.
The Game of Heritagization (Davallon, 2019)	Parks & museums	Europe	Analyses governance of shaping the selective process of heritagization.
Heritage – Public & Expert Discourse… (Kajda, 2019)	Poland	Europe	Mediates stakeholder priorities by influencing resource allocation, community recognition, and cultural tourism initiatives.
Dark Tourism & Sites of Suffering (Becker, 2019)	Rwanda	Africa	Generates genocide memorials through dark tourism while raising ethical concerns about commodifying historical trauma.
Restoring the Glory of Serampore (Wolff, 2020)	Kolkata	Asia	Links colonial heritage to urban regeneration initiatives.
The City is a Journey (Møller-Olsen, 2020)	Taipei	Asia	Cultivates cultural memory and literary preservation to stimulate heritage tourism.
Walking in Historic Neighbourhoods of Beijing (Svensson, 2020)	Beijing	Asia	Enhances pedestrian economy in crafting heritage trails.
Tales of Heritagization (Mai Le, 2021)	Vietnam	Asia	Reframes local communities ' participation, challenging the top-down approach.
Beyond "Imagined" Nostalgia: Gunsan (Lee, 2021)	Gunsan	Asia	Uses colonial fabric to diversify heritage tourism and cultivate productive nostalgia.
Heritagising Asian Cities (Salemink, 2021)	Multiple	Asia	Reveals how vernacular heritage shapes local livelihoods through everyday practices and nostalgic attachments.
Tenements in New York & Riads in Marrakesh (Gravari-Barbas, 2022)	NYC & Marrakesh	N. Am./Africa	Highlights migrant mobilities fuelling heritage economies.
Heritagization of Religious Sites (Thouki, 2022)	Various	Global	Generates economic value through tourism while diminishing their spiritual and religious significance.
Loss in Translation: Catholic Monasteries (Kock, 2023)	NL monasteries	Europe	Strengthen local economic opportunities through cultural tourism while also redefining the site's social value.
Heritagization of Religious Festivals… Sri Lanka (Indika, 2023)	Sri Lanka	Asia	Stimulates local enterprise via festival tourism and social cohesion.
Heritagization of Cooch Behar Town (Das *et al.,* 2024)	Cooch Behar	Asia	Leveraging historic assets to boost heritage tourism, create employment, and encourage the inclusive development of an old town.
Discourses of Heritagization in East-Central Europe (Eitler & Ament-Kovács, 2024)	Region-wide	Europe	Shapes local economies through the negotiation of cultural value by diverse social actors.
Reclaiming the Lost Cultural Identity via Heritagization (Hanif, 2024)	Gulf States	Gulf	Revives cultural identity, balancing the post-oil modernization and heritage preservation.
Heritagization of Historic Sites: Transformation of Al Diriyah from a Ruin to a Branded Cultural Capital (Hanif & Riza, 2024)	Riyadh	Gulf	Converts ruins into branded cultural capital for heritage tourism and global competitiveness.
Heritagization as an Authoritarian Urban Practice in China (Mascaro, 2024)	Lijiang	Asia	Legitimises state-led redevelopment via heritage-making, questioning forced/voluntary gentrification.
International & National Heritagization of Religion in Asia (Khetrapal, 2024)	Region-wide	Asia	Shapes cultural diplomacy through the reconstruction of religious values and practices for international recognition.
Heritagization of the Colonial Period in Dalian (Xiao, 2025)	Dalian	Asia	Reveals how cultural politics intersect with economic commodification for tourism and urban development.

3. Heritagization and Its Origin

Poria (2010) connects the term "heritagization" from Anglo-Saxon studies to the concept of "patrimonialisation," both referring to processes that utilize heritage as a historical resource to achieve specific social objectives. Originating in Francophone scholarship, "patrimonialisation" describes the transformation of places, individuals, practices, and artifacts into heritage assets that are preserved, exhibited, and safeguarded—a notion developed in the early 1990s by geographers, historians, and anthropologists (Babelon & Chastel, 1994; Davallon, 2002; Jeudy, 1994; Poulot, 1998; Gillot *et al.,* 2013). Scholars have linked patrimonialisation to the evolving interpretation of the past, highlighting its basis in a linear, Western-centric conception of time associated with European modernity. This perspective raises challenges when applying the concept to non-Western contexts, as the globalization of patrimonialisation processes can be viewed as extensions of imperialism or neo-colonialism. Researchers emphasize that patrimonialisation is not a monolithic process; it involves multiple actors, including scholars, government institutions, public officials, and civil society members, who collectively engage in the negotiation and formation of heritage (Rautenberg, 2003; Tornatore, 2006; Gillot *et al.*, 2013).

Sánchez-Carretero (2013) notes that "heritagization" originates in French and European discourses, particularly under the term “patrimonialisation” and is relatively uncommon in English-language contexts, where it is often used in either a derogatory or a critical context. He derives this from Walsh’s (1992: 4) interpretation of framing heritagization as the transformation of authentic places into places aimed at catering to heritage tourism. The term Heritagization, thus evolved from patrimonialisation, also refers to the process of designating certain past practices or objects as culturally valuable. This process is shaped by the perspectives and intentions of those involved, as well as the audiences they address. By viewing heritage as a dynamic process rather than a fixed category of material culture, discussions move away from debates over what qualifies as heritage and instead emphasize the mechanisms and motivations behind assigning value to elements that are on the spectrum of being considered as heritage (Ashley, 2014; Hanif, 2024).

Stuart Hall’s (2005) critique of “The Heritage”—as a concept historically tied heritagization to white English cultural dominance and illustrates how what is often seen as universal is, in fact, one of many possible English heritagization narratives. Furthermore, Becker (2019) highlights that since the 1990s, the phenomenon of "heritagization" has gained momentum, characterized by a notable increase in memorials worldwide. This trend stems largely from efforts to commemorate pivotal historical events, such as the two World Wars and the Holocaust, particularly in Western nations, Eastern Europe, the United States, Australia, and Asia, especially China and Japan. Additionally, the dissolution of the Soviet Union has played a significant role in shaping this shift toward heritage-making practices. Consequently, heritagization has emerged as a process that drives the intensive creation of cultural territories that extend well beyond the confines of any single nation (Gillot *et al.*, 2013).

Nonetheless, it was not till the late 20th century that 'Heritagization' emerged as a commonly used term in the framework of urban regeneration. Heritagization in this context became the process of selective reinterpretation of the past to fulfill contemporary objectives (Zhu & Maags,2020; Mascaro, 2024). Khetrapal (2024) highlights that at the national scale, the dynamics of heritagization-driven urban regeneration also facilitate the revitalization and reinterpretation of intangible traditions and socio-economic practices. Meanwhile, on the international stage, heritagization contributes to the construction of national identity by displaying cultural heritage globally.

4. Results

4.1 Dynamics of Heritagization in the Context of Urban Regeneration

While substantial research has focused on top-down, often corporate-led approaches that reshape cities into hubs for cultural heritage consumption, it is only in recent years that scholars have begun to explore how urban regeneration engages with heritagization through practices that extend beyond mere commodification (Picard & Leite, 2016). Within the context of consumption, heritagization has evolved into a branding strategy that positions cultural heritage as a marketable asset, encompassing both tangible and intangible symbolic elements of the city's heritage—such as monuments, architecture, infrastructure, traditions, and stereotypes associated with residents' socio-economic and socio-cultural aspects (Hague & Jenkins, 2004). The commodification of cultural heritage through branding presents a fundamentally debatable aspect of the heritagization process. This approach also highlights the prospective scope of showcasing cultural heritage on a global scale, aiming to create a lasting and immersive heritage display (Hanif & Riza, 2024).

The process of heritagization is shaped by the diverse historical contexts and interpretations, as well as the perspectives of various stakeholders toward heritage. This term refers to the act of creating cultural significance around places, objects, and events, emphasizing their societal value (Murzyn-Kupisz, 2012). It also involves the appropriation of elements that may initially appear insignificant, such as deteriorating modern buildings and redefining them as meaningful to specific groups (Walsh, 1992). In this vein, the process of urban regeneration also introduces innovative approaches for restoring, reinterpreting, or reconstructing heritage by assigning new functions (Gravari-Barbas *et al.,* 2025). Heritagization, therefore, represents a dynamic process of (re)interpreting heritage, which can either gain broad public recognition or remain significant only to smaller, more specialized groups (Kajda, 2019).

This quest for recognition that underlies heritagization often manifests as a state-driven or political initiative wherein national mandates guide urban regeneration to shape the national vision or development agendas. This leads to not just the transformation of heritage but also the displacement of residents who attribute value to heritage (Arcilla,2025). Although this phenomenon is observed globally and heritage is often viewed as a governance tool, there remains a need to understand how heritagization functions as a form of gentrification. In this context, the persistent socio-economic hierarchy between areas designated for development and those already developed not only drives gentrification but also favours the interests of dominant mainstream groups (Dang, 2021). Employing a practice perspective, as discussed by Glasius (2018), can provide deeper insights into state-society relations within an authoritarian context, revealing how power dynamics are exercised and contested in the process of gentrification that results from heritagization-driven urban regeneration. Consequently, Heritagization, understood as a socially constructed aspect of gentrification, has increasingly gained prominence in urban regeneration discourse. This growing scrutiny has illuminated the socio-economic disparities and inequities that arise as a result of the heritagization process (Mascaro, 2024).

However, the initial purpose of urban regeneration remains to counter socio-economic challenges and mobilize both tangible and intangible aspects of heritage (Moufid *et al.* 2025). The objective extends beyond the mere restoration of depleted heritage structures, emphasizing the improvement of living conditions for residents occupying historic districts (Boussaa *et al*., 2023). Urban regeneration in this context plays a crucial role in promoting socio-economic potential and enhancing the aesthetic representation of heritage (Suwaidi & Boussaa, 2024). Yue *et al. (*2019) elaborate that the concept of heritage often reaches its explanatory limits when analysing the transformations of urban spaces in such a contemporary context, particularly under the influence of heritagization.

In this vein, Jean Baudrillard's notion of the simulacrum (1981) offers a more nuanced understanding. Baudrillard describes simulacra as representations that lack an original reference point, emerging from a culture dominated by mass reproduction and media saturation. These simulacra are not mere imitations; they are autonomous constructs that disrupt the traditional

relationship between original and copy. Heritagization through the concept of simulacra serves as a compelling example of an urban regeneration initiative that provides an aesthetic image of heritage (Hadjri & Boussaa, 2007). The aesthetic representation of heritage, however, is often altered to such an extent that it results in significant cycles of heritagization (Hanif,2024). As a result, reversing the process of heritagization proves to be difficult, especially when urban regeneration is embraced by the local population (AlShaikh, 2024).

Gravari-Barbas (2018, 2019) highlights that urban regeneration in this context is often driven by cultural tourism and amplifies and disseminates representations of heritage. These stereotypical images, in turn, shape the creation of themed destinations. Over time, such environments often detach from their authentic reference and evolve into the commodified version of heritage. Boussaa (2021) highlights that cultural tourism becomes a catalyst for altering the representation of heritage under urban regeneration initiatives. Xue (2022) links this to placemaking, highlighting how urban regeneration tends to focus on developing tourist-oriented destinations. According to Wise and Jimura (2020), such urban regeneration in turn impacts the socio-economic implications, community engagement, and the influence of investments and developments on human interactions with heritage. Heritagization in the context of urban regeneration, hence, becomes an intricate process of creating, redefining, and reconstructing heritage within a society. This dynamic phenomenon is shaped by a variety of internal and external influences unique to the socio-economic context (Mazzetto & Vanini, 2023). It serves as a mechanism to reclaim elements of the past, aligning them with contemporary objectives to sustain the legacy of a current political system (Nilsson 2018: 37; Indika, 2023).

Das *et al.* (2024) highlight that to analyse the dynamics of the heritagization process, consultations must be conducted with key stakeholders, including responsible authorities, academics, and activists. These discussions aimed to assess the current state and trajectory of the process can identify emerging opportunities, and examine any associated challenges or shortcomings. In this vein, Khetrapal (2024) insists that it is reasonable to contend that non-Western nations might introduce new standards of heritagization, thereby highlighting a form of competitive heritagization. Dissecting the East-West dichotomy[2] can help understand the emerging competition and could serve as a strategic tool not only for advancing the understanding of heritagization but also the Critical Heritage Studies (Fig.3). By examining heritagization as a cultural process of valuation utilized by different cities of different countries in the context of Eastern and Western dichotomy, we can gain a more nuanced understanding of the dynamics involved in these processes. Its valuation also provides a sustained socio-economic framework for examining the development trajectory (Obeng-Odoom, 2024). Instead of viewing heritagization merely as an act of designating the heritage, it could be understood as a communicative urban regeneration practice, encompassing multiple socio-economic objectives and subjectivities in the creation of heritage.

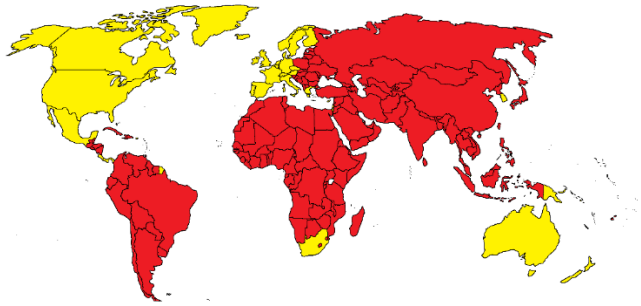

Figure 3. Map illustrating the Geographical East-West Divide. Countries shaded in yellow are categorized as Western (developed countries), whereas those in red are classified as Eastern (developing countries).

[2] East-West dichotomy is a term that denote a method of grouping countries based on their defining characteristics with regard to socio-economic development and political influence. The term also delineates the Brandt Line, a conceptual division distinguishing between "developed" and "developing" nations, also known as the Global North-Global South divide (Drawn differently). Notably, the divide suggests a consistent geographical pattern in the classification of global economic development.

4.2 Heritagization: Eastern Approach

In the East, particularly South Asian context, Wolff (2020) explores how the process of heritagization shapes the perspectives, experiences, and practices of local Bengali residents and officials regarding Danish colonial heritage in Serampore, a town close to Kolkata, India. Based on her involvement in conservation efforts, Wolff highlights the residents' deep sense of ownership and attachment to these Danish colonial structures. Nonetheless, the distinction between "us" and "them" fluctuates depending on spatial, temporal, and socio-economic dynamics, with different local groups perceiving entities such as British colonials, Kolkata cosmopolitans, and Delhi authorities as representing the "heritage of others." Similarly, Svensson (2021) investigates walking as a practice that accelerates the process of heritagization in a hutong district in Beijing, China. Focusing on the Nanluoguxiang area in central Beijing, Svensson examines its rapid urbanization driven by touristification, commodification, and gentrification, which underpin the heritagization process (Salemink, 2021).

Møller-Olsen (2021) investigates heritagization through literary analysis, focusing on themes of nostalgia, selective memory, and mnemonic erasure within the framework of urban regeneration in Taipei. The novella portrays people's increasing detachment from the past, shaped by forgetting, loss, and the material erasure of historical elements. Møller-Olsen translates this narrative as a nostalgic attempt to reconstruct a lost city, ultimately crafting a fictional urban landscape through fragments of the heritagization process. Similarly, Low (2017) examines how heritage in Singapore is experienced through sensory perceptions and memory-embodied interactions. Other than the conservation of the built heritage, selected routes are also designated as heritage trails as part of urban regeneration efforts. Through heritagization, these buildings and trails acquire symbolic meaning, shaping how heritage is curated and presented to both residents and tourists (Hanif,2024).

Lee (2021) examines how South Korea's approach to its Japanese colonial legacy in Gunsan diverges from the common practice of heritagization in many formerly colonized Asian nations, which often seeks to evoke positive nostalgic sentiments. Instead of relying on personal recollections or straightforward romanticization, Gunsan's heritage-making has unintentionally fostered a sense of "imagined nostalgia." This nostalgia does not stem from an authentic portrayal of colonial-era Gunsan but rather from a reconstructed version of the past. For visitors unfamiliar with the city's colonial history, Gunsan offers access to a reimagined past that appears exotic. The city's economy faced a considerable downturn following the unsuccessful Saemangeum Seawall Project, a land reclamation effort aimed at urban renewal (Yi & Ryu, 2015). In response to economic decline and demographic shrinkage, the Gunsan Municipal Government sought to reposition the city as a contemporary urban hub through the colonial heritagization process. Gunsan restored its colonial-era buildings, repurposing vacant spaces into guesthouses and cafes designed in the Japanese colonial style, while also promoting its gastro-tourism initiatives (Song *et al.*, 2019). Under the slogan "Time travel back to the 1930s," Gunsan witnessed a remarkable surge in tourism, with visitor numbers increasing from 220,000 in 2013 to 1 million in 2016, solidifying its status as a successful urban regeneration initiative in South Korea (Lee, 2021). In Gunsan, heritagization was deeply intertwined with nostalgia, understood as a "longing for what is absent in a transformed present." This phenomenon has the dual function of reinforcing ties to the past while simultaneously prompting a critical examination of the intentions behind its use (Cronberg, 2009; Angé & Berliner, 2022; Thouki, 2022).

Mascaro (2024) classifies the process of heritagization as an authoritative urban practice in China. She asserts that the transformation of Lijiang from a rural village into a cultural destination catering to the middle class has gradually displaced its original inhabitants to accommodate new residents. Hence, she highlights that heritagization in China is eventually inclined towards the process of gentrification, which can often come as voluntarily by the residents as a result of touristification. Unlike the overt forced displacement associated with urban regeneration discussed by Lees *et al.* (2016), this shift in Lijiang represents a more subtle form of displacement that nevertheless diminishes the voices of the local community. Mascaro (2024) highlights how heritagization acts as

a practice-based approach to authoritarian urbanism and reveals how heritage preservation is commodified not merely to showcase heritage but also as a strategic tool for state-led gentrification. This process involves transforming historic districts into commodified spaces that cater to socio-economic needs and marketing interests, thereby marginalizing original residents and suppressing dissent.

Following the catastrophic 2008 Wenchuan earthquake in China, a state-led heritagization initiative was implemented in Beichuan and Wenchuan Counties, areas predominantly inhabited by the Qiang ethnic minority. These efforts involved preserving certain devastated landscapes as earthquake relic sites and transforming the former Beichuan County seat into a heritage site for memorialization, economic development, and patriotic education. However, this approach generated emotional tensions among the local community, still coping with the tragic event and trauma that followed. Additionally, Qiang cultural traditions were rapidly selected and designated as national and international intangible cultural heritage, while reconstructed Qiang villages were repurposed as heritage tourism destinations. The intersection of promoting Qiang intangible cultural heritage and designating disaster ruins as heritage sites highlights both the implemented projects and the lived experiences of local communities. Despite these initiatives, Beichuan County's economic recovery—largely dependent on disaster heritagization—did not appear to contribute to long-term socio-economic benefits or socio-psychological healing (Mentec & Zhang, 2017).

Xiao (2025) explores the process of heritagization in China further by highlighting that Dalian stands out among China's modern cities for its prominent legacy of Russian and Japanese colonial rule, lasting over half a century. This unique context has shaped the city's heritagization, revealing two distinct approaches to colonial heritage: a "nationalist" perspective that frames heritage within cultural politics, and a commercially driven orientation tied to economic development. These contrasting approaches highlight the complex interplay between cultural identity, economic priorities, and heritage preservation in post-colonial societies, offering valuable insights into how colonial legacies are negotiated and integrated into the heritagization practices. Mai Le Quyen (2021) examines the process of heritagization in Vietnam, emphasizing how heritage is constructed through intricate interactions among global, national, and local stakeholders. She emphasizes the pivotal role of communities in this evolving transnational phenomenon, which unfolds through three interrelated stages and two mutually developed dimensions. Drawing on Di Giovine's (2009) theoretical framework, these stages—segregation, idealization, and valorization—illustrate the transformation of cultural assets into recognized heritage. Segregation entails the detachment of specific cultural elements from their original context, elevating them to an international platform where they are redefined according to global heritage criteria. Idealization represents the national government's endeavour to integrate these newly ascribed values into the country's historical and cultural narratives, thereby granting heritage an enhanced status. Lastly, valorisation reintroduces the World Heritage designation into the broader social fabric, striving to gain legitimacy and endorsement from both local communities and international visitors.

In a similar vein, Indika (2023) highlights that the concept of heritagization within Sri Lanka's heritage discourse has been relatively underexplored, particularly in the broader South Asian context. In the 21st century, there has been a notable intensification of Buddhist festivals across the island, leading to an oversaturation and normalization of such events, which he terms as "festivalization". Some of these festivals appear to be strategically utilized to imbue religious sites with new heritage values, often drawing upon nostalgic elements from the dominant heritage narratives of the country. A prominent example is the recently introduced Kañcuka Pūjā, which has rapidly gained popularity due to its distinctive ability to build community cohesion and provide deeply immersive experiences cantered around sacred Buddhist symbols. This ritual exemplifies how contemporary events can be crafted to resonate with both spiritual significance and communal identity, thereby reinforcing the regeneration of Intangible cultural heritage. Moving towards Africa, Assoma (2010) analysed the heritagization process of the Konso Cultural Landscape in Ethiopia led by the government, which first included the inclusion of the site in its tentative list for

UNESCO World Heritage nomination in 1997 and then its inscription as a UNESCO World Heritage Site in 2011. This journey entailed identifying, selecting, isolating, documenting, and constructing the landscape's heritage value. However, the process was marked by conflicts, contestations, socio-economic disparities and negotiations over legitimacy and authority among various stakeholders, including local communities, traditional leaders, and governmental entities. These dynamics reflected both optimism about the potential benefits of heritage recognition and scepticism regarding the implications for local autonomy and heritagization practices.

In the Gulf Region, Hanif (2024) explored how heritagization is playing a pivotal role in redefining the lost cultural identity of the Gulf States that suffered significant heritage loss due to post-oil modernization and rapid urbanization. The heritagization process has emerged as a strategic response to regenerate historic districts by preserving their cultural identities and also branding them within the context of contemporary urban development. Hanif & Riza (2024) extend this discussion by illustrating that the heritagization process in Al Diriyah, Riyadh in the Kingdom of Saudi Arabia, initially aimed at the preservation and regeneration of the historical site, extended beyond and rebranded the ruins as a revived cultural capital. This transformative process not only regenerates previously neglected heritage sites, turning them into thriving hubs for cultural tourism but also confirms the risks of over-commercialization and cultural commodification.

Correspondingly, AlShaikh (2024) investigates the process of heritagization in terms of evolving practices and representations of intangible cultural heritage (ICH) in the United Arab Emirates, focusing on both official and grassroots safeguarding efforts. She analysed how state-led initiatives and community practices interact to preserve and present elements such as traditional crafts, performances, and socio-political customs as authorized heritage. She further highlights the tensions arising from the modernization of the nation-state, particularly in balancing authentic traditions with commodified heritage forms, and how these dynamics contribute to the construction of Emirati national identity. The dynamics here are influenced by international commitments of representing intangible heritage and how responsive the local community has been towards the universal understanding of heritage.

Figure 4 presents a process diagram illustrating the dynamics of heritagization within the context of urban regeneration in the Eastern part of the world.

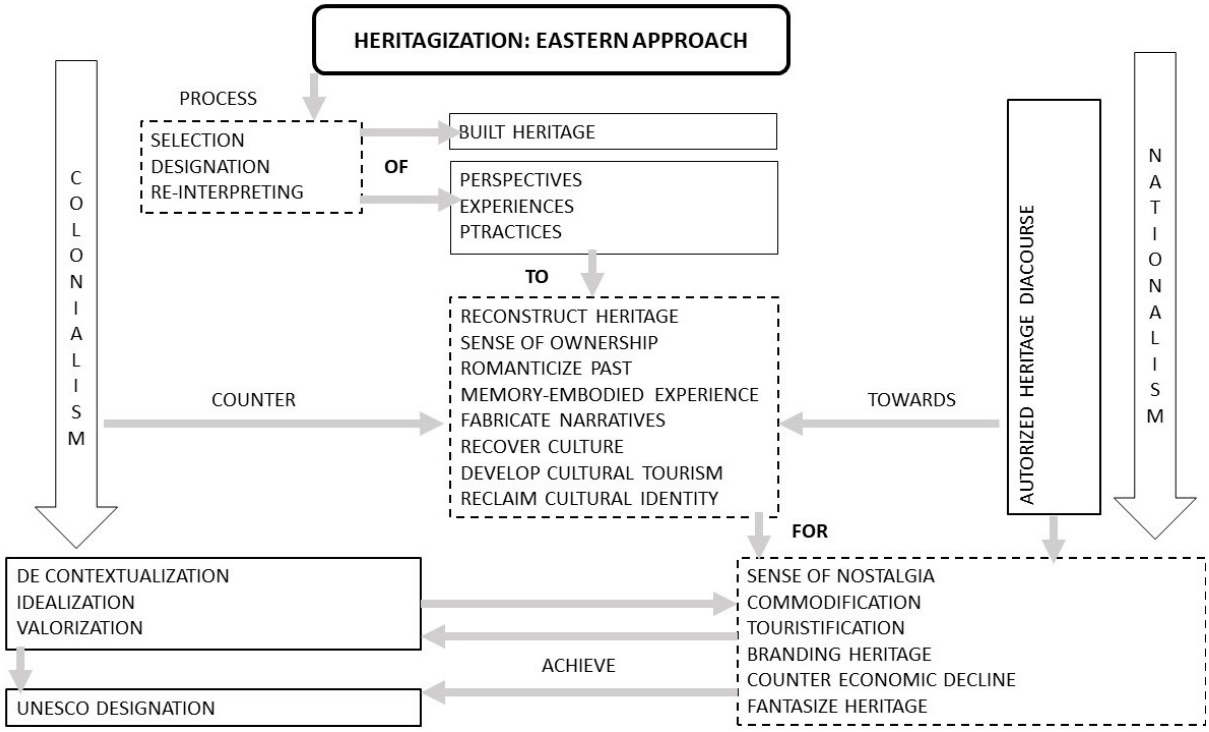

Figure 4. Process Diagram Illustrating the Dynamics of Heritagization in the Eastern Context.

4.3 Heritagization: Western Approach

In the West, heritagization initiatives have been implemented in various ways since their inception. During Poland's communist regime from 1945 to 1989, rather than eliminating cultural heritage, efforts were made to reshape it to align with communist ideology. Churches were permitted to function, provided they conformed to party directives. However, the regime's geopolitical shift westward led to a revisionist approach to history, culminating in the "1000 Years of History" project. This initiative sought to present Poland as an ancient nation with an uninterrupted historical narrative, requiring the selective omission, emphasis, and reinterpretation of historical events to facilitate heritagization (Zamoyski, 1993; Lukowski & Zawadski, 2001; Kirchanov, 2004). Kajda (2019) extends this discussion by stating that the establishment of local and national museums, the organization of cultural events, the publication of articles in books and newspapers, and the restoration and renovation of heritage have significantly influenced the perception of Polish history. These efforts have led to a revival of neglected heritage and past narratives. Furthermore, this revival has exceeded expectations, with sites linked to Jewish communities becoming some of the most notable and frequently visited tourist destinations in cities like Cracow and Łódż. In this context, the public often plays a significant role in shaping the societal perception of heritage and influencing its treatment, sometimes challenging decisions made by heritage experts, as seen with Soviet heritage in Poland or the Białowieża Forest. However, the actions of experts frequently prompt communities to engage with and preserve their heritage. Experts also encouraged the public to recognize the value of various places, objects, and narratives, as demonstrated in the cases of Jewish and German heritage. In these instances, heritagization is driven by researchers aiming to rediscover and rewrite Poland's neglected multicultural history. Inspired by expert initiatives, the public is able to develop a sense of collective identity and belonging (Ashley 2014: 40) to the cultural and natural environment of their homeland.

The historical village of Castelo Rodrigo in Portugal underwent a heritagization process shaped by both state-led initiatives and local residents, with the Portuguese government spearheading the effort. This top-down approach, funded by the European Union, was carried out between 1994 and 2006 to regenerate the villages' socio-economic and socio-cultural challenges through heritage tourism, aiming to harness heritage as an economic asset (Graham *et al.*, 2000). However, tensions emerged between the stakeholders and the local community due to differing viewpoints and intervention strategies within the regeneration proposal. The initiative sought to create a visually cohesive heritage tourism destination, eliminating architectural inconsistencies and modern interventions. The primary goal was to shield the village from modern influences while preserving its valued architectural heritage. As a result, heritagization efforts prioritized the conservation that inclined towards the aesthetic harmony of facades and roofs, alongside the removal of modern interventions. As a result, the natural progression of heritage was disrupted, as stakeholders prioritized a fixed and selective portrayal of historical elements over continuous architectural evolution (Silva, 2011).

In Canada, Matt James (2013) critically examines the heritagization initiatives promoted by Canadian Heritage, describing them as neoliberal strategies designed to regulate and discipline citizens and their diverse cultural identities. James contends that the nation-building and socio-cultural aspects of heritage function as hegemonic processes. Heritagization in this context becomes a process that transforms cultural differences and socio-economic disparities into a more acceptable yet powerless representation of diversity. Additionally, Bains interprets the retelling of history as a "recovered history" project, emphasizing the colonized biases that were previously marginalized and remained neither openly seen nor openly told within the Canadian heritage discourse (Bains, 2013: 174; Ashley, 2014). Ashley (2014) highlights that the ongoing heritagization of the first Sikh temple in Canada extends beyond traditional government heritage designation and protection, as well as local community efforts to retrieve and reaffirm their history. In this vein, heritagization has increasingly influenced immigrant-led heritage sites through an institutionalized approach. This reflects a broader issue in heritagization when leveraged by authoritarian stakeholders or national

governing bodies to fulfil socio-economic objectives aimed at "historicizing" and "culturalizing" contested spaces, effectively relegating them to the past while circumventing unresolved contemporary urban regeneration concerns.

Drawing on a similar idea, Eitler & Ament-Kovács (2024) stress that in the Eastern European context, heritage is perceived by a group of people based on what they collectively identify as significant. The establishment of a heritage canon is shaped by various factors, including the historical evolution of a region or country, the process by which it transitioned into a nation, the background and composition of the elite governing this transition, and the elements that frame the discourse surrounding the nation's interpretation of its past. Examining the European map reveals distinct types of heritage, each aligned with a timeline that holds particular significance for its respective society. Heritagization thus represents a multifaceted, ongoing process embedded within socio-economic disparities and socio-political inclinations.

Türeli (2014) examines the heritagization process in the European part of Istanbul, Türkiye, particularly within its historic districts. This process involved the formulation of expert strategies aimed at preserving Istanbul's vernacular architecture, consisting of Ottoman characteristics. Proposals by French planners in the 1930s and 1940s, including Henri Prost's proposed archaeology park, were ultimately unfulfilled due to diplomatic challenges and financial limitations. From the 1970s onward, international organizations like UNESCO and the European Council, alongside local experts, introduced heritage conservation projects focusing on areas such as Sultanahmet and Topkapı. These initiatives sought to restore historic districts to their nineteenth-century condition and commodify them for heritage tourism. While such government-led urban regeneration initiatives have frequently been criticized for contributing to gentrification and diminishing authenticity, the heritagization process also highlights the tension between heritage preservation and contemporary urban development. Influenced by international protocols and local demands, the heritagization process in this context also strives to balance past interpretations of heritage with socio-economic growth, though their outcomes have been met with both success and critique.

Van de Kamp (2019) examines the heritagization of post-industrial Amsterdam North, Netherlands, highlighting the process of ascribing cultural significance to former industrial sites. This transformation, driven by urban planners, policymakers, and other stakeholders, repositions neglected industrial spaces as urban heritage, incorporating both tangible and intangible aspects of the industrial past. While such an urban regeneration has the potential to strengthen community identity, it also risks deepening socio-economic inequalities. Specifically, the emphasis on particular social groups, such as the white working class, may marginalize the diverse immigrant communities within the area. The case of Amsterdam illustrates how heritagization can be strategically leveraged by different actors to serve distinct agendas, resulting in a complex dynamic of integration and omission within urban regeneration initiatives.

Sjöholm (2016) examines the process of heritagization in the West through the town of Kiruna, Sweden, highlighting the town's urban transformation and its implications for built heritage. The heritagization of Kiruna unfolded in multiple phases, beginning in the 1980s when significant portions of the central town were designated as cultural heritage. This initial phase involved attributing heritage value and meaning to previously unrecognized environments, leading to the formal recognition of historical buildings and spaces as heritage assets. During the urban planning process, re-heritagization primarily occurred through reaffirmation, reinforcing the town's existing heritage status rather than introducing reinterpretation or expanding heritage classifications through addition. Concurrently, de-heritagization emerged as a notable factor, particularly following a 2011 agreement between the local government and the mining company Luossavaara-Kiirunavaara Aktiebolag (LKAB). This agreement influenced decisions regarding financial support for relocating specific heritage buildings, thereby shaping the extent to which heritage elements were preserved, moved or altered. The roles and priorities of key stakeholders significantly influenced the outcomes of heritagization in Kiruna, reflecting broader socio-economic and cultural dynamics. The case of Kiruna exemplifies a distinct Western approach to heritagization, wherein built heritage undergoes

processes of selection, designation, reaffirmation, or de-selection in response to the relocation of the town.

Similarly, Ashworth (2008) examined the transformation of Groningen's central square, the Grote Market in the Netherlands, through the lens of re-heritagization. This concept refers to the process by which urban spaces are reinterpreted and reshaped to reflect contemporary heritage values, often involving the reintegration of historical elements into modern urban planning and urban regeneration plans. Ashworth's analysis situates the Grote Market within broader discussions of heritagization discourse, exploring how historical narratives and cultural heritage are leveraged to enhance public spaces and stimulate cultural tourism even after their initial designation as heritage. Figure 5 presents a process diagram illustrating the dynamics of heritagization within the context of urban regeneration in the Western part of the world.

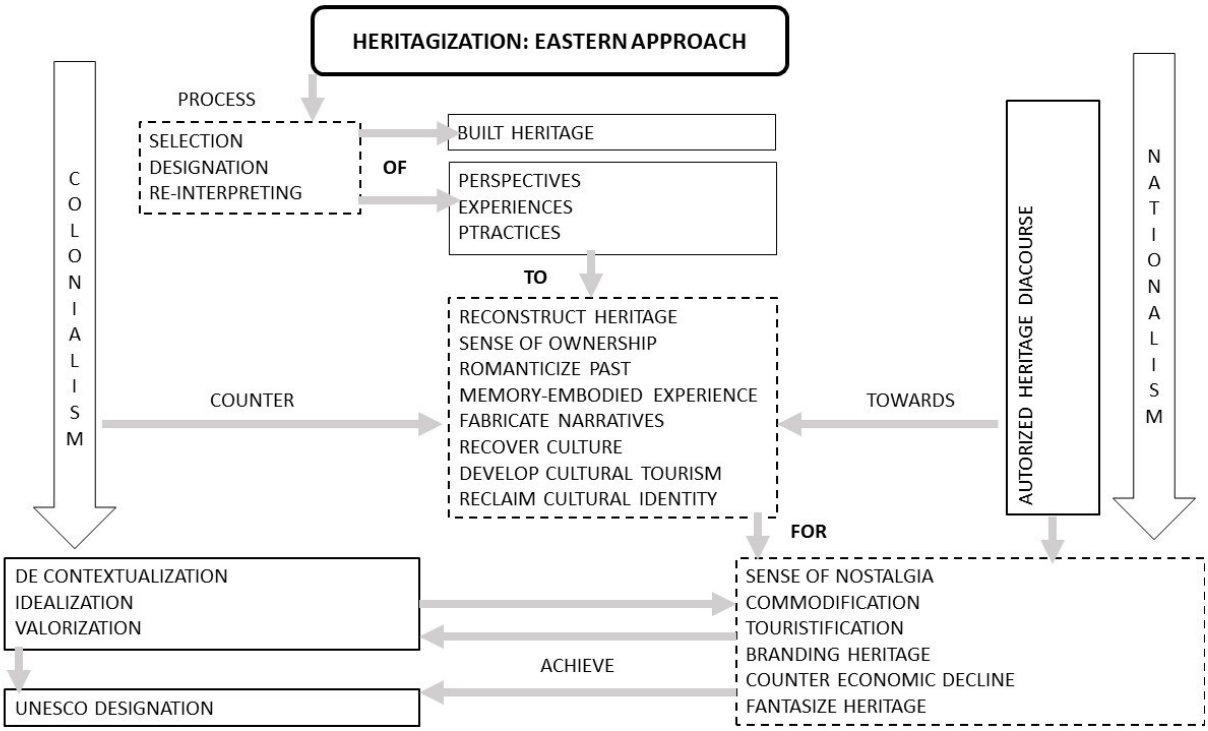

Figure 5. Process Diagram Illustrating the Dynamics of Heritagization in the Western Context.

5. Discussion

5.1 Heritagization as a Socio-Political Construct

In recent years, there has been a significant rise in research focusing on "the politics of heritagization." This approach encourages scholars to develop a more nuanced understanding of heritage politics and the politics of designation, which centre on the rights to govern status and authority within the heritagization process (Smith,2007; Bozoğlu *et al*, 2024). This adopts an institutionalist perspective, contrasting previous approaches to heritage(Park & Kang,2025). Davallon (2019) contends that viewing heritagization as an institutional or political act reveals the real dynamics behind granting or constructing heritage status to objects. This involves a societal interest in the object, acknowledgment of its specific traits, elimination of socio-economic disparities and the assignment of a status that elevates it above ordinary objects, revealing the dynamic nature of heritagization.

Kirshenblatt-Gimblett (1995) previously conceptualized heritage as a form of cultural production in the present that derives meaning from the past. Within this framework, the process of heritagization emerges as a mechanism that amplifies various historical narratives to address contemporary needs, challenges, or contexts. As a socio-political construct, heritagization enables discourse and diverse viewpoints, as heritage is shaped by collective determinations regarding what qualifies as 'heritagizable.' This process entails deliberation, selection, contention, and negotiation. Thus,

heritagization functions as a politically motivated practice of value attribution, designating significance to locations, individuals, artifacts, traditions, histories, or concepts as inheritances from previous eras (Park *et al.*, 2018). This perspective emphasizes the interplay between historical processes that shape distinct socio-political formations and the evolving cultural narratives crafted to enhance heritage's significance. Such an approach acknowledges that heritage is not a static entity but a dynamic construct influenced by both national and international commitments (Gillot *et al.*, 2013).

5.2 Comparison with Previous Studies

AlShaikh (2024) highlights that as societies undergo globalization, urbanization and rapid modernization, the significance attributed to heritage evolves, reflecting contemporary socio-economic challenges. Consequently, perceptions of what constitutes heritage are subject to change, influenced by the current needs and interests of local communities. This dynamic nature of cultural heritage necessitates adaptive preservation strategies that align with present-day values. Implementing heritagization processes can thus serve as a modern heritage safeguarding approach, contributing to the construction and reinforcement of the identity of the nation's experiencing challenges related to cultural heritage (Masri *et al.,* 2025) (Fig.5).

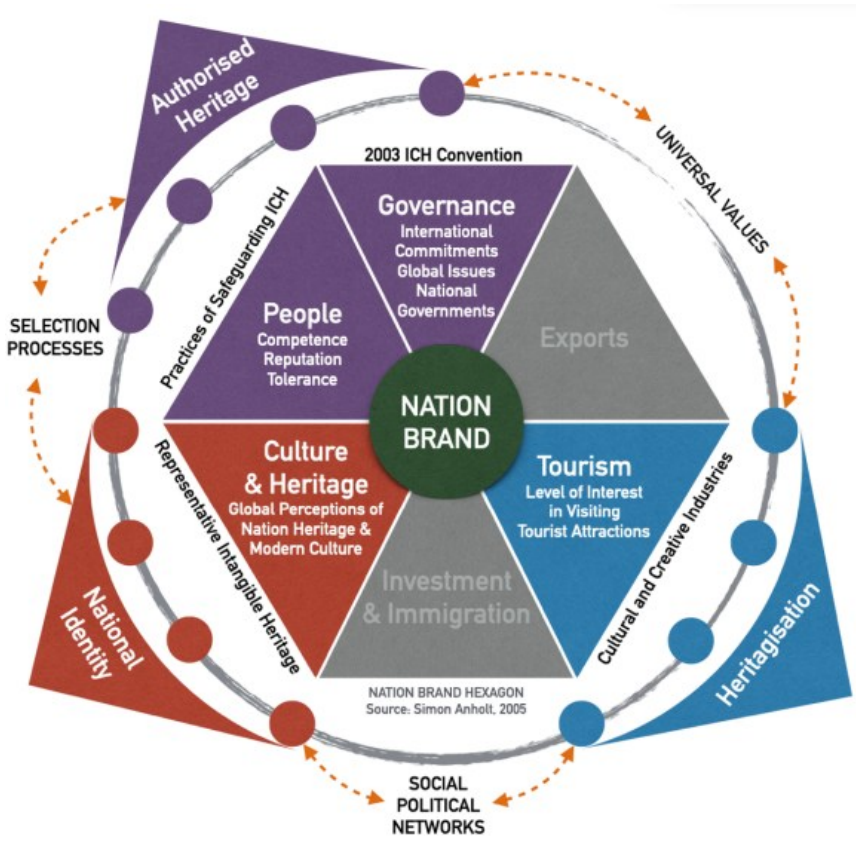

Figure 6. Heritagization as a socio-political construct linking authorized discourse, nation branding, and national identity.

Although AlShaikh's framework based on Anholt (2005) study focuses on the intangible cultural heritage, its application is appropriate in the context of urban regeneration where socio-economic revival through socio-political networks, universal values and most importantly selection processes upgrade the heritage and provide opportunities for the government as well as the local community aiming to reap the positive benefits of the heritagization process. It also reveals how national and international commitments play a pivotal role in steering the heritagization process beyond mere heritage preservation and more toward the celebration of cultural heritage, highlighting heritagization as a socio-political construct.

5.3 Implications and Future Directions

Recognizing heritagization as an inherently socio-political construct also requires understanding how its dynamics unfold differently across political and geographic contexts. State and non-state actors operating at the national or international level shape the heritagization process in ways that may be celebrated in one setting yet criticized in another. What might be viewed as a manipulation of heritage on the Western side of the globe can, under different political frameworks, produce meaningful urban regeneration in Eastern contexts. These dynamics can also operate vice versa. By mapping the "of," "to," and "for" dimensions of heritagization that dictate these dynamics, the analysis above acknowledges the role of political agendas in steering these heritagization processes beyond heritage preservation. Moreover, by understanding the dynamics through the process diagrams illustrated in the study (Figs. 4 & 5), heritagization-driven urban regeneration can opt for a bottom-up approach, thereby strengthening heritagization's theoretical foundations and ensuring its context-sensitive application.

For instance, in Western contexts, heritagization is strategically leveraged as a tool for socio-economic growth, focusing on rewriting history, incorporating immigrants' heritage, countering gentrification and commodification or branding of heritage. Conversely, in Eastern regions, the process is still evolving, with a primary focus on addressing socio-economic disparities and ensuring equitable access to heritage resources. The focus remains on invoking a sense of nostalgia, fantasizing the post-colonial heritage, countering economic decline and commodification, brandification and touristification of heritage for socio-economic gains. This contrast highlights the differing priorities in the heritagization process and the need to dissect the East-West dichotomy.

Thus, understanding heritagization as a socio-political construct also reveals that heritage status is conferred upon objects through a combination of societal valuation, recognition of their distinctive attributes, and the political processes that elevate them above everyday artifacts. This understanding will further assist Critical Heritage Studies to move beyond the East-West binary, emphasizing fluid cultural flows, multiple heritages, and the hybrid forms of heritage-making processes that emerge through global interconnections.

6. Conclusion

The primary aim of this paper was to scrutinise the dynamics of heritagization within urban regeneration and, in particular, to interrogate the oft-assumed East–West divide in heritage practice. By assembling and analysing a broad, chronologically ordered body of literature, we demonstrated that heritagization is not a monolithic Western export but a globally variable process shaped by local agency, historical circumstance and contemporary development agendas. This finding meets a key gap identified in Critical Heritage Studies, where sweeping generalisations about "Western hegemony" have tended to obscure the diverse rationales and trajectories of heritage-led regeneration elsewhere.

Our comparative reading revealed two dominant, though overlapping, regional tendencies. In many Western cases, heritage is mobilised chiefly as an economic commodity, branding districts for cultural tourism, attracting investment and supporting post-industrial place-making. Conversely, Eastern examples more frequently leverage heritage as an instrument of post-colonial identity reconstruction, state legitimation and socio-economic uplift. Crucially, both clusters show that the selection, elevation and display of heritage are invariably intertwined with questions of power: who authorizes the narrative, who reaps the economic return and who is displaced or silenced in the process. Heritagization, therefore, functions less as a cultural practice in conservation and more as a socio-political construct for negotiating collective memory, national identity and institutionalized narratives.

The analysis further illustrates that heritagization is rarely linear. Processes of re-heritagization, de-heritagization and even simulacral re-invention (as observed in Kiruna, Groningen, Dalian and Lijiang) show that heritage statuses can be revoked, re-scaled or entirely fabricated to match shifting policy goals or market appetites. Such plasticity carries opportunities for imaginative reuse

of the past, yet it also exposes heritage to cycles of gentrification, touristification and superficial aestheticisation. The study's process diagrams map these recurrent dynamics, offering a transferable tool for diagnosing how economic aspirations, ideological projects and preservation logics coalesce in different political economies.

While illuminating, the research is framed by two limitations. Firstly, it concentrates on heritagization within urban regeneration, leaving rural and natural-heritage contexts for future inquiry. Secondly, the broad categorical use of "East" and "West" elides finer-grained sub-regional variations—for instance, between South-East and North-East Asia, or between Mediterranean and Nordic Europe. Addressing these nuances will require targeted fieldwork and stakeholder interviews capable of capturing situated voices that desk-based literature reviews inevitably miss.

In sum, the paper positions heritagization as a dynamic, contested and profoundly socio-political practice that transcends the East-West binary. Recognising this complexity enables planners, policymakers and scholars to move beyond essentialized narratives towards more context-sensitive, inclusive and reflexive heritage strategies. Future research should refine the process diagrams through case-specific testing, explore intangible-heritage iterations of urban regeneration and examine how emergent risks—climate change, digital commodification and mass displacement—are re-shaping the process of heritagization in twenty-first-century cities.

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The author(s) declare(s) no conflicts of interest.

Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding authors.

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Credit author statement

S. H.: *Conceptualization, Methodology, Writing – Original Draft, Formal Analysis* – Contributed to the conceptualisation and design of the study, developed the methodological framework, and drafted the initial manuscript. M. R.: *Writing – Review & Editing, Supervision* – Critically reviewed and refined the manuscript to enhance its intellectual rigour and provided the final structure.

All authors have read and approved the final version of the manuscript.

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What Do Egypt's New Urban Communities Need to Outperform? A Strategic Framework for Equitable Population Redistribution

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ABSTRACT

Low occupancy and persistent dependence on Greater Cairo reveal that Egypt's New Urban Communities (NUCs) cannot fully fulfil their foundational mandate of population redistribution. Grounded in polycentric urban governance theory, this study evaluates the effectiveness, livability, economic autonomy and strategic practice of twenty-two NUCs. Mixed-method analysis combined official statistics, spatial datasets and a questionnaire survey of fifty-four domain experts. Quantitative indicators show that, on average, NUCs have absorbed only 31 % of their planned residents; densities in five cities remain well below the UN-Habitat benchmark of 7,000 inh./km². Expert scores confirm low liveability (mean = 3.26/6) and merely moderate economic independence (3.92/6), while strategic review exposes unrealistic population targets and contradictory datasets across national platforms. Synthesizing these insights, the research formulates a five-phase integrated development strategy: (1) revise NUCA's vision in line with Egypt Vision 2030/2050; (2) establish an up-to-date geo-referenced database; (3) conduct SWOT diagnostics; (4) delineate mutual and unique development areas; (5) implement a realistic, priority-driven strategic plan that mobilises private partnerships and community input. The findings mirror international evidence that new cities risk privileging real-estate speculation over long-term socio-economic sustainability, providing a transferrable framework for corrective action and immediate implementation.

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Highlights:	Contribution to the field statement:
- Occupancy success is curtailed by fragmented and multi-factor governance structures. - Livability rating declines with high living costs and unaffordable housing. - Economic independence 3.92/6 stalls despite large industrial land allocations and housing supply. - Conflicting population datasets erodes strategic accuracy, lowering effectiveness and expected outcomes. - Five-phase framework—vision revision, geo-database, SWOT, tailored development, priority action—advances equitable redistribution and robust polycentric governance.	By integrating polycentric governance theory with mixed-method measures, this study exposes Egypt's New Urban Communities' 31 per cent occupancy shortfall and quantifies livability and economic independence gaps. It contributes an evidence-based, five-phase strategic framework that recalibrates targets, databases, and public-private participation, offering transferable guidelines for equitable population redistribution and urban performance.

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1. Introduction

Egypt's urban landscape has undergone significant transformation over the past four decades, with the national population nearly tripling to reach 107.2 million by 2025. Approximately 28% of this population is concentrated within the three governorates constituting the Greater Cairo Region (GCR), intensifying the pressure on existing urban infrastructure and resources. In response to these escalating urban challenges—rooted in complex global socio-economic and geopolitical dynamics (Husain & Nafa, 2020)—the Ministry of Housing, Utilities, and Urban Communities (MoHUUC) initiated strategic interventions aimed at reshaping the spatial and structural configuration of Egypt's urban system to support broader development goals.

Established in 1979, the New Urban Communities Authority (NUCA) was mandated to mitigate population congestion in Cairo and the Nile Valley by developing New Urban Communities (NUCs) in underutilized desert areas. These NUCs were envisioned as self-sustaining urban settlements capable of managing their growth independently of older metropolitan centres. This approach aligns with global trends in urban expansion adopted by lower-middle-income countries seeking to manage rapid urbanization, redistribute population, and catalyze economic growth through large-scale, planned developments (Sorensen, 2018). Comparable efforts, such as Morocco's Bouregreg Valley and India's Dholera Special Investment Region, similarly aim to establish new economic poles through strategic investments in infrastructure and urbanization. However, these initiatives often encounter persistent barriers, including insufficient attention to social equity, long-term livability, and sustainable economic generation, beyond real estate speculation (Burger & Meijers, 2012; Aligica & Tarko, 2012).

NUCA has overseen the creation of twenty-two NUCs across three generational waves, with a projected capacity to accommodate 12 million inhabitants and absorb 50% of Egypt's annual population growth. A fourth generation, launched in the early 2000s, is planned to house an additional 30 million people. Despite this ambitious agenda and extensive financial investments, NUCs have recorded average occupancy rates standing at a mere 31% (Kadry & Husain, 2024).

Numerous studies have documented dissatisfaction among NUC residents (Kotby et al., 2021; Elnady, 2024; Kadry & Husain, 2024). Residents have reported concerns related to safety, availability and quality of services, accessibility to public transport, housing affordability, walkability, recreational and green spaces, and access to employment opportunities and social infrastructure (Haseeb, 2017; Abdel Raheem et al., 2020; Kotby et al., 2021; El Sebai, 2023; Kadry & Husain, 2024). These qualitative experiences corroborate the quantitative data and suggest that NUCs have not met their central objective of population redistribution and liveable urban development.

Existing literature has identified various structural and policy-level challenges contributing to this underperformance. These include weak inter-governmental coordination, limited institutional capacity, outdated legislative frameworks, fragmented planning, unrealistic growth targets, and a lack of coherent national urban policy (Nada, 2014; Ahmad, 2015; Salem & Monir, 2017; Haseeb, 2017; Darwish et al., 2019; Mohammed, 2019; Shawkat, 2020; Abdel Raheem et al., 2020; Hegazy, 2021; Kadry & Husain, 2024). In response, a number of reforms have been proposed. These include strengthening urban growth management (Tipple, 1985), promoting decentralization (Soliman & Sharaf El-Din, 1999), enhancing private sector engagement (Amin et al., 2004; Ghalib et al., 2021), prioritizing the regeneration of existing NUCs over the development of new ones (Sims, 2014; Kadry & Husain, 2024), and expanding local economic activities (Yoseph, 2020; Hegazy, 2021).

Nevertheless, the fragmented and siloed nature of these reform attempts suggests a lack of integrated vision. Despite good intentions, they have failed to reverse the stagnation in occupancy rates or improve resident satisfaction. This evidences a critical gap in both theory and practice, highlighting the necessity of a holistic, strategic framework to enhance the socio-economic performance and demographic efficacy of Egypt's NUCs.

To address this gap, the present study adopts the lens of polycentric urban governance theory, which focuses on how decision-making authority is distributed among multiple actors, including

central and local governments, developers, and community stakeholders. This framework is increasingly recognized as vital in assessing the multi-scalar governance structures shaping urban outcomes (Ostrom, 2010; Finka & Kluvánková, 2015). We argue that effective urban development of Egypt's NUCs, as demonstrated in this study, requires a networked governance approach in which overlapping authorities collaborate to deliver integrated services, cultivate social cohesion, and foster sustainable economic autonomy (Ostrom, 2010; Li et al., 2022).

Accordingly, this paper investigates the question: Is the current development strategy for Egypt's New Urban Communities appropriate for achieving population redistribution? The remainder of this article is structured as follows: Section 2 provides a historical background and literature review on the development of NUCs. Section 3 outlines the study's methodology, including variable definitions, data collection, and expert survey design. Section 4 presents the analytical findings. Section 5 concludes by proposing a comprehensive, multi-phase strategy for revitalizing Egypt's NUCs in alignment with principles of integrated urban development and polycentric governance.

2. Background and Literature

2.1. Historical Background

In the 1950s, the Cairo Governorate had a population of 2.8 million, about one-sixth of today's numbers, growing at over 6% annually due to rapid industrial expansion and infrastructure development. However, the 1967 war disrupted this growth, causing economic strain and prompting a mass migration to Cairo, which experienced a 65% population increase from 1950 to 1970. To address overcrowding, the government introduced spatial planning policies in the 1970s to create self-sufficient communities, focusing on affordable housing for low- to medium-income households through the NUCs (Becard, 1985; Sims, 2014).

The main objective of establishing NUCs in Egypt was to stimulate development through various industries and services. For instance, El Obour City sought to decentralize the wholesale agricultural market from Rod El Farag in Cairo, while the 6th of October City concentrated on enhancing tourism and agro-processing. New Noubaria and New Salhia were designed to integrate reclaimed land into the national framework and improve agricultural activities. These communities aim to reduce travel to major cities like Cairo and Alexandria, thus alleviating congestion (Stewart, 1996).

However, the NUCs have not effectively reduced the population density in the Greater Cairo Region (GCR), which includes Cairo, Giza, and Qalyubia and is home to about 28% of Egypt's population. A comparison of the Greater Cairo Region in 1997 and 2022, as shown in Figures 1 and 2, reveals that the region has developed several centers, expanding into the eastern and western deserts. Nevertheless, most new cities have emerged in the eastern desert and often seem incomplete or inadequately organized. Furthermore, despite the growth of these new cities, the population concentration in Cairo remains high. This situation underscores the need for a revised development approach to enhance the appeal of these new cities and promote a more balanced population distribution away from Cairo.

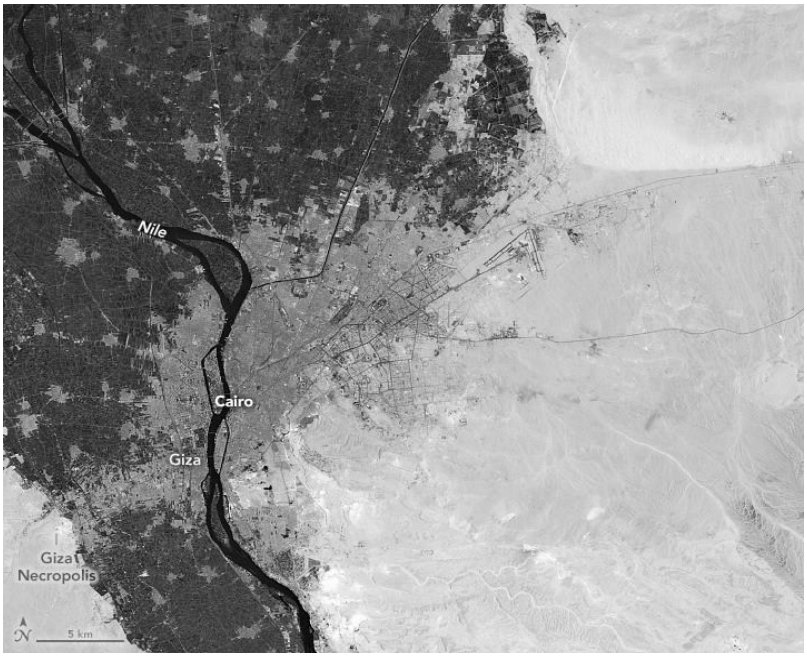

Figure 1. Greater Cairo Region in 1977.
Source: Google Earth, modified by the authors.

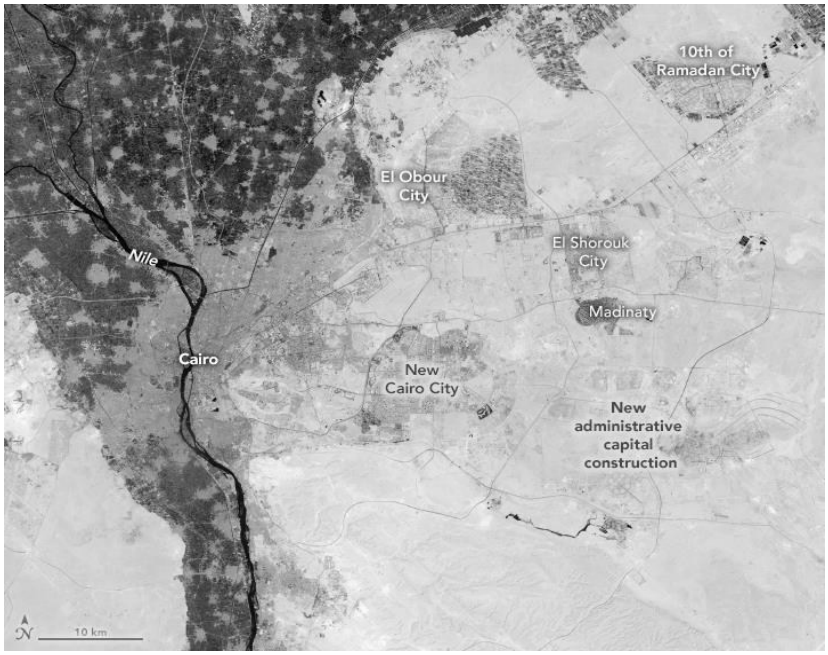

Figure 2. Greater Cairo Region in 2022
Source: Google Earth, modified by the authors.

2.2. Literature Review

The low average occupancy rate of NUCs in Egypt, combined with dissatisfaction among their residents, raises concerns about the effectiveness of these communities in redistributing the population. Two overlapping streams of literature can be identified in this regard. The first stream has focused on various aspects of the NUCs' urban development policies, their attraction and contribution, sustainability, housing affordability, and quality of life. It has highlighted several reasons hindering NUCs' effectiveness and residents' satisfaction. These reasons include weak national coordination, insufficient organizational capacity, outdated legal frameworks, unrealistic and exaggerated growth goals, and fragmented development policies (Nada, 2014; Ahmad, 2015; Salem & Monir, 2017; Haseeb, 2017; Darwish et al., 2019; Mohammed, 2019; Shawkat, 2020; Abdel Raheem et al., 2020; Hegazy, 2021; Kadry & Husain, 2024).

The second stream of literature has focused on making NUCs more appealing to residents to redistribute the overpopulation in Egypt. Suggestions presented in prior studies include developing of NUCs in conjunction with effective growth control and proper planning (Tipple, 1985), promoting decentralization (Soliman & Sharaf El-Din, 1999), encouraging private investor participation (Amin et al., 2004; Ghalib et al., 2021), ensuring better organization alongside effective growth management (Barrada, 2006), prioritizing the enhancement of existing NUCs instead of introducing new ones (Sims, 2014; Kadry & Husain, 2024), launching services and economic activities (Kenawy, 2017; AbouKorin, 2018), and modifying fundamental urban development processes while and implementing socio-spatial strategies (Yoseph, 2020; Hegazy, 2021).

Despite numerous explanations for residents' dissatisfaction with Egypt's NUCs, highlighted by low occupancy rates, a review of previous studies reveals a significant research gap. Although earlier studies have identified several reasons for this dissatisfaction and proposed various solutions to improve occupancy rates, further research is essential to develop a comprehensive strategy for enhancing the effectiveness of NUCs in Egypt. This conclusion is backed by findings from prior studies, which indicate that the lack of a clear long-term integrated urban development strategy has resulted in increased investment in NUCs without optimizing resource use (Darwish et al., 2019; Shehata et al., 2022; Bahgat, 2023).

Thus, drawing on the polycentric urban governance theory, we argue that the fragmented and multi-actor governance structures inherent in NUCs significantly shape their socio-economic outcomes, particularly in fostering genuine livability and economic self-sufficiency. From the perspective of polycentric urban governance, the effectiveness of NUCs is not solely determined by central planning; it also depends on the coherence and coordination among diverse governing actors. Livability, in this context, arises from how effectively these fragmented authorities can provide integrated services and create a sense of community, rather than being merely a result of top-down design. Economic independence is influenced by the extent to which local economic development is supported by various actors, not just through state investment. Ultimately, the strategic approach to urban development within NUCs reflects the complex interplay of power dynamics and decision-making across these multiple centers (Ostrom, 2010; Li et al., 2022). Therefore, this study addresses the following research question: Is the current NUC's development strategy appropriate for population redistribution in Egypt?

3. Materials and Methods

3.1. Variable Measurements

Four key variables—effectiveness, livability, economic independence, and strategic practices—were used to assess the success of NUCs in Egypt and develop an effective integrated urban development strategy.

Effectiveness refers to the NUCs' ability to redistribute the population away from the Greater Cairo Region and the Nile Valley. Livability pertains to the availability of facilities and services that impact residents' quality of life (Shamsuddin et al., 2012; Chiu, 2019; Kotby et al., 2021; Sanni-Anibire & Adenle, 2022; Koçak Güngör & Terzi, 2024). Economic independence reflects the NUCs' capacity to operate and develop autonomously without relying on nearby major cities. Lastly, strategic practices involve strategic planning and goal-setting within the NUCs (ElShamy & Nadim, 2020; Shehata et al., 2022).

Each of the previously discussed variables is measured as follows: The effectiveness of the NUCs is assessed by occupancy rates, population concentration in the Greater Cairo Region, and the achievement of the NUCs' mandate objectives (Nada, 2014; Salem & Monir, 2017; Kadry & Husain, 2024). According to Kadry and Husain (2024), livability is evaluated based on adequate maintenance operations, sufficient green and recreational spaces, affordable living costs, reasonable housing prices, appropriate public transportation, and adequate security and safety measures. The economic independence of the NUCs is evaluated by the availability of healthcare services,

educational resources, housing units, job opportunities, essential goods and services, and investment opportunities (Kenawy, 2017; Salem & Monir, 2017; ElShamy & Nadim, 2020; Shehata et al., 2022; Kadry & Husain, 2024). Finally, strategic practices are examined by focusing on the strategic vision and priorities that guide decision-making, ensuring data accuracy (Abdel-Kader & Ettouney, 2013; Elsisy et al., 2019; Nadim, 2022), setting realistic goals (El Menchawy, 2008; Ahmad, 2015; Aboelnaga, 2017), and considering city expansion (Moller, 1998; Barrada, 2006; Ellahham, 2014).

3.2. Data Collection and Sampling

This research utilized secondary and primary data sources. Secondary data were collected from various published sources, including the NUCA website, the Citypopulation.ed website, the City Development Authority (CDA), the Egyptian General Surveying Authority (EGSA), the General Authority for Topographic Maps, and the Central Agency for Public Mobilization and Statistics (CAPMAS).

Primary data was gathered by designing a questionnaire to assess the opinions of professional experts in the NUCs in Egypt, including professors, architects, urban planners, affiliates of the New Urban Communities Authority (NUCA), consultants, practitioners, and master's and Ph.D. researchers) using a six-point Likert-type scale (where 1 = Strongly Disagree; 6 = Strongly Agree).

Given the widespread geographical distribution of the NUCs and the professional experts, it was challenging to reach all cities across the three generations and engage with all the experts. Therefore, a questionnaire was created using Microsoft Forms and distributed online in October 2022, targeting professional groups and societies specializing in NUCs in Egypt. The response period was open for one month, resulting in 60 questionnaires being collected, with 54 valid responses for analysis.

The Statistical Package for the Social Sciences (SPSS) program is utilized to conduct quantitative analysis. The variance of responses from each respondent did not show any zero values, with a minimum of 3.3, indicating no signs of a straight-liner problem in the datasets (i.e., the same answer for all questions from the same respondent). Furthermore, the one-way Analysis of Variance (ANOVA) test did not show significant differences among the respondents' answers across various demographic variables (the F-test was not significant in any case, as $p>0.05$). Additionally, the validity and reliability of the questionnaire were confirmed, with Cronbach's $\alpha > 0.70$ for each scale, and the Pearson correlation coefficients between each scale and its items were significant ($p<0.01$).

Table 1 presents the descriptive statistics of the professional experts' sample. The gender distribution among the experts is 68.5% male and 31.5% female. The largest percentage of experts (27.8%) falls into the 40<50 years old category. Approximately 70.4% of the respondents have at least ten years of experience. Furthermore, the areas of expertise among the respondents are diverse, covering fourteen disciplines. For instance, nearly 33.3% of the respondents are professors of architecture and urban design at various universities in Egypt. In addition, 57.4% of the experts have participated in NUCs projects, with 32.3% having done so for over ten years. Moreover, 64.8% of the experts currently work or reside in NUCs, while 31.4% have worked or lived there for more than ten years. The NUCs where experts reported working or living include New Cairo (62.9%), 6th of October (11.4%), El Obour (8.6%), Sheikh Zayed (8.6%), El Shorouk (5.7%), and New Assuit (2.9%).

Table 1: Descriptive Statistics of Professional Experts Sample.

		N	Percent
Gender			
	Male	37	68.5%
	Female	17	31.5%
Age			
	<30	14	25.9%
	30<40	8	14.8%
	40<50	15	27.8%
	50<60	10	18.5%

>60	7	13%
Years of Experience		
<5	10	18.5%
5<10	6	11.1%
10<15	4	7.4%
15<20	6	11.1%
20<25	9	16.7%
>25	19	35.2%
Area of Experience		
Architect	9	16.7%
Urban Planner	4	7.4%
NUCA Affiliate	1	1.9%
Professor	18	33.3%
Practitioner	1	1.9%
Consultant	2	3.7%
Teaching Assistant	6	11.1%
Master's Degree	2	3.7%
Ph.D. Degree	5	9.3%
Designer	2	3.7%
Architect & Urban Planner	1	1.9%
Public Administration	1	1.9%
Businessman	1	1.9%
Professor & Urban Planner	1	1.9%
Participating in NUCs' Projects		
Yes	31	57.4%
No	23	42.6%
Years of Participation in NUCs' Projects		
<1	4	12.9%
1<3	9	29.0%
3<6	4	12.9%
6<10	4	12.9%
>10	10	32.3%
Working or living in NUCs		
Yes	35	64.8%
No	19	35.2%
Years of Working or Living in NUCs		
<1	2	5.7%
1<3	7	20%
3<6	7	20%
6<10	8	22.9%
>10	11	31.4%
Experts working or living in NUCs		
6th of October	4	11.4%
El Obour	3	8.6%
El Sheikh Zayed	3	8.6%
El Shorouk	2	5.7%
New Cairo	22	62.9%
New Assuit	1	2.9%
Experts working or living in NUCs Generations		
1st Generation	7	20%
2nd Generation	5	14.3%
3rd Generation	23	65.7%

Source: Developed by the authors.

4. Analysis and Results

4.1. NUCs' Effectiveness

Firstly, the study assessed the effectiveness of NUCs in redistributing the population by examining occupancy rates for each generation, evaluating the professional experts' opinions on NUCs' objectives, and analyzing population concentration in the Greater Cairo Region. The occupancy rate for the three generations of NUCs was calculated using published data from the NUCA Arabic website. This calculation involved dividing the actual population by the target population, and the results are presented in Figure 3.

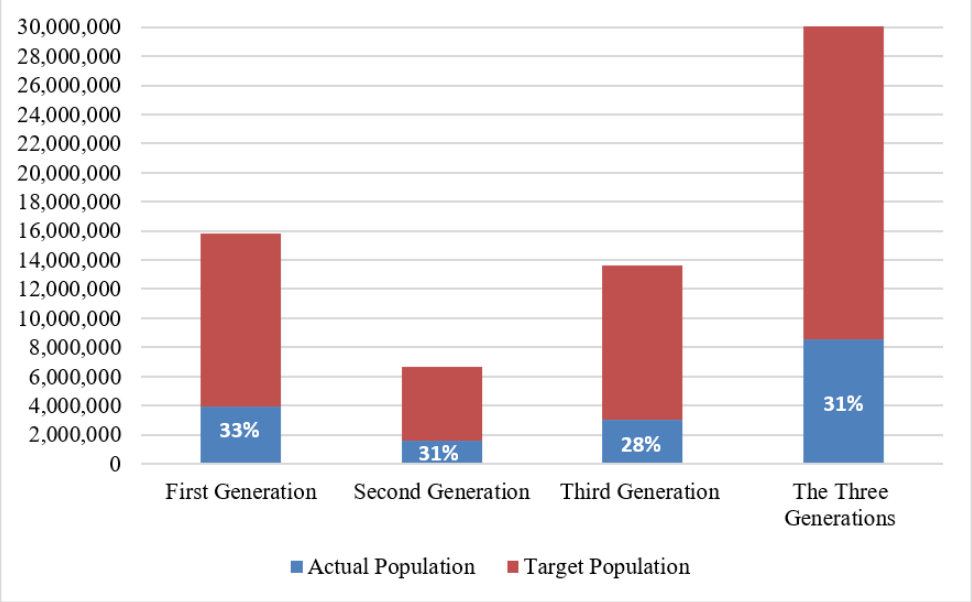

Figure 3. Occupancy Rate for the Three NUCs' Generations, Egypt
Source: Calculated by the authors from the NUCA Arabic website data.

The analysis revealed that the combined population of the three generations of NUCs is 8,543,000, while the target population stands at 27,489,500, indicating that only 31% of the target has been met. Additionally, the average actual-to-target population ratio decreases as we move from the first generation to the third generation, with the percentages being 33%, 31%, and 28%. Notably, if New Cairo City were excluded from the third-generation cities, the rate of decline would be even more significant.

Secondly, professional experts evaluated the effectiveness of the five objectives of the NUCs in Egypt, based on Articles 1 and 2 of Law No. 59/1979, as amended by Article 1 of Law No. 1/2018. The assessment utilized a six-point Likert scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Slightly Disagree, 4 = Slightly Agree, 5 = Agree, and 6 = Strongly Agree. The results are presented in Table 2, which indicates that the experts slightly agree that the NUCs are meeting their objectives, with an average score of 3.98. However, the goals of reducing urban sprawl on agricultural land and redistributing the population away from the Nile Valley received the lowest ratings, with scores of 3.48 and 3.70.

Table 2: Professional Expert's Evaluation of the NUCs' Objectives.

Objectives of Establishing NUCs in Egypt	Average Score
Reducing the urban sprawl on agricultural land	3.48
Redistributing the population away from the narrow strip of the Nile Valley	3.70
Creating new civilized centers that achieved social stability and economic prosperity	3.83
Establishing new attractions outside the scope of the existing cities and villages	4.31
Contributing to extending the urban axes to the desert and remote areas	4.61
Total Average Score	3.98

Finally, the evaluation of population concentration focused on the eight NUCs surrounding the Greater Cairo Region: New Cairo, 6th of October, 15th of May, Badr, Sheikh Zayed, El Obour, 10th of Ramadan, and El Shorouk. The total actual population in these cities is 7,209,950, representing 84.5% of the existing population across all Egyptian NUCs. In contrast, the target population for these communities is 19,204,500, which accounts for 65% of the overall target population. This results in an actual-to-target ratio of 69.8%. Population distribution in the Greater Cairo Region is illustrated in Figure 4, where the darkest areas indicate the highest population density. Figure 4 shows that population concentration decreases as one moves from the center of Cairo to the NUCs. According to the distribution data presented in Figure 5, the eight NUCs have not yet achieved 60% of their population targets, even after an average of 35 years since their establishment. Meeting these targets is crucial for alleviating pressure on the city.

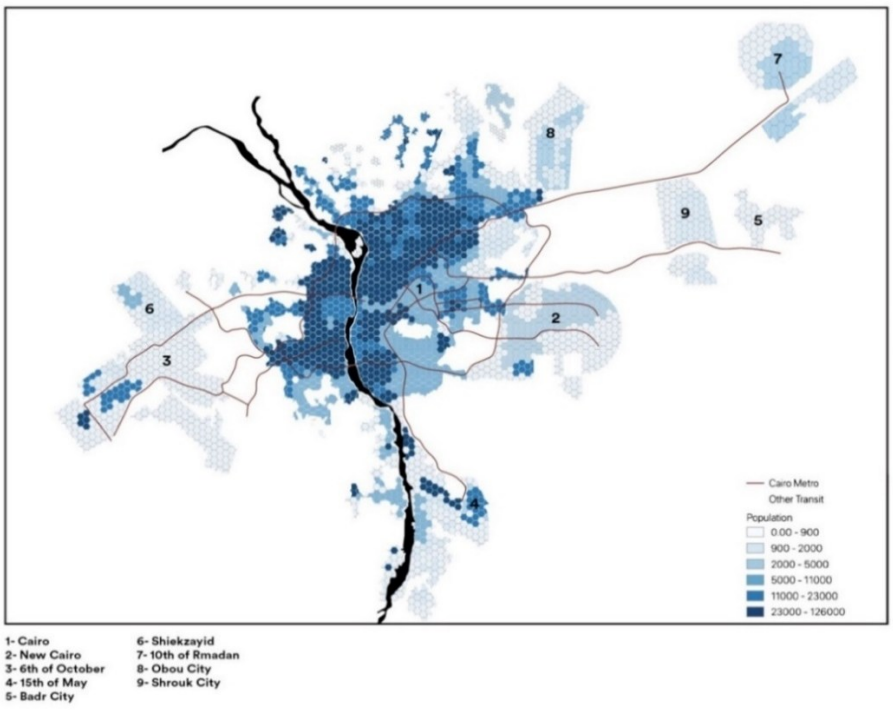

Figure 4. Population Distribution in the GCR and the Surrounding NUCs
Source: Developed by the authors from Kalila & Mahfouz (2019).

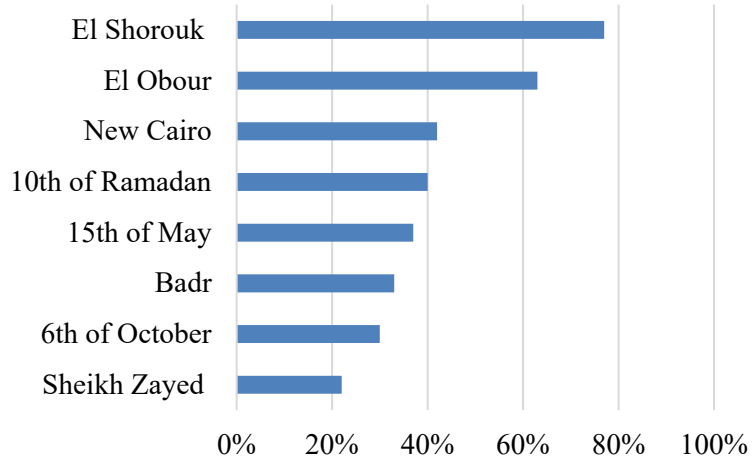

Figure 5. Percentage Achieved of Target Population in the NUCs Surrounding GCR
Source: Developed by the authors from the NUCA Arabic website.

Furthermore, the current population densities in five of the eight NUCs fall significantly below the UN-Habitat standard of 7,200 inhabitants per square kilometer for lower-middle-income countries, as illustrated in Figure 6. This indicates that a significant portion of Cairo's residents continue to live within the city itself.

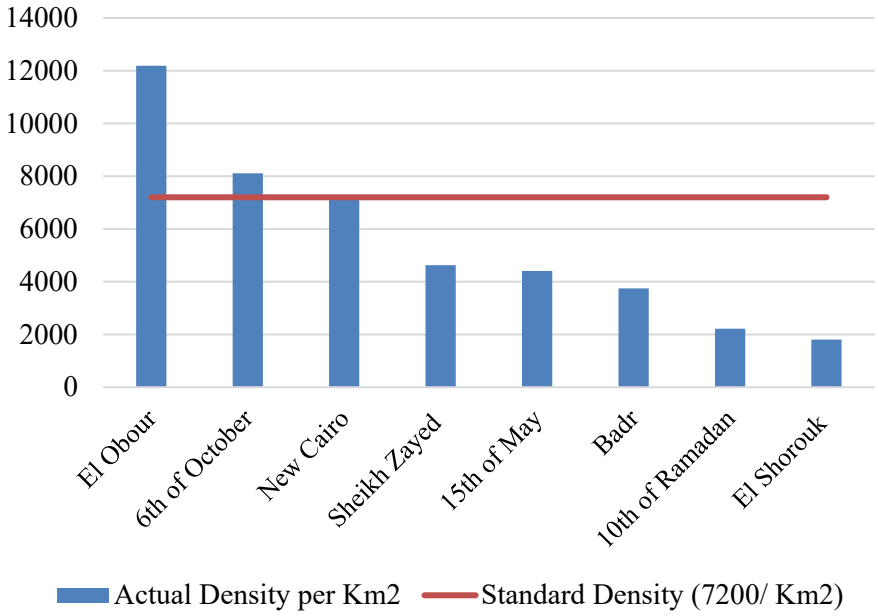

Figure 6. Population Density for the NUCs Surrounding GCR
Source: Developed by the authors from the NUCA Arabic website.

In conclusion, the low average occupancy rate of NUCs across various generations, moderate success in achieving their objectives, and the high population concentration in the Greater Cairo Region indicate that NUCs are ineffective at attracting and satisfying residents. As a result, they struggle to effectively redistribute the population throughout Egypt.

4.2. NUCs' Livability.

Table 3 assesses the livability of NUCs using seven indicators from the perspective of professional experts. According to these experts, the overall livability of NUCs is considered low, with a total average score of 3.26. Furthermore, the factors needing the most improvement are the cost of living,

affordable housing, and adequate public transportation, which received the lowest ratings from the experts.

Table 3: Professional Experts' Assessment of NUCs' Livability.

Indicators	Average Score
Lower cost of living	2.22
Affordable house prices	2.67
Appropriate public transportation	2.94
Adequate maintenance operations	3.48
Sufficient security and safety	3.54
Sufficient green and recreational spaces	3.69
Better living place	4.31
Total Average Score	3.26

4.3. NUCs' Economic Independence.

Table 4 evaluates the economic independence of NUCs using six indicators based on expert opinions. According to professional experts, the overall economic independence of NUCs is deemed moderate, with an average score of 3.92. The areas identified needing the most improvement are access to adequate healthcare services, the sufficiency of essential daily needs and wants, and the availability of sufficient job opportunities, which received the lowest ratings from the experts. The primary conclusion drawn from the experts' evaluation is that the economic development of NUCs still depends heavily on the nearby major cities.

Table 4. Professional Experts' Assessment of NUCs' Economic Independence.

Indicators	Experts
Adequate healthcare services	3.41
Available needs and wants	3.44
Sufficient job opportunities	3.52
Sufficient educational services	4.11
Available housing units	4.28
Available investment opportunities.	4.80
Total Average Score	3.92

4.4. NUCs' Strategic Practices.

The effectiveness of NUCs' strategic practices in redistributing the population in Egypt is evaluated based on their strategic vision and priorities, data accuracy, the realism of their goals, and decisions regarding city locations.

4.4.1. Strategic Vision and Priorities.

The strategic vision of the NUCA, according to its Arabic website, states "to achieve many of the social and economic goals called for by the revolutions of January 2011 and June 2013 to achieve social justice and ensure a decent life for all citizens by providing urban and residential communities with integrated services that include housing units suitable for all segments of society and their facilities, in addition to educational, health, cultural, and recreational services. The NUCA pays great attention to developing radical solutions to the problem of unsafe slums and unplanned areas and integrates them with urban and planned areas in Egyptian cities. Its programs and projects aim to increase the sector's contribution to gross domestic product growth and create hundreds of thousands of direct and indirect job opportunities."

While the strategic vision of the NUCA acknowledges many contemporary changes in both the national and international environments, it still requires further development. For instance, key components of Egypt's Vision 2030 and 2050 - emphasizing justice and social integration, such as

sustainability and the creation of a competitive, balanced, diversified, and knowledge-based economy - should be included in the NUCA's strategic vision. Additionally, the strategic priorities that outline goals, plans, and policies need to be clearly defined in the current vision of the NUCA. The short timeframe between generations suggests that a lack of prioritization may result in unrealistic goals, making it challenging to evaluate past experiences, address flaws, and develop effective learning strategies for future generations of the NUCA.

4.4.2. Data Accuracy.

Obtaining updated and accurate data about the NUCs can be challenging, as published figures vary significantly among different sources. For example, as shown in Table 5, the latest population estimates for 2023 for the 10th of Ramadan City differ widely across three websites: the Citypopulation.de website reports a population of 226,000. In contrast, the NUCA Arabic website claims the population is 850,000. The NUCA English website lists the population as 650,000. A similar discrepancy is noted for the 6th of October City, where reported populations are 355,000, 1,800,000, and 1,500,000, respectively.

Table 5: Actual Number of Inhabitants in NUCs from Different Sources.

G	N	NUCs	Citypopulation.de website	NUCA Arabic website	NUCA English website	Coefficient of variation
1st	1	10th of Ramadan	226000	850000	650000	13%
	2	15th of May	32000	335000	250000	15%
	3	El Sadat	66000	470000	300000	22%
	4	6th of October	355000	1800000	1500000	9%
	5	New Bourg El Arab	44000	177000	150000	8%
	6	New Damietta	51000	245000	150000	24%
	7	New Salhia	54000	42000	42000	0%
2nd	8	Badr	32000	280000	160000	27%
	9	El Obour	133000	661600	550000	9%
	10	New Minya	15500	77000	45000	26%
	11	New Noubaria	20300	35000	35000	0%
	12	New Beni Suef	29000	150000	75000	33%
	13	Sheikh Zayed	92000	398000	330000	9%
3rd	14	El Shorouk	90000	385350	170000	39%
	15	New Aswan	102	6000	6000	0%
	16	New Cairo	302000	2500000	1500000	25%
	17	New Assuit	8600	60000	30000	33%
	18	New Sohag	185	8000	8342	2%
	19	New Quena	1600	3000	NA	0%
	20	New Fayoum	418	3500	NA	0%
	21	New Akhmim	0	200	NA	0%
	22	Thebes	19000	47500	21000	39%

Source: Developed by the authors.

Furthermore, the targets achieved by NUCs published on the Arabic version of the NUCA website differ significantly from those on the English version. As shown in Figure 7, the percentage of targets met varies considerably between the two sites. For instance, El Shorouk reports that it has reached 77% of its target population on the Arabic website, while the English website states that it has only achieved 34%.

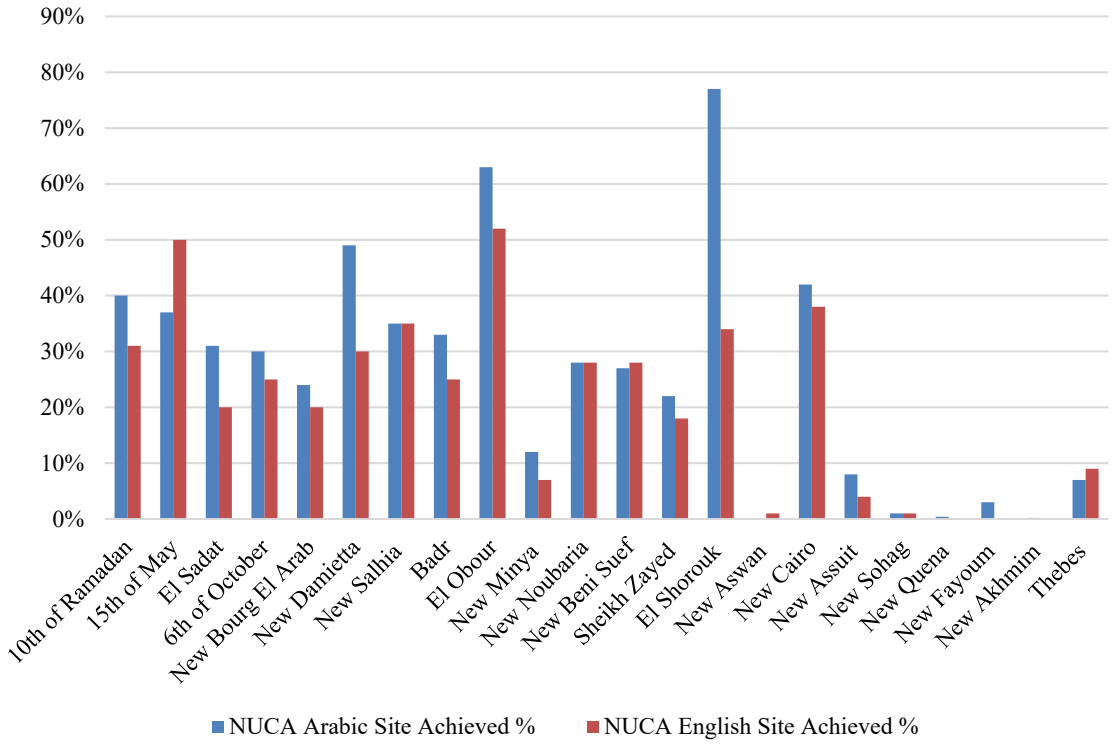

Figure 7. NUCs' Achieved Targets according to the NUCA Websites.
Source: Developed by the authors from the NUCA websites.

Similarly, New Damietta has achieved 49% of its target population on the Arabic site, in contrast to 30% on the English site. Additionally, the English version of the NUCA website does not provide data on the actual and target populations for several NUCs, including New Aswan, New Fayoum, and New Akhmim.

4.4.3. Goals' Realism.

The feasibility of the NUCs' goals was assessed by analyzing the actual and target population per housing unit, the density per square kilometer, and the years needed to reach the target population. Due to inconsistencies in previously published data on NUCs, the official data available in Arabic from the NUCA was used for the subsequent analyses. Figure 8 contrasts the actual and target population per housing unit in the NUCs with the average number of family members per housing unit. In Egypt, the average number of family members is five; however, the actual number of citizens per housing unit often does not align with this average. For instance, El Shorouk has an actual population of 14.8 citizens per housing unit, while the 6th of October has 8.7. In contrast, New Akhmim, New Fayoum, New Quena, and New Aswan report fewer than one member per housing unit. The situation becomes even more perplexing when the target population per housing unit is compared to the average family size. According to Figure 8, the targeted population per housing unit ranges from 5.3 in New Damietta to 115.4 in New Quena.

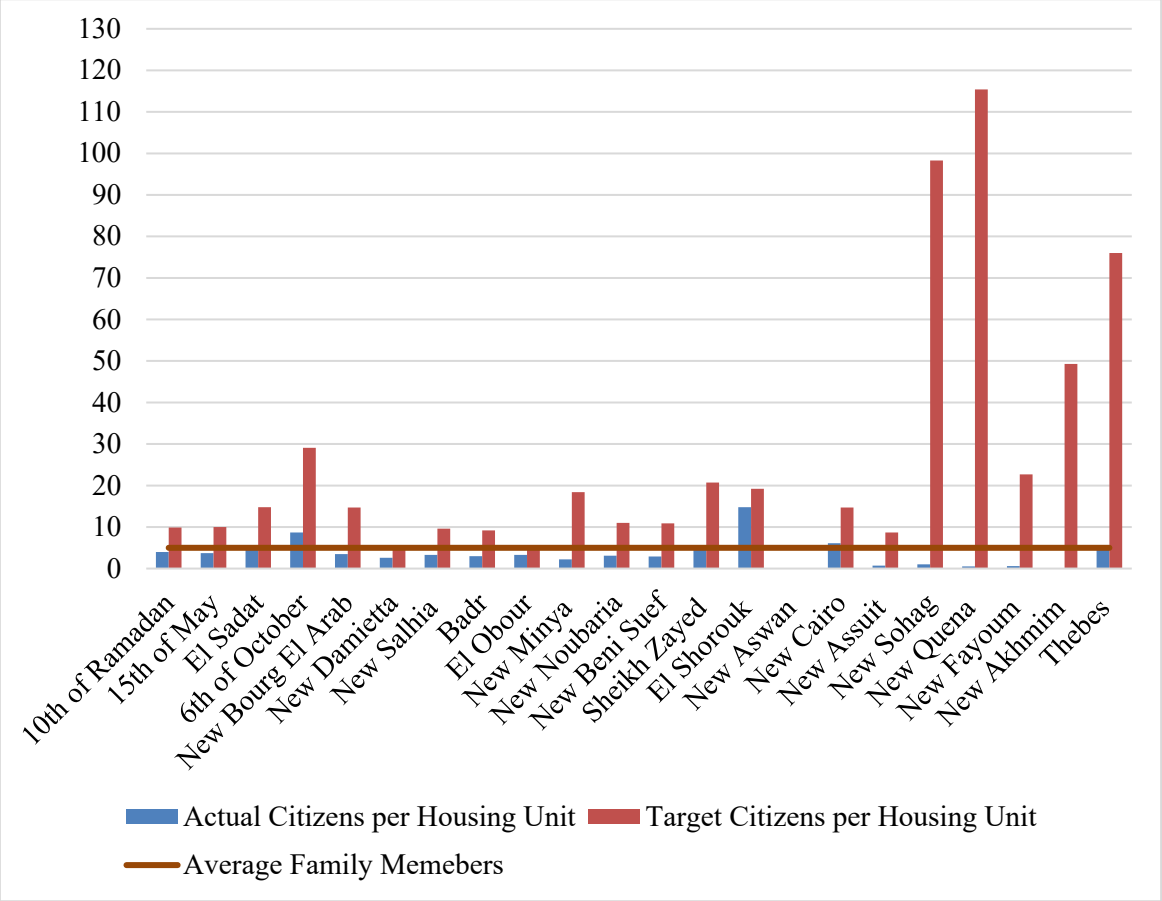

Figure 8. The NUCs' Actual and Target Citizens per Housing Unit Compared to Average Family Members.
Source: Developed by the authors.

Additionally, the actual and target population density per square kilometer for the NUCs was compared to UN-Habitat's recommended density of 7,200 citizens per square kilometer for lower-middle-income countries. As shown in Figure 9, most NUCs fall below this threshold, suggesting that these communities are less attractive. This contradicts the strategy of increasing the number of housing units and expanding construction in NUCs.

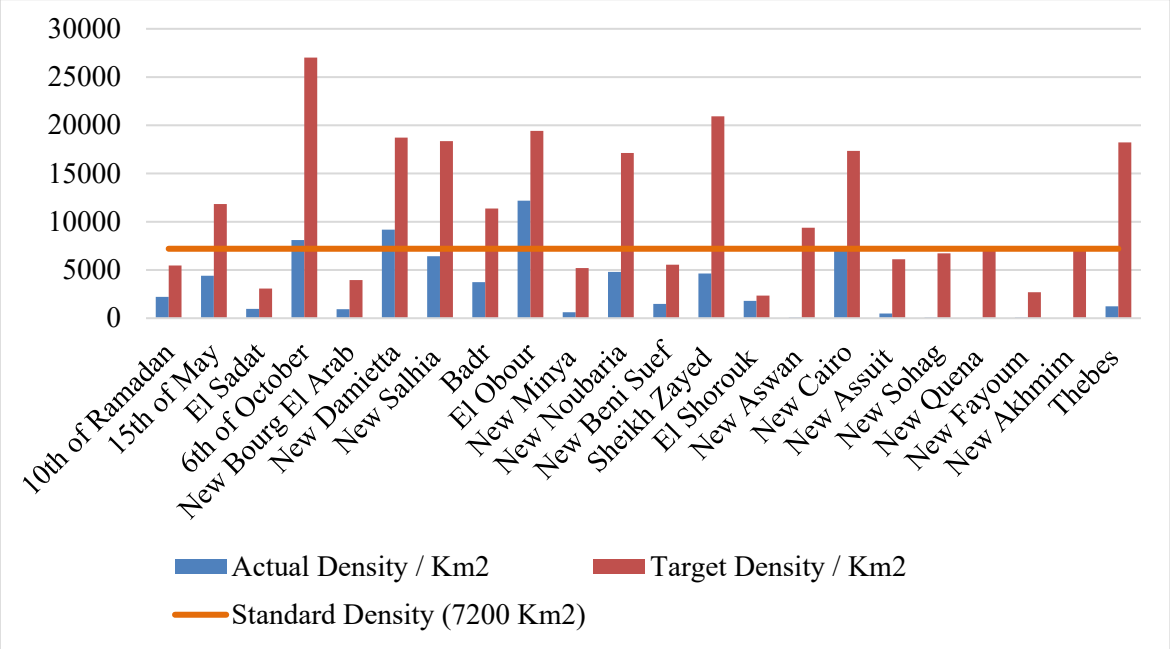

Figure 9. The NUCs' Actual and Target Density Compared to Standard per Km^2 .
Source: Developed by the authors.

Thus, the goals and targets set for the NUCs seem to be unrealistic and unattainable. For example, if the target population for the NUCs were to be achieved, it would likely lead to the same issues of high population density that are already problematic around Cairo. This scenario would require the establishment of additional NUCs to address the resulting challenges, contradicting the original objective of developing these communities.

Moreover, the Greater Cairo Region includes eight NUCs; these eight NUCs encompass two in the western desert (6th of October and Sheik Zayed), five in the eastern desert (10th of Ramadan, El Shorouk, El Obour, Badr, and New Cairo), and one in the southern suburb of Helwan (15th of May). The borders of these NUCs were initially determined under Law 59/1979, which established the NUCA. The lack of accurate data on NUCs and realistic goals has led to inadequately informed strategic decisions. This is evident in the expansions occurring in the NUCs surrounding the Greater Cairo Region, as illustrated in Figure 10. The figure depicts the current development status of the eight NUCs in this area, with their borders expected to be completed by 2030. However, many cities still have significant progress to make. For example, cities like 10th of Ramadan and New Cairo have only occupied about half of their allocated borders. Additionally, the 6th of October area had increased by at least seven times over its original surface area. Other cities have expanded their borders two to three times since their inception, but have not yet fully developed their initial areas. In conclusion, the vast scale of these cities also presents challenges in determining their optimal size and managing resource depletion. This aligns with what the professional experts reported when asked to assess the relevance of the location planning for the NUCs. The experts showed slight agreement that the locations of the NUCs significantly contribute to their goals, giving an average score of 3.83.

Figure 10. Borders of the Eight NUCs Surrounding the Greater Cairo Region
Source: Developed by the authors from Kalila & Mahfouz (2019).

5. The Proposed Integrated Development Strategy

Based on the above results, the current study proposes an integrated strategy for developing existing or potential NUCs in the subsequent section. As shown in Figure 11, this strategy employs a cohesive approach that incorporates feedback and learning from all components and phases.

5.1. Revising the NUCs' Vision

The proposed strategy starts by revising the vision and goals of the NUCs to align with Egypt's visions for 2030 and 2050. The revised vision could be: "To create sustainable, independent, and knowledge-based cities that promote justice, social integration, and community participation within a balanced ecosystem." The Ministry of Housing, Utilities, and Urban Communities (MoHUUC), along with NUCA, will oversee this revision.

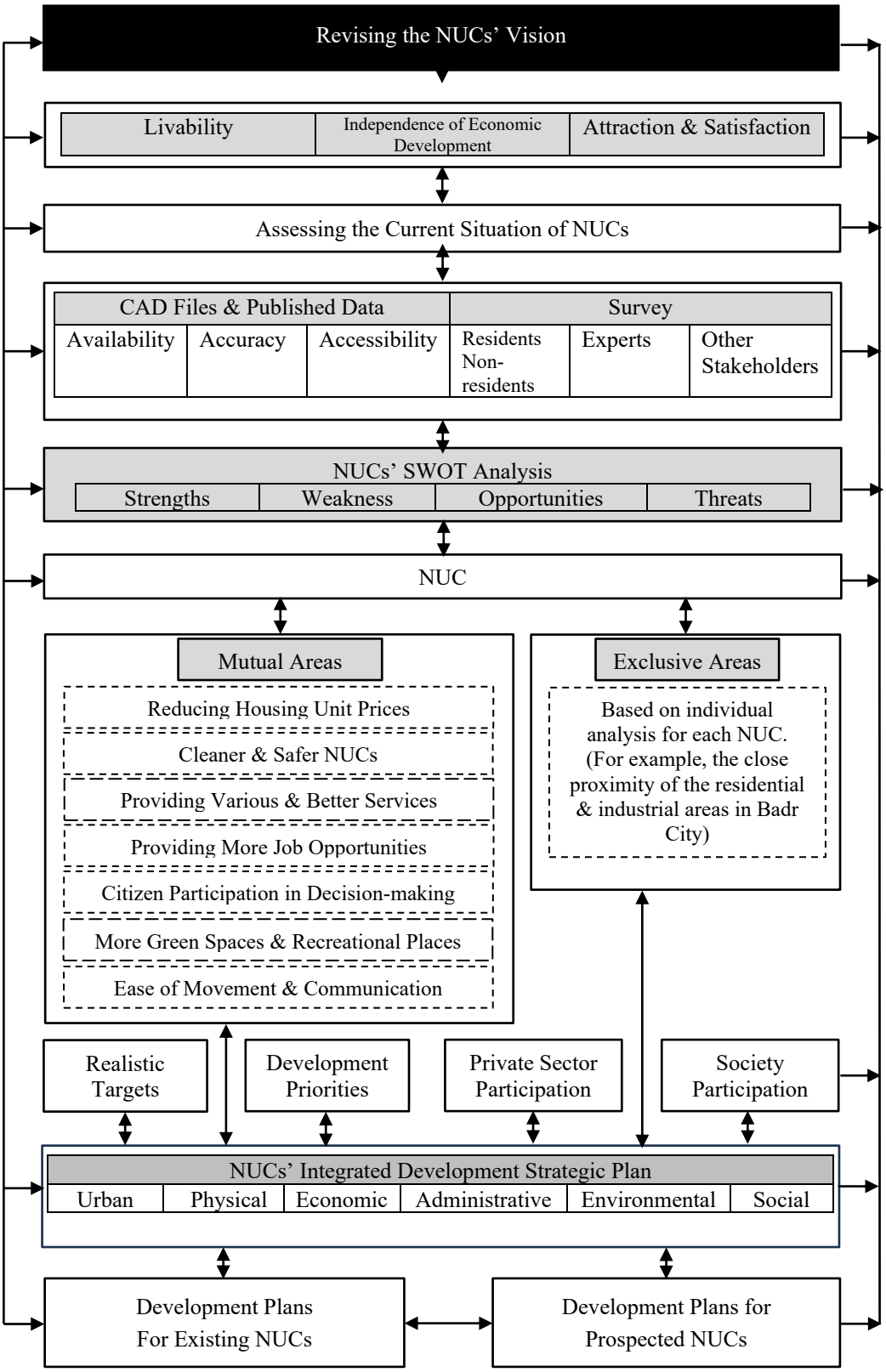

Figure 11. A Proposed Integrated Urban Development Strategy
Source: Developed by the authors.

5.2. Assessing the Current Situation of NUCs

The second phase of developing an integrated urban development strategy involves assessing the current situation of the NUCs. In this stage, it is crucial to evaluate the availability, accuracy, and

accessibility of various data sources, including CAD files, published reports, and surveys related to the NUCs.

The findings reveal that accurately assessing the achievements of the NUCs in meeting their target populations is challenging due to inconsistent published data. To address this, it's essential to create a comprehensive and updated database of Computer-Aided Design (CAD) files for all NUCs, as current files from institutions like the Egyptian General Surveying Authority (EGSA) and the NUCA are largely outdated, dating back to 2004. Furthermore, published data must be consistent and regularly updated. NUCA should review the data for all NUCs to resolve contradictions in reports regarding the number of inhabitants, vacant houses, and unoccupied land sold.

Furthermore, the current supply-driven urban strategies depend on top-down planning, frequently neglecting the needs and preferences of residents. In contrast, the proposed integrated regenerative urban strategy embraces a bottom-up approach, incorporating feedback from various stakeholders to enhance the development of NUCs. This strategy prioritizes gathering updated data through two surveys: the first targets residents and professionals to assess satisfaction and pinpoint areas for improvement. The second survey is conducted during the feasibility study of projected NUCs, aiming to understand the needs of future residents to ensure the community's attractiveness and suitability. These surveys bolster citizen participation initiatives, creating a comprehensive database for effective NUCs development in Egypt. Each City Development Authority (CDA) can administer the first survey. In contrast, NUCA will compile an integrated database and collaborate with the Ministry of Planning and Economic Development for the second survey.

5.3. Developing SWOT Analysis.

A SWOT analysis is a strategic planning technique that helps assess NUCs from four perspectives: Strengths (S), Weaknesses (W), Opportunities (O), and Threats (T). While strengths (and weaknesses) relate to internal factors that represent the advantages (and disadvantages) of NUCs, opportunities (and threats) focus on external factors that help (or hinder) them in achieving their goals. The primary goal of SWOT analysis is to increase awareness of the factors that should be considered when establishing a strategy. Thus, the third phase of generating an integrated urban development strategy involves the data from different sources presented in the preceding phase to compile a SWOT analysis for the Egyptian NUCs.

5.4. Determining NUCs' Areas of Development.

The fourth phase of developing an effective integrated urban development strategy involves examining the outcomes of the SWOT analysis conducted in the previous phase to identify potential areas for development in NUCs. These potential areas can be categorized into two groups: mutual (or standardized) development areas and exclusive (or unique) development areas. This classification aids in understanding the specific needs of each of the NUCs, prioritizing objectives, and allocating resources more effectively. Mutual or standardized development areas refer to factors shared among most NUCs that negatively impact residents' attraction and satisfaction. In contrast, exclusive or unique development areas consist of specific issues that affect only certain NUCs and are not present in all communities; these issues require urgent attention from their residents. For instance, Badr City has industrial activities that are close to residential areas. This layout can result in health problems, such as air and noise pollution. One proposed solution is to construct a green buffer zone to separate these activities, ensuring the health and safety of the citizens.

5.5. Deriving an Integrated Development Strategic Plan

The fifth phase of developing an integrated urban strategy focuses on creating a strategic plan for NUCs that addresses the needs of both current and potential residents while aligning with government capabilities. This plan should promote cohesive urban, economic, environmental, and social growth for existing and future NUCs. Its success depends on identifying areas for improvement and considering four key inputs: setting realistic targets, establishing development priorities, advocating for private sector partnerships, and promoting societal participation.

5.5.1. Setting Realistic Targets

This study identifies a key limitation affecting the success of NUCs in Egypt: their targets are often unrealistic. It is recommended that the NUCA consider the following when setting realistic targets and goals for their development plans:

- To determine the density of NUCs, NUCA can refer to a formal global standard source such as the United Nations Human Settlements Programme (UN-Habitat). According to UN-Habitat, the ideal population density for cities in lower-middle-income countries like Egypt is 7,200 people per square kilometer.
- To estimate the number of inhabitants in NUCs, NUCA can multiply the number of active electrical meters in each home by the average number of family members in Egypt, ranging from 4 to 5. Additionally, NUCA can enhance the accuracy of this estimate by calculating the average population for all months throughout the year, which helps minimize errors in the result.
- To decide the number of housing units required per NUC, the target population should be divided by the average number of family members, which in Egypt is typically between 4 and 5 members per household.
- To estimate the years required to reach the targets, NUCA can calculate the time by dividing the current population by the average yearly increase in citizens. The average annual increase in citizens represents the population growth rate over a specific period. According to the World Bank definition, this figure can be found by dividing the sum of the differences between the population at the beginning and end of each year by the number of years within that period. This method offers a consistent view of population changes instead of focusing on annual fluctuations, which may be influenced by anomalies.

5.5.2. Establishing Development Priorities.

Establishing development priorities is vital for creating an effective NUCs model tailored to Egypt's goals for population redistribution. This approach will benefit both current and future generations while minimizing resource waste. The NUCA should prioritize redevelopment based on three criteria: proximity to Cairo, annual migration rates, and community clustering.

The first criterion for selecting NUCs is their proximity to Cairo, with closer NUCs receiving higher priority for redevelopment. This strategy aims to alleviate pressure on Cairo and the Nile Valley. In contrast, NUCs that are farther away, such as New Luxor, will be lower on the priority list and require more time for improvement. The second criterion is the average annual migration to each of the NUCs. Average yearly migration is the average number of citizens who have migrated to the NUCs since their establishment, calculated by dividing the current population by the years since establishment. A higher average migration indicates a greater need for redevelopment, maximizing results with limited resources. The third criterion combines the age of the NUCs, the percentage of the target population achieved, and the proximity to Cairo. Cluster analysis can group these variables to enhance homogeneity within the groups and diversity between the groups.

5.5.3. Advocating Private Sector Partnership

The private sector is essential for developing mega projects and alleviating pressure on public resources. The NUCA should collaborate with the Ministry of Finance and other institutions to create incentives for private investment in NUCs, such as tax breaks and reduced land prices. Financial initiatives that offer low-interest loans can further stimulate this investment. Additionally, NUCA can explore Public-Private Partnerships (PPPs) to enhance collaboration, utilizing models like Build, Operate, and Transfer (BOT), Build, Operate, Lease, and Transfer (BOLT), and Build, Operate, and Own (BOO). These partnerships can promote residential development while benefiting the private sector.

5.5.4. Promoting Society's Participation

Promoting society's participation in developing NUCs is essential, as stakeholders have varying priorities. Therefore, the City Development Authority (CDA) should establish a "Consulting

Residential Group" in each NUC to identify trends, challenges, and feedback that help the planning process. Supporting these initiatives helps create databases for NUCs at the NUCA level to develop a well-structured new Egyptian urban community model while also contributing to reducing resource waste and the annual budget spent on NUCs.

6. Conclusion and Future Research

Existing evidence shows that the Egyptian New Urban Communities (NUCs) are viewed as a feasible option for redistributing the population from the Greater Cairo Region (GCR) and the Nile Valley. However, the persistent high population density in the GCR and the low occupancy rates in the NUCs indicate that further studies are necessary to develop an integrated strategy for enhancing the NUCs. Based on the theory of polycentric urban governance, this research contends that fragmented governance systems in developing NUCs significantly affect their livability, economic independence, strategic practices, and overall effectiveness. Analyses of expert insights, published data, and maps reveal that NUCs have not yet been able to redistribute Egypt's population effectively. The findings showed that the NUCs have not successfully redistributed the population across Egypt, as evidenced by the low average occupancy rates in NUCs over various generations, moderate success in achieving their objectives, and the continued high population concentration in the GCR. Moreover, the overall livability of the NUCs is rated as low, with significant improvements needed in areas such as the cost of living, affordable housing, and public transportation. Regarding economic independence, NUCs are moderately independent, as many still depend heavily on nearby major cities. Additionally, NUCA's outdated strategic vision, lack of accurate data on NUCs, and unrealistic goals for NUCs have resulted in inadequately informed strategic decisions.

Therefore, the study proposed an integrated urban development strategy for NUCs. The interconnected components of this strategy include revising the vision and strategic priorities of the NUCs, assessing the current situation, creating updated databases and CAD files, completing a SWOT analysis, and classifying development areas. The next phase involves deriving a strategic development plan that addresses the needs of both existing and potential residents while aligning with the government's capabilities. However, the success of the integrated development strategy relies on setting realistic targets, defining development priorities, and engaging the private sector and community. Furthermore, the proposed strategy assumes that development is a multi-stage process that ensures flexibility and harmonizes urban, physical, economic, administrative, environmental, and social development for current and prospective NUCs. The findings of this research align with global evidence suggesting that new urban cities often prioritize real estate speculation over long-term livability and sustainable economic value.

Although this study sheds light on the dynamics of NUCs in Egypt, its findings are limited by the measurement of the variables used, the data from experts' opinions, and the available published data and maps, which may not adequately reflect the complexity of the NUCs in Egypt. Thus, future research is invited to address these limitations by extending this study to different contexts, utilizing a larger sample size, and incorporating feedback from various stakeholders of the NUCs. Additionally, future studies could build upon the proposed strategy in this study by conducting comparative case studies to deepen our understanding of urbanization complexity in a global context.

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Conflict of Interests

The Authors declare that there is no conflict of interest.

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Data availability statement
All the relevant data from this study are available from the corresponding author upon request.

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Conceptualization: M.K.K., and H.R.H. Methodology: M.K.K., and H.R.H. Software: M.K.K. Validation: M.K.K., and H.R.H. Formal analysis: M.K.K. Writing-original draft preparation: M.K.K., and H.R.H. Writing-review and editing: M.K.K., and H.R.H. Visualization: M.K.K. All authors have read and agreed to the published version of the manuscript.

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Formalisation of the Informal: Can Vertical Community Spaces Enable Equitable High-Density Slum Upgrades in Bangkok?

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ABSTRACT

By 2050, nearly 68% of the global population will reside in urban areas, while 1.6 billion people already inhabit informal settlements lacking tenure security, basic services, and public space. This study explores whether vertically integrated community spaces can enable medium- to high-rise slum upgrading in Bangkok, where land scarcity constrains conventional low-rise approaches. A research-by-design methodology, conducted through a postgraduate studio in collaboration with a local community, informs the investigation. Spatial analysis, mapping, and participatory processes guided the development of modular walk-up block proposals, featuring stacked semi-public 'streets-in-the-sky' and compact communal spaces. These configurations offer vertical social interaction zones, economic potential via shophouses above ground level, and environmental benefits through enhanced daylight penetration and cross ventilation. Findings indicate an improved sense of belonging, social cohesion, and place identity despite vertical displacement. Vertically shared spaces demonstrate capacity to align high-density urban forms with evolving informal practices, providing a replicable, climate-responsive model for inclusive regeneration in rapidly urbanising contexts across the Global South.

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Highlights:

- This paper highlights informal settlements are not a problem to be solved but rather a condition to be understood.
- This research suggests the need for community participation in the development of slum upgrading projects in the Global South as part of sustainable urbanization practices.
- Vertical common or public spaces in high-density medium- to high-rise projects go beyond physical implications, but can also potentially reduce urban inequalities and enhance community resilience.

Contribution to the field statement:

This paper contributes to understanding the potential of community participation for informal settlement upgrade projects in Southeast Asian cities, as well as the socio-economic and environmental opportunities offered by the provision of vertical semi-public common spaces within such projects, as a way to reduce urban inequality and enhance community resilience.

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1. Introduction

Rapid urbanisation continues to redefine the global demographic landscape. At present, 55 % of the world's inhabitants reside in urban areas, and this proportion is projected to reach 68 % by 2050 (United Nations Department of Economic and Social Affairs [UN DESA], 2019). While the Global North experienced an extended, two-century transition to majority-urban status—crossing the 50 % threshold in 1940—the Global South is undergoing the same demographic shift at unprecedented speed and scale, moving from 18 % urban in 1950 to an anticipated 56 % by 2030 (United Nations Human Settlements Programme [UN-Habitat], 2014). Such acceleration contributes to the proliferation of slums and informal settlements: recent estimates suggest that 1.6 billion people already live in such conditions and that their number may climb towards three billion by mid-century (Boanada-Fuchs, Kuffer, & Samper, 2024; UN-Habitat, 2014).

Figure 1. Informal settlements along the canal in Khlong Toei, Bangkok, Thailand.

Asia sits at the epicentre of these transformations, currently housing 54 % of the world's urban population—over 2.2 billion people—and standing at 51 % urbanised overall (UN-Habitat, 2020). The region's cities enlarge by more than 40 million residents each year—well over 100,000 people per day—propelling a proliferation of megacities such as Bangkok, Ho Chi Minh City and Jakarta (Asian Development Bank [ADB], 2011). This velocity of growth strains infrastructure amplifies environmental degradation and deepens socio-economic disparities, particularly through the expansion of informal settlements whose footprints, densities and internal morphologies remain to be better understood (Ren et al., 2020; Visagie & Turok, 2020).

Within South-East Asia, urbanisation patterns vary markedly—from 22 % in Cambodia to roughly 50 % in Thailand and Indonesia, and 100 % in Singapore (Association of Southeast Asian Nations [ASEAN], 2022). In 2015, 47 % of the ASEAN population lived in urban areas; by 2030 this share is expected to reach 56 %, equating to some 405 million urban dwellers (ASEAN, 2022). Yet the benefits of urban growth remain unevenly distributed. Rising land values in central districts, coupled with limited affordable housing supply, push low-income households into marginal or interstitial spaces, leaving them vulnerable to eviction and chronic tenure insecurity (UN-Habitat, 2020).

Thailand—Southeast Asia's second-largest economy—offers a pertinent context for examining slum upgrading. Through a combination of top-down state initiatives and bottom-up community mobilisation, the country's *Baan Mankong* (secure housing) programme has enabled numerous informal communities to obtain tenure security and infrastructural upgrades. Nevertheless, Bangkok's dwindling supply of large, affordable land parcels now challenges the predominantly low-rise model on which such upgrade models were premised. Significant knowledge gaps persist concerning how medium- to high-rise, community-engaged upgrades might operate within the city's intensifying density and land-value pressures. Consequently, this research asks: What social, economic and environmental implications arise when vertical community spaces are incorporated into medium- and high-rise slum-upgrade projects in Bangkok?

To address this question, the study explores a research-by-design studio conducted during the 2023–2024 academic year at Thammasat University. Partnering with a local resettling community in

Chatuchak District, the studio employed mixed spatial analysis and mapping as well as community participation to propose designs for modular walk-up blocks that layer semi-public 'streets-in-the-sky', pocket common spaces and recreational zones. By foregrounding community participation, the studios sought to reconcile formal housing standards with informal livelihood practices, thereby supporting residents' Right to the City.

The paper proceeds as follows. First, it reviews the literature on informal settlements—definitions, prevalence and upgrading strategies in Thailand—situating the discussion within wider housing-policy debates. Second, it outlines the research-by-design methodology used to interrogate high-density, community-led upgrades. Third, it presents the two case-study proposals, contextualising them within their urban and socio-cultural milieu **(**Figure 2**).** Fourth, the discussion evaluates the environmental, social and economic opportunities and potential outcomes of vertical semi-public common spaces, referencing participatory feedback. Finally, the conclusion reflects on the broader implications for equitable, climate-sensitive slum upgrading across rapidly urbanising cities of the Global South and identifies avenues for future research on post-occupancy evaluation and financing mechanisms.

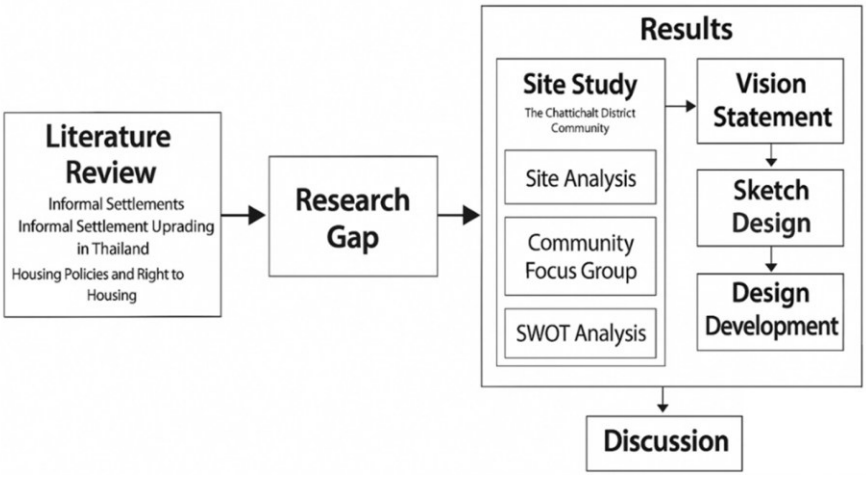

Figure 2. Structure of the Study.

2. Literature Review: Informal Settlements

Nowadays, the world is facing a severe urban housing crisis, with 1.6 billion people lacking adequate housing, of which one billion live in slums or informal settlements (UN-Habitat, 2020). According to the UN Department of Economics and Social Affairs, slums are urban areas in which housing is of poor quality and inadequate services, failing to meet at least one of the key conditions including access to improved water sources, access to improved sanitation, sufficient living areas, tenure security, and housing durability (UN DESA, 2020). Moreover, the prevalence of slums is driven by various forces such as rapid urbanization; ineffective planning; lack of affordable housing; ineffective urban and housing policies; lack of housing finance; and cycles of poverty and low incomes (UN-Habitat, 2020).

This crisis tends to be exacerbated by the failure of the state to adequately regulate the private housing market and inadequate attention to affordable or public housing (UN-Habitat, 2020). As a result, the cost of private housing has risen beyond the reach of low-income residents, forcing them to reside in slums in the suburbs or on the city's periphery, often in undeveloped spaces (UN-Habitat, 2020). These settlements often emerge spontaneously, unplanned and beyond state control, and are characterized by high density, congestion, poor environmental conditions, and recognized as messy or chaotic (Kamalipour, 2016; García-Villalba, 2015). In addition to the illegal occupation of informal clusters of temporary structures on the urban fringe, informal settlements are often self-constructed dwellings made from waste or recycled materials such as wooden boards or iron sheets and do not have formal building permits, thus being unauthorized or illegal constructions

(Kamalipour, 2016; Yap & De Wandeler, 2010; Suhartini & Jones, 2023). Furthermore, settlements located near the coast, rivers, canals or other water sources are vulnerable to environmental hazards, exacerbated by climate change, especially floods and heavy rains in Southeast Asia.

The global proliferation of slums is accelerating at an alarming pace, particularly in developing nations across Asia and Africa, such that the growth of informal settlements accompanying rapid urbanization is occurring at a rate of development that is unpredictable, where urban expansion typically corresponds with the formation of slums (UN-Habitat, 2012). Urban informalities, whether it be housing or economy, is both a process and a product, such that they are simultaneous modes of insurgent spatial production and regulation that typically occur through a condition of exceptionality (Kamalipour & Peimani, 2020; Sweeting, 2017). Urban informalities are developed in a self-organized manner, emerging organically and incrementally, however, this has become the norm rather than a deviation in the Global South, such that informality forms an integral part of both housing and economic activities (Kamalipour, 2016; UN-Habitat, 2020). Nevertheless, informal settlements can also demonstrate inventiveness, provide livelihoods, and be a vibrant place of residence, challenging conventional understandings of illegality and disorder (Kamalipour, 2016).

Similarly, public spaces are essential to street vendors and informal markets, open spaces such as passageways or other common areas in informal settlements play a critical role in the daily lives of families, where narrow streets are needed for keeping street vending units and motorcycles, or where a household may conduct some commercial or industrial activity (Usavagovitwong et al., 2013). In informal settlements, low-rise houses typically integrate residential and commercial, or spaces for rent as storefronts for home-based businesses (Usavagovitwong et al., 2013; Thai et al., 2022).

In contrast, Thailand's National Housing Authority's (NHA) supply-driven government-led public housing programmes tend to be designed vertically and taller to accommodate many households in a single block, but at the expense of ground-level public open spaces, which are essential for business operations and social interactions (Usavagovitwong et al., 2013). Therefore, improving housing for informal residents requires a comprehensive approach that not only focuses on housing, but also considers the residents' physiological needs (food, water, sanitation), security (economy, employment, health, education), and belonging (social identity, connection), along with open spaces for informal and income-generating activities, providing daily living for low-income households (Maslow, 1954; Usavagovitwong et al., 2013).

Figure 3. Public housing of National Housing Authority in Bangkok (left) and CODI Pathum Thani Model, relocated community in Pathum Thani, Thailand (right).

2.1 Informal Settlement Upgrading in Thailand - Formalising the Informal

Thailand has implemented top-down public housing strategies to tackle slums and informal settlements, such as the NHA social housing, but has also initiated bottom-up demand driven-approaches, particularly the *Baan Mankong* or secure housing programme operated by the Community Organizations Development Institute (CODI), a government institution under the Ministry of Social Development and Human Security. Acting as a key connection between formal

and informal systems, the *Baan Mankong* programme is a participatory approach towards upgrading, formalising, and legalizing communities through community-based savings, ownership, and execution, so as to improve the livelihoods of the people.

As indicated by the prior director of CODI, Somsook Boonyabancha, before the establishment of *Baan Mankong*, people lived under the persistent threat of displacement, where the only idea was to push slums and areas of illegal housing out of the city, without legally addressing the situation of these poor communities or their violations of various laws (Boonyabancha, 2006). As a consequence, the core principle of CODI's *Baan Mankong* programme is the transition of land tenure status from illegal to legal, and thus the formalisation of the informal, which in turn alters the relationships between the slum or squatter communities and the urban authorities due to the acceptance and legitimation of disadvantaged or marginalized urban populations as being integral parts of the city (Boonyabancha, 2006).

Baan Mankong is a people-oriented community upgrading initiative with a bottom-up, participatory approach, in which the community, as the collective owners of the project, are key decision-makers at every stage of the project, from design to implementation and construction (Boonyabancha, 2006; Usavagovitwong et al., 2013). The communities themselves, with the establishment of community savings groups and administrative representatives, take responsibility for the overall management of repayment of flexible, soft low-interest loans for land purchase or housing construction (Boonyabancha, 2006; CODI, 2005; Usavagovitwong et al., 2013).

Since its launch in 2003, the CODI *Baan Mankong* programme has employed five key approaches to upgrade informal settlements, namely: 1) on-site upgrading, 2) reblocking, 3) land sharing, 4) reconstruction, and 5) relocation. The first method of on-site upgrading refers to the physical improvement of the living conditions and essential services whilst preserving its location, identity, and community structure (CODI, 2005). The second approach of reblocking involves the organized improvement of the existing settlement by improving the layout of the building cluster/s, with the realignment of blocks and streets, as well as the installation of sewers and drains, developing better walkways and roads, while moving as little houses as feasible (CODI, 2005).

The third approach of land sharing refers to the negotiation between the community and the landowner for sharing or dividing the land, such that a part of the land is purchased or rented for housing development, and in return the landowner retains the remaining land for commercial or public development (CODI, 2005). The fourth approach of reconstruction refers to when existing settlements are completely removed and reconstructed on the same land under a long-term lease or through a potential full land purchase (CODI, 2005). Similar to the reblocking strategy, the new reconstructed development could have new block and street layouts for better land and infrastructural optimization (García-Villalba, 2015). Finally, the fifth approach of relocation refers to the construction of houses at a new site, which becomes applicable if the previous four on-site strategies are not possible. There are both nearby resettlement locations, for sites within three kilometers of the initial community, and distant relocation, to sites further than three kilometers. Nevertheless, the trade-off for distant sites is more housing stability and land tenure rights (CODI, 2005).

Regardless of the upgrading approach, public spaces play a key role in the community's development. Even though there are narrow misaligned walkways or passages fronting each house in existing dense informal settlements, the fundamental issue is not so much the limitation of quantity of public open spaces, but moreover, the limitation is with regards to their quality. Thus, in the city-wide informal settlement improvement initiative of the CODI *Baan Mankong* programme, the development of the street or courtyard as a fundamental public space becomes a key design consideration. The design and implementation of streets in *Baan Mankong* projects, whether newly created or by the realignment of blocks, should maximize the use of the land and the setting of infrastructure. Hence, the public space design not only establishes the physical environment and setting of the neighborhood, but also helps to cultivate a deep sense of community, and strengthen

social relationships and local economies, such that it is not the physical space that matters, but rather what that space enables (García-Villalba, 2015).

However, given the socio-cultural challenges in moving from a horizontal lifestyle to a vertical setting in medium- or high-rise buildings due to development constraints in optimizing as many units as possible in limited land area, slum upgrade projects need to address how neighbours can gather for socialization, meetings, or other kinds of interactions, albeit in a vertical manner. This aligns with the New Urban Agenda which describes how urban planning and design should provide a social mix of housing "with access to quality basic services and public spaces for all, enhancing safety and security and favouring social and intergenerational interaction and the appreciation of diversity" (UN-Habitat, 2016).

2.2 Housing Policies and Right to Housing

Before moving onto the results and discussion sections, it is worth understanding slum upgrades in the context of rapid urbanization, market-driven property, and the social-economic challenges associated with these issues, in particular, spatial justice and housing rights (Rigon, 2022; Saiz, 2023). In neoliberal urban development, housing is seen as a form of commodity, to be bought, sold, and speculated, rather than as shelter and a fundamental human right. Thus, in 2003, the Thai government initiated the one million units low-income housing policy, divided into two nationwide programmes namely, the NHA *Baan Eua Arthorn* (home with care) programme for some 600,000 units, targeted for low-income households, and the CODI *Baan Mankong* (secure housing) slum upgrading initiative for around 300,000 units (Usavagovitwong, 2012). To this day, NHA social housing, which is more top-down, and *Baan Mankong*, which is bottom-up, continue to serve these populations, albeit with changes since 2003.

As more contemporary condominiums and highrise apartments continue to be built in the capital of Bangkok, low-income households coming into the city for opportunities continue to have nowhere to live other than informal settlements, reiterating the vicious cycle of inequality and housing unaffordability. Amidst a market-driven urban development approach that supports the economic growth of cities such as Bangkok, where private property rights are seen as a right to transfer rather than a right to adequate housing (Shelby, 2017), urban informality, according to literature, becomes a norm or a way of life, or a form of survivalism in the city, particularly in the Global South (AlSayyad & Roy, 2003; Davis, 2006; Roy, 2012).

The ongoing housing crisis prompts further action and the continued need for housing programmes in the country. A recent government-supported housing initiative, called *Baan Puea Kon Thai* (Homes for Thais), aims at new housing estates for low-income households, while adhering to eligibility criteria such as 50,000 THB per month salary limit, aged 20 or above, and never owned any housing, amongst others, raises the critical issue of the sustainability of these housing policies and programmes over time, whether top-down or bottom-up (Chantanusornsiri, 2025). The first generation implemented CODI *Baan Mankong* projects were considered successful due to being closely connected to the original founding principles of the programme such as strong community ties, a well-established sense of place, and a feeling of belonging. However, over time these ideals have differed from community to community, due to various circumstances.

Despite several key limiting factors which pose challenges for *Baan Mankong's* successful continuation, including lengthy procedures and implementation issues, land negotiation and acquisition for communities, and households lacking the financial capability to pay off long-term mortgages, the programme has served to ameliorate the issue of slums in the country. The programme provides legally recognised land tenure for communities as an alternative to private property rights, which also brings communities together as a unit, as part of a wider social movement in the Global South towards social equity (Shelby, 2017). *Baan Mankong* has helped uplift low-income communities allowing them to uphold their "right to adequate housing for all as a component of the right to an adequate standard of living" (UN-Habitat, 2016).

The foregoing discussion about social equity and property rights situates this study in the framework of the 'Right to the City' in the proposition of community-engaged high-density slum

upgrades with vertical community spaces on legally tenured land. Lefebvre's and Harvey's 'Right to the City' is about the right of citizens to participate in the decision-making processes and shape the development of their urban environments, particularly those who are most vulnerable, challenging the dominance of neoliberal market forces thus arguing for inclusivity and spatial justice in cities (Harvey, 2008; King, 2018). The Right to the City is more than simply an individual's liberty, claim, or access to urban resources such as property, but rather "a right to change ourselves by changing the city" (Harvey, 2008, p. 23; King, 2018). Low-income communities can therefore exercise their Right to the City, not only in terms of access to housing, but also participate and be included in the city, as adequate housing is a foundation for socially inclusive, spatially just, resilient, and sustainable cities.

3. Methodology

This study adopts a research-by-design methodology to investigate the potential of vertical community spaces in enabling medium- to high-rise slum upgrades in Bangkok. Rooted in practice-based inquiry, research-by-design facilitates critical spatial exploration and hypothesis testing through iterative design processes, grounded in real-world contexts. In this case, the method was operationalised through a postgraduate academic design studio, enabling a collaborative, analytical, and participatory investigation into the formalisation of informal settlements in Thailand's capital.

The research is based on two case study projects developed during the second semester of the 2023–2024 academic year as part of the Master of Urban Design and Development programme at the Faculty of Architecture and Planning, Thammasat University, Thailand. The design studio aimed to interrogate the socio-economic, environmental, and spatial implications of community-based slum upgrade strategies in contexts where horizontal expansion is no longer viable due to land scarcity and rising urban densities.

The studio was organised around a stepwise design-research framework, which began with multi-scalar spatial analyses of the site—at provincial, district, and neighbourhood levels—followed by SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis, site visits, and participatory activities. Community engagement was embedded in the process, including focus group discussions, demographic profiling, and informal interviews to gather socio-economic data and to inform design decisions based on local needs and perceptions.

Two exemplary student projects are selected for detailed analysis in this paper. These were developed by international postgraduate students from Japan and Vietnam, with academic backgrounds in architecture and urban planning, respectively. The projects integrated participatory planning approaches, allowing for the co-creation of design strategies in partnership with residents from a resettling informal community in Bangkok's Chatuchak District. These participatory sessions were particularly vital in establishing residents' priorities, identifying spatial practices of informal livelihoods, and generating feedback on preliminary design proposals.

The design outputs were developed through an iterative process, combining hand-drawn concept sketches, computer-aided design (CAD), and Building Information Modelling (BIM). Designs were evaluated based on their social, economic, and environmental opportunities and potential.

By integrating qualitative insights from community stakeholders and international best practices, this research-by-design methodology contributes a holistic and context-sensitive understanding of how verticality can be reimagined to support inclusive, sustainable, and climate-resilient slum upgrades in Bangkok. The next section presents and analyses the spatial design proposals derived from this process.

4. Results

As a practical example of a *Baan Mankong*-style project at its early stages, the Urban Design and Development International (UDDI) programme's informal settlement improvement design studio, conducted at Thammasat University shows how public space design, both on and above the ground floor, plays a crucial role in the proposed regeneration of a community. This project, incorporating

both group and individual components, was based on a real world scenario and developed in collaboration with CODI's *Baan Mankong* initiatives in the Bangkok area.

Students analyzed and proposed alternative spatial solutions for an existing informal settlement, the Chatuchak District community, in the Bangkok Metropolitan Area, Thailand. The key focus of this project was not only the street or courtyard as urban commons, a public space serving the residential neighborhood, but given the scale of the site and the number of units it had to accommodate, public or semi-public open spaces were proposed above ground to explore a vertical network of common spaces throughout the building. This design study provided students with the opportunity to engage in public or common space design in the context of a real-world informal settlement relocation initiative which was then presented to the community for their feedback. The designs were developed based on a comprehensive understanding of the challenges and opportunities presented by the site identified via contextual analyses and fieldwork.

4.1 Site Introduction and Analysis - Relocation

The postgraduate Urban Design and Development studio is a practical module that combines the comprehensive knowledge of spatial analysis in urban design with cultural and social analysis, presented here in relation to community participation and engagement in a slum upgrade project. The study site is located in the Chatuchak District, in Bangkok, near the Bang Sue Grand train station. The project involved multiple communities to be merged into one potential site, following the aforementioned relocation approach. The students engaged in focus group discussions facilitated by a guest instructor who helped with the translations, which sought to profile the community in terms of the household sizes, occupations, cost of living, range of household incomes, transportation modes, educational and medical access, as well as daily routines.

The study specifically involved five communities within the Chatuchak and Bang Sue area that would come together into a trapezoidal site with a total of 192 households, having an average of four people per household. The community members are mainly low-income workers (earning around 400-500 THB/day/household) who are engaged in jobs such as motorcycle taxi drivers, and street vendors, as well as small businesses such as grocery or food trading. The pace of life is fast with people from multiple generations connected through many interactive activities. Moreover, the community expressed interest in more spaces for community activities as well as a market space for both trading and living.

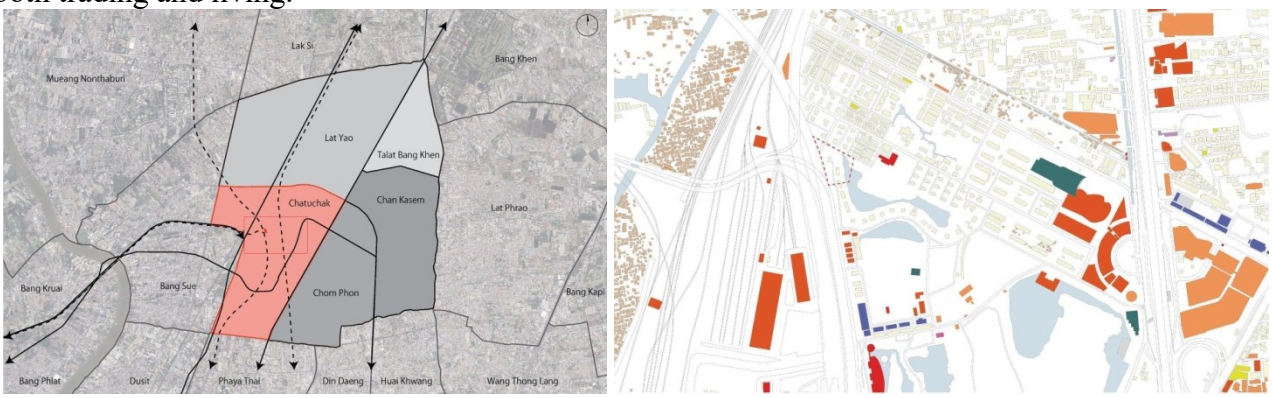

Figure 4. Chatuchak district and building-use maps of Chatuchak community and surroundings.

Within the study area, along the main road to the east, there are large shopping malls and offices, including the PTT Power Complex. To the west are railways, main roads, expressways, and a large State Railway of Thailand (SRT) train depot. Some informal settlements and a few shops are located along the canal to the north. There are many bus stops and other public transport facilities, all within walking distance of the community. Moreover, Bang Sue is an area with many future developments, as it is likely to be a new centre for Bangkok (see Figure 4).

The study site poses many challenges and opportunities. Although there are many surrounding facilities, there is only one small hospital. There are several large green parks (Wachirabenchathat Park, Chatuchak Park) including some sports fields, but these are not easily accessible to the public.

Moreover, there is a lack of green spaces around the site for the community. There are many large unused spaces on the riverbank or under the overpass. Schools and SRT red line, BTS as well as MRT for public transportation around this area are not too far from the community but are disconnected by the main road making them difficult to access. Following their contextual analysis, the students developed a joint vision for this project which was to design a new living complex for the community with more public spaces for community and children activities, provide more connectivity and accessibility, as well as improve the living environment.

4.2 Case Study 1: Multiple Building Clusters

In the first project by Toan Le Phuc, the scheme originated from an idea of creating open spaces and physical connections, where the households were arranged into a series of blocks to allow for continuous movement and take advantage of the gaps created between the blocks to create a community open space. Initially, the idea was to arrange the households at low density designed only on the ground floor which covered a larger site area, however, another scheme was developed to reduce the site coverage and increase vertical density, thus making more open spaces between the buildings (see figure 5).

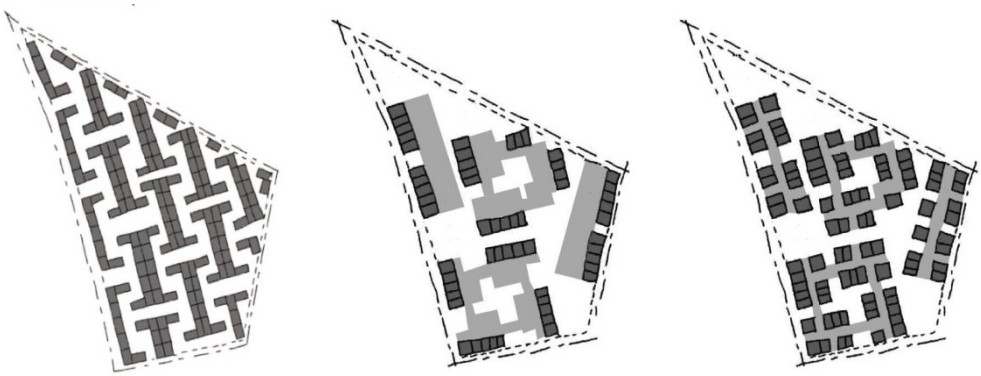

Figure 5. Sketch designs of low-density (left) and high-density (middle and right) schemes of Toan Le Phuc's project.

In this second scheme, there is a combination of three different types of apartments, including 96 Type A units (21m^2 over 2 levels), 12 Type B units (21m^2 over 3 levels), and 88 Type C units (30m^2 on 1 level), totalling 196 units over four floors. The main difference between the floors of the building is the change in the horizontal placement or position of the units, which created gaps between the households (see Figures 6-7).

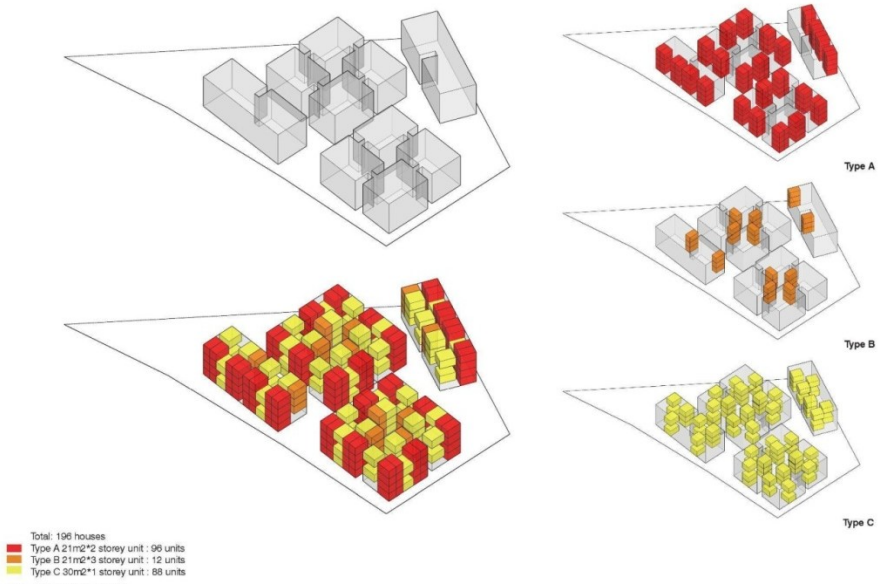

Figure 6. 3D Diagram of unit types of Toan Le Phuc's project.

Figure 7. Floor plans of Toan Le Phuc's project.

As seen in the floor plans, the units are arranged in an alternating manner so that they change positions when going from floor to floor. Due to the alternation of units from floor to floor, this creates pocket spaces between the households for socialization and informal gatherings. The circulation of the building is continuous throughout each level, with pocket spaces distributed on the sides, which can be seen in Figure 8.

Figure 8. Section showing alternating vertical open spaces of Toan Le Phuc's project.

By developing vertical pocket spaces on alternating floors, creates semi-outdoor spaces for community interactions around the building, along with the courtyards in the middle of the blocks. In addition, there is more space for landscaped community areas on the ground floor, as well as space for commercial activities to best serve the needs of the community, particularly adjacent to the courtyards where there is more spatial connectivity.

4.3 Case Study 2: Building with Central Courtyard

The second project by Shun Yamai, in contrast, is a building complex with a large singular courtyard. Similar to the previous scheme, the building is composed of three unit types, 100 Type A units (42m^2), 43 Type B units (63m^2), and 50 Type C units (30m^2), totalling 193 units distributed over four floors.

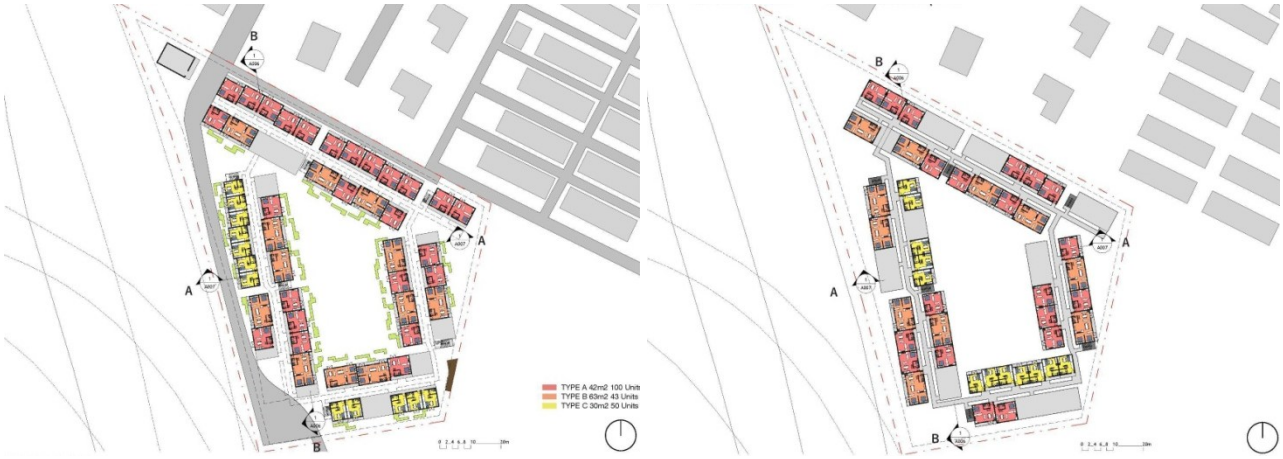

Figure 9. Floor plans of Shun Yamai's project.

The change in layout between the floors of the building is due to the shifting placement of the units, which produced alternating open spaces between the households (Figure 9). The floor plans demonstrate how the various unit types are placed in a staggered arrangement so that open spaces appear at different locations between each level. Similar to the previous scheme, this creates semi-outdoor pocket spaces between the units for social gatherings and informal interactions. The circulation here is like a continuous bridge throughout each level, with common spaces distributed at the corners. The diverse range of open spaces in this scheme, both on the ground level and above ground, gives the design a highly eventful and interconnected quality.

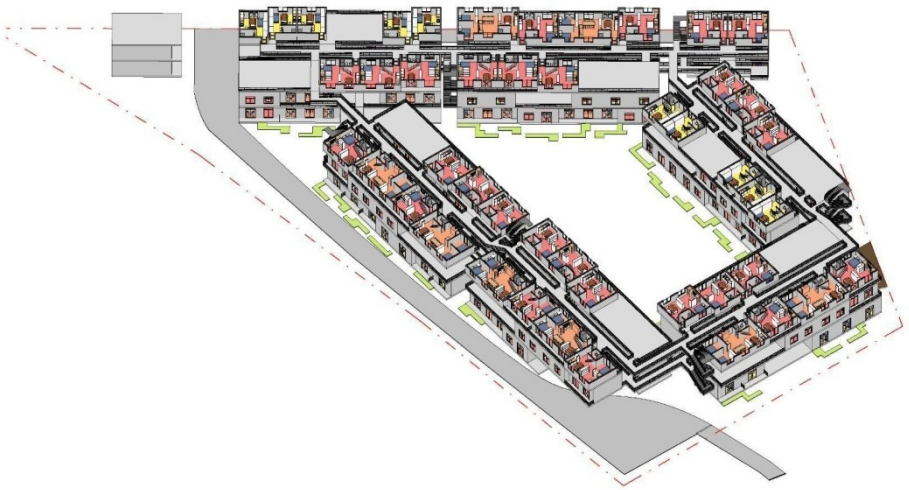

Figure 10. 3D plan of Shun Yamai's project.

Like the previous scheme, Shun's design was developed to reduce the overall site coverage by increasing the vertical density, thus producing the large landscaped community courtyard seen in the middle which can also hold commercial activities (Figure 10). With multiple passageways into the courtyard, the design allows for variation in people's movements and promotes informal or chance encounters.

5. Discussions

5.1 Opportunities of Vertical Common Spaces

The two designs described in this paper demonstrate the innovative use of semi-public common spaces within the informal settlement upgrade in a site of limited area. This section will discuss some of the environmental, social, and economic opportunities offered by the development of these vertical common spaces.

With urban design's main role of defining public spaces, such spaces should be conceived as positive open spaces produced by the surrounding negative volumes of the buildings, and not simply seen as the residual spaces between building masses. This design studio places emphasis on the primacy and significance of semi-public spaces for the community both on the ground level and above ground. In the students' proposed masterplans and building designs for the informal settlement relocation, space is primary, framed by the built volumes, and promotes community engagement such as social activities, gathering with neighbours, intergenerational recreation, food vending, or other social-economic activities. Such community spaces permit the coexistence of informal and formal, unplanned and planned, disorder and order, thus challenging the continuum of formal to informal.

Figure 11. Perspectives showing common spaces in Shun Yamai's project.

In Shun Yamai's project, the units above ground are connected and accessed by open-air corridors, with voids between the units and the corridors, such that the corridors effectively act as a bridge, which provides numerous environmental benefits. By proposing open-air corridors or bridges, this allows natural light to vertically penetrate deeper into the building, while also allowing fresh air into the corridors. A conventional double-loaded corridor would mean long corridors requiring artificial light for illumination, but with limited costs for electrical installation and operation, these open-air corridors allow for natural lighting and ventilation. More importantly, the units have the opportunity for cross ventilation. In typical double-loaded corridors, the corridor-facing wall would not have a window, but in this design, facilitated by the void between the unit and the 'bridge', a window can be included to create a sense of an 'exterior' within the interior and allow the units to have windows on opposite sides to facilitate cross ventilation.

Figure 12. Perspectives of common spaces in Toan Le Phuc's project.

The designs demonstrated in this paper both illustrate an example of modular housing units with vertical community spaces indicative of sustainable urban housing strategies for low-income communities. Such ideas of common areas above the ground can help to address potential socio-

cultural challenges in the transition from traditional low-rise informal settlements to high-density housing which are typically not very accommodating in terms of horizontal living patterns. Moreover, such medium-rise high-density apartment buildings will typically not have a lift/elevator to save installation, operation, and maintenance costs. This makes the circulation particularly important to the design of the movement, but also a key opportunity for community interactions. The fundamental needs for gathering and socializing, children playing, drying of clothes, and conducting informal activities as they would on the ground are here reconceived above the ground in open-air corridors and pockets of common spaces. Such vertical common spaces therefore facilitate the communities' Right to the City, not only in the participatory and collective ownership of such a project, but also in their eventual development of a sense of community, identity, and belonging, where the people can go about their everyday activities and maintain socio-cultural continuity in semi-public spaces vertically distributed throughout the building (García-Villalba, 2015; UN-Habitat, 2020).

Figure 13. Cafe Apartments, Ho Chi Minh City, Vietnam.

The Cafe Apartments in Ho Chi Minh City, Vietnam, provides a distinct case or precedent study for such medium- to high-rise high-density housing projects, showing the opportunity for commercial activities in a vertical manner (see figures 13-14). Such case studies can inform the design process as a form of research, to show students or potential communities how to optimize economic opportunities by turning units essentially into 'shop-houses' above ground, with their brand clearly visible on the public facade, and the corridor becomes effectively a 'street-in-the-sky', as per Alison and Peter Smithson's concept of public hallways connecting the units above ground (Cunha & Marat-Mendes, 2019).

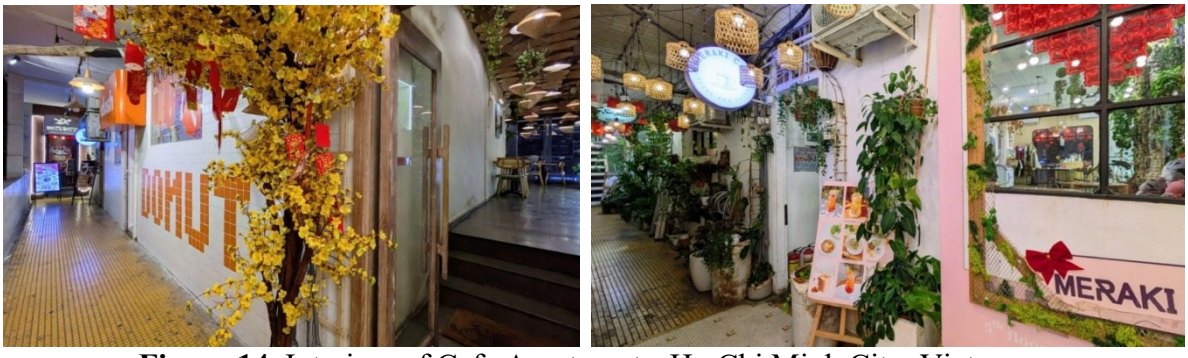

Figure 14. Interiors of Cafe Apartments, Ho Chi Minh City, Vietnam.

Another key case study in order to compare high-rise slum upgrades in other cities in Southeast Asia is Kampung Akuarium in Jakarta, Indonesia. This slum upgrade project is an interconnected cluster of high-rise buildings with common spaces above the ground level, designed as setbacks along the corridors. A unique feature of Kampung Akuarium is the split-level floors which encourage social interactions to foster a sense of community among the residents. The wide corridors, around four meters in width, are instrumental in preserving the traditional kampung or village lifestyle in a vertical setting, such that these hallways become spaces for gatherings or even workshops between neighbours.

5.2 Implications and Future Research Directions

Although evaluation metrics are beyond the scope of the one-semester design studio outlined in this paper, these can however be useful for further investigation. Particularly, the environmental benefits from deep daylighting and natural ventilation, though having precedent in housing projects from Hong Kong to Australia, could nevertheless benefit from modelled measurements or simulations. The socio-economic advantages of the courtyards and vertical common spaces would also benefit from further community feedback. Additionally, an evaluation matrix linking the proposed spatial interventions to socio-economic indicators from shop-house turnover or job retention, to the cost of living savings (indicated by survey percentages and average daily incomes, for instance), would allow for potential post-occupancy evaluation.

6. Conclusion

This study set out to determine whether vertically integrated community spaces can support equitable, medium- to high-rise slum upgrading in Bangkok, where escalating land values increasingly constrain ground-oriented or low-rise redevelopment. Adopting a research-by-design methodology, two case study studio designs partnered with a resettling community in Chatuchak District were proposed that demonstrate modular walk-up blocks which stack semi-public ‘streets-in-the-sky’, pocket common spaces and recreational zones.

The key findings can be summarised as follows. The design strategies demonstrated in this paper show various potential implications for medium- to high-rise slum upgrade projects including social spaces for gathering in a vertical setting, economic opportunities in terms of ‘shop houses’ above the ground level, as well as environmental benefits in terms of deep daylighting and natural cross ventilation. The design feedback indicated that the community saw in these projects the potential for higher levels of belonging, cohesion and place identity despite vertical relocation, corroborating arguments for the socio-cultural value of informal spatial practices within formal housing structures.

Collectively, these results suggest that vertical common spaces function as socio-spatial mediators, reconciling density imperatives with the informal livelihood practices that sustain low-income communities. When embedded in a participatory upgrade framework—such as the Community Organisations Development Institute’s *Baan Mankong* model—verticality can thus deliver social, economic and environmental co-benefits. These insights align directly with the New Urban Agenda’s call to “leave no-one and no place behind” (UN-Habitat, 2016) and reinforce multiple Sustainable Development Goals, notably SDG 1, SDG 10 and SDG 11.

Limitations of the present research include its reliance on design-studio prototypes rather than built projects, the relatively small sample of resident participants, and the use of rule-of-thumb daylight metrics instead of full dynamic simulations. Moreover, financing mechanisms for vertical upgrades—particularly for construction and long-term maintenance—are yet to be explored.

Future research should therefore (a) undertake post-occupancy evaluations of completed vertical-upgrade projects to validate social, economic, and environmental performance; (b) examine alternative funding and tenure structures that can secure affordability over time; and (c) expand the geographic scope beyond Bangkok to test transferability across diverse socio-climatic contexts in the Global South (Boanada-Fuchs, Kuffer, & Samper, 2024; Ren et al., 2020).

In conclusion, urban informality ought not to be framed solely as a deficit to be eradicated but as a repository of adaptive capacity. By integrating vertical community spaces that accommodate informal social and economic practices, cities can transform density from a threat into an opportunity—advancing inclusive, sustainable and climate-sensitive regeneration that formalises the informal without losing community identity or sense of place.

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Adopting GIS to Enhance Alexandrian Urban Cultural Heritage: The Case of Alexandria, Egypt

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ABSTRACT

Heritage conservation in Alexandria demands integrative, data-driven approaches that reconcile preservation efforts with satisfactory visitor access. This study investigates how Geographic Information Systems (GIS) can document, evaluate, and spatially optimise the city's cultural heritage. A four-stage framework was applied: (1) compiling a multi-source geodatabase of 294 heritage assets in addition to transport nodes; (2) digitising attributes for value scoring based on five National Organisation of Urban Harmony (NOUH) criteria; (3) conducting spatial analytics—hot-spot, nearest-neighbour, buffer, and network analysis—together with a six-parameter walkability index; and (4) translating findings into policy-relevant interventions and interactive web maps. Results reveal pronounced clustering in the historic downtown;however 83 high-value assets lie outside a 400 m walk from transit, notably in Foad Street, Kafr-Abdo, and Ancient Catacombs sub-areas. Proposed measures—two bus-stop extensions, and one new tram halt would reduce unserved sites to 8.5 per cent. Six optimised cultural routes cut average walking time within heritage clusters to maximise exposure to unique assets. A dashboard links routes, heritage metadata, and multimodal travel options as well as enabling user-defined preference customisation. The research demonstrates GIS's capacity to integrate qualitative heritage evaluation with quantitative mobility analytics, offering a transferable model for sustainable, economically beneficial urban heritage management.

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Highlights:

- GIS adoption contributes to optimising the walkability index along six cultural routes as well as mobility options between heritage clusters.
- GIS-based value scoring pinpoints 83 high-value assets beyond 400 m transit access , steering targeted mobility upgrades.
- Hot-spot analytics uncover significant downtown clustering versus three underserved sub-areas, informing balanced heritage regeneration.
- Network analysis optimises six tourist itineraries, trimming mean walking time and widening heritage site coverage on the city-scale.
- Interactive GIS dashboard drives real-time heritage–mobility integration and visitor engagement, amplifying sustainable tourism marketing.

Contribution to the field statement:

By integrating value-based heritage scoring with GIS-driven mobility and walkability analytics, this study produces transferable dashboards that reveal underserved cultural clusters, propose transit–heritage synergies, and quantify tourism gains. It extends urban heritage scholarship by embedding socio-economic accessibility metrics within asset documentation and evaluation processes. In doing so, it proposes scalable, replicable, and policy-ready tools for sustainable urban development.

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1. Introduction

1.1 Background and Context

Architectural heritage is a key aspect of communities' history, having witnessed the evolution of civilisation and remaining as a historical, spiritual, and cultural wealth for future generations (Liang et al., 2023). The development and structuring of cities with a tourist vocation are significantly influenced by the preservation and promotion of such heritage. It becomes an invaluable asset that stimulates the development of associated economic activities, promotes investment, generates employment, and boosts tourism (Diego et al., 2024). Nowadays, heritage conservation can no longer be comprehended from a single perspective; however, it should be approached within a larger regional context. Thus, heritage conservation should be promoted holistically in integration with urban development (Liang et al., 2023).

Founded by Alexander the Great, Alexandria has been a centre of intellectual and scientific activity since 331 BC, particularly during the Greek and Roman Empires. Stretching thirty-two kilometres along the Mediterranean coast, serving as the country's main harbour, it is the second-largest city in Egypt, with a population of 5.48 million according to the 2022 census. Historically, it is a cosmopolitan city that was a key city in the Hellenistic and Roman eras (Hussein et al., 2020b). Alexandria is a major Mediterranean metropolis with a rich multicultural heritage and a unique urban fabric shaped by European architects (Abdelhamid et al., 2023). However, many coastal heritage sites in Alexandria, like Qaitbay Citadel, face significant threats from natural hazards such as earthquakes, land subsidence, and sea level rise caused by climate change, which endangers their preservation (Abdelaal et al., 2024). Additionally, rapid urban expansion driven by population growth often leads to gentrification, loss of memory, and erosion of place identity. To address this, UNESCO introduced the historic urban landscapes (HUL) concept, which integrates urban conservation with planning by emphasising the social and cultural values people attach to their environments (Hussein et al., 2020a). Also, the Venice Charter of 1964 and the International Council on Monuments and Sites (ICOMOS) Washington Charter of 1987 established global principles for conserving historic urban areas, emphasising context and social involvement (Abdelhamid et al., 2023).

Alexandria’s heritage sites face challenges in balancing preservation efforts with the demands of modern infrastructure (Idrus Malik & Kwei Haliday Nyingchia, 2024). They are increasingly isolated from one another, creating a disconnection between the integral value of these sites and the sightseeing value they offer. This segregation is further compounded by an unsustainable transportation system contributing to severe traffic congestion, lengthy delays and queues, and environmental degradation (Darwish et al., 2024). An article by Elsorady & Hussein (2024) explores the revitalisation of Alexandria's historic Turkish District through the enhancement of pedestrian pathways. Their study emphasises the importance of integrating heritage conservation with adequate pedestrian infrastructure to promote sustainable urban tourism. Thus, such evidence to promote Alexandria as a premier day trip destination strengthens the paper’s argument.

Recognising the importance of heritage assets, Egypt authorised Rule No. 144 of 2006 to protect such assets, with heritage catalogues created in each governorate, emphasising that both authorities and local communities share responsibility for preservation (Ezz Eldin & Magdy, 2024). While the government’s Technical Secretariat of the Heritage Conservation Commission is officially responsible for heritage conservation in the city of Alexandria, most heritage preservation efforts are carried out by NGOs like the Alexandria Preservation Trust. The Trust was created in 1999. It developed an inventory documenting over a thousand buildings and numerous heritage sites, which was published in 2008. However, by 2016, this list had drastically reduced (Abdelhamid et al., 2023). Such initiatives are the base resource of heritage data collection for this research.

As for mobility, Alexandria’s road infrastructure follows the east-west strip of the city, with five key arterial roads: Abu Qir Road, Mahmoudiya Road, Coastal Road, Al Cornish Road (also known as El Geish Road), and El Max Street. It depends on public transportation via three main systems:

Tramlines (City and Raml), Railway lines (Abu Qir and Borg El-Arab), and Bus lines (Darwish et al., 2024). In 2025, the city is planning to include the Metro. Taxis and microbuses are also popular paratransit modes. The historic city centre remains a key transportation hub, featuring the tram "Ramleh Station" and train "Misr Station," connecting regional and local travel routes in addition to a main bus stop located on El Geish Road at the entrance to Saad Zaghloul Street, one of Alexandria's main commercial streets. Alexandria's street system has followed a grid-iron pattern since the 19th century, which supports walkability. However, vehicular traffic and parking issues hinder pedestrian movement and access (Ammar, 2018). In the study, Ammar (2018) devised a survey that concluded other challenges in Saad Zaghloul Street and the city centre zones. These challenges include inconsistent sidewalk widths, damaged pavements, poorly maintained ramps, insufficient, poorly placed street furniture obstructing pedestrian flow, and a lack of greenery.

The "Alexandria New Vision 2032" strategic urban plan promotes sustainable development. With input from the General Organisation for Physical Planning (GOPP) and the United Nations Development Program, the plan focuses on preserving the city's heritage while enhancing its appeal as a tourist destination. This creates a further motivation for the research to apply its methodology in Alexandria as a case study.

1.2 Problem Statement and Research Gap

This paper aligns with the broad aim of proposing actionable strategies that contribute to a more inclusive and resilient user experience of the urban heritage. Accordingly, the research problem can be discussed in two sections. Firstly, Heritage sites are often poorly integrated into existing public transportation networks, resulting in:

i. Over-tourism in easily accessible areas;
ii. Underutilisation of less accessible sites, reducing their economic and cultural potential;
iii. Increased private vehicle use, contributing to traffic congestion and pollution;
iv. Lack of efficient multimodal connections, limiting visitor mobility between different heritage zones.

Secondly, investigating the clustering of heritage sites is facing key obstacles, including:

i. Lack of comprehensive documentation with incomplete or outdated records;
ii. Gaps in understanding how clustered heritage sites influence local communities, tourism, and the economy;
iii. Underexplored, smaller, or less-recognised sites that may be part of important cultural clusters;
iv. Unclear integration with urban planning strategies, including land use zoning, as well as heritage preservation and conservation policies.

According to Salem et al. (2025), historic urban heritage sites face challenges due to increasing tourism. Existing research often examines factors such as visitor flow, route length, walking speed, and environmental impact in isolation. However, a comprehensive, integrated framework incorporating spatial, temporal, and comfort dimensions remains globally absent. In this regard, Salem et al. (2025) introduce innovative tools to evaluate balancing tourism and preservation in Cairo's historic urban fabric, revealing disparities across different areas, with key challenges including overcrowding, conflicting land uses, and insufficient infrastructure.

In Egypt, heritage protection laws focus on physical sites listed in official registers. Stakeholders are primarily government agencies, including the National Organisation of Urban Harmony (NOUH), the Ministry of Antiquities, the Governorates, and little involvement from local communities, highlighting another gap (Teba et al., 2025).

In this regard, an interdisciplinary approach to understanding and documenting heritage clusters in urban environments is essential for urban development. This approach aims to improve the utilisation of heritage sites to overcome the discussed downsides. Gagula et al. (2025) mention that GIS offers innovative solutions by mapping, route optimisation, and visualisation, enhancing traveller

experience and cross-cultural interaction. By designing GIS-enabled optimised routes that highlight significant landmarks, the paper aims to enhance the user-driven experience while fostering the preservation of these sites.

A study by Al-Jaberi and Hasan (2022) emphasises that cultural routes serve as catalysts for historical revitalisation by integrating these routes into development plans through a framework highlighting environmental preservation, socio-cultural engagement, and economic development. According to Nugraha et al. (2023), the EU has implemented "Cultural Routes," which link historic and cultural attractions. Cultural routes are thematic itineraries that connect heritage sites, landscapes, and cultural landmarks to promote cultural tourism, education, and sustainable development. According to UNESCO and ICOMOS, cultural routes are networks of tangible and intangible heritage elements that reflect the movement of people, ideas, goods, and traditions over time (Ruchinskaya et al., 2025).

In recent studies, Zouridaki et al. (2024) conducted a systematic literature review, involving screening 117 publications from various disciplines, including tourism, heritage studies, and urban planning, which highlighted a gap in academic research at the intersection of sustainable mobility and cultural routes. According to Zouridaki et al. (2024), publications on cultural routes and sustainable mobility were minimal between 1987 and 2016, but interest grew after 2011, with 76% of studies published between 2017 and 2022. Additionally, most research follows a qualitative, case study-based approach, while quantitative, mixed methods and literature reviews remain limited. Thus, this paper aims to support sustainable tourism by directing users to heritage sites through cultural routes based on spatial analysis workflows and principles in a comprehensive methodology balancing qualitative and quantitative analysis.

1.3 Study Objectives

The study explores the extent to which GIS technologies can be adopted and utilised to enhance the cultural heritage experience through four main objectives:

i. To identify, document and assess heritage assets;
ii. To employ cultural mapping tools, enhancing user experience;
iii. To analyse spatial interrelations between heritage sites and transportation networks;
iv. To propose GIS-based Urban planning strategies that balance heritage conservation and sustainable tourism development.

1.4 Significance and Structure of the Paper

While the research gaps exist within the little theoretical framework that adopts GIS directly into heritage conservation efforts, the spatial analysis field, on the other hand, witnesses an increase in literature over time. In response, this paper aims to bridge the gap between the theory and practice of utilising GIS. In the following sections, the paper tackles the topic in question through the structure presented in Figure 1.

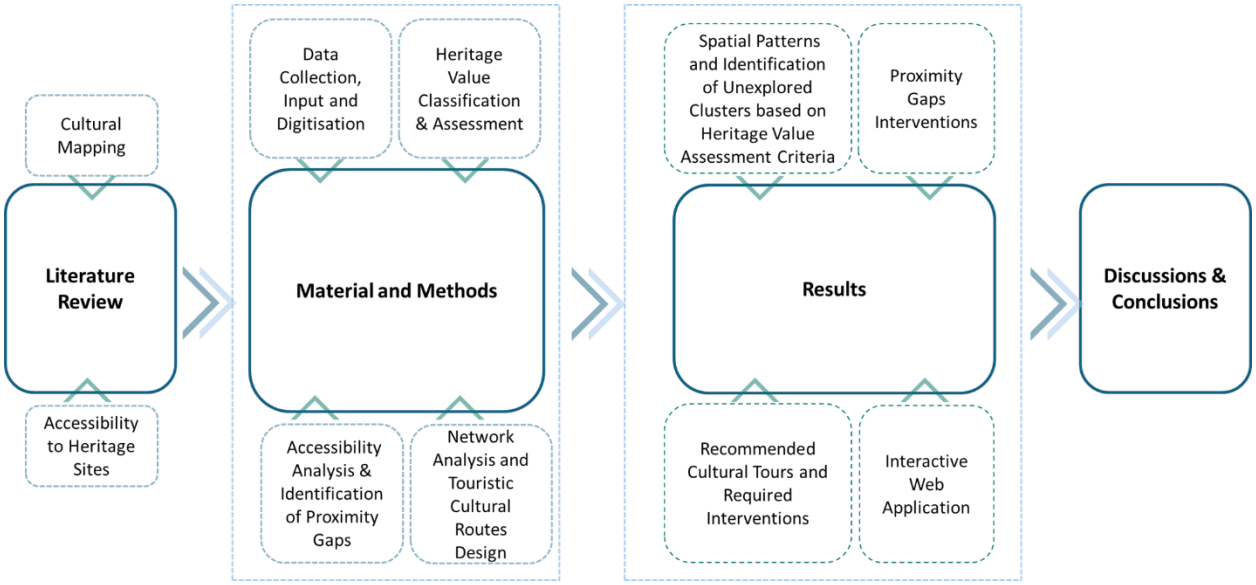

Figure 1. Structure of the Study.

This structure includes a literature review introducing the relevance of cultural mapping and accessibility to heritage sites in adopting GIS to propose walkable cultural routes. It also involves a detailed display of conducted analysis highlighting materials and methods, followed by reporting and interpreting results in order to discuss findings and concluding outcomes.

2. Literature Review

2.1 Cultural Mapping as a tool and the Importance of GIS in its application

The digital age has significantly transformed how information is shared and accessed through electronic media. This is why visualisation plays a crucial role in mapping cultural heritage (Mahadzir et al., 2024). Cultural mapping is important in urban planning, considering the complexity of mapping different potentials for the tangible and intangible (Freitas, 2016). Cultural mapping could involve various techniques, ranging from community-based participatory data collection to advanced GIS tools (Rashid, 2015). Researchers are increasingly utilising GIS in addressing spatial challenges, considering destinations' distribution, users' mobility, and infrastructure needs. Through spatial analysis, GIS helps in making informed decisions, and guiding tourism towards more sustainable practices (Sang & Piovan, 2019; Xing, 2024).

It has become a common approach among urban planners to involve citizens and stakeholders in expressing what they value in their surroundings (Jeannotte, 2016). This is why it is essential to explore examples of visual interactive mapping efforts such as the Cairo Urban Initiatives Platform (CUIP), which is a directory highlighting initiatives in Cairo related to architecture, art, advocacy, urban development, and public spaces. It provides an interactive map and resources for navigating the city's urban cultural landscape. The platform is managed by CLUSTER (Cairo Lab for Urban Studies, Training and Environmental Research), established in 2011, and aims to address urban and environmental issues in Cairo and other Egyptian cities (Panetta, 2018). However, their latest issue supporting cultural routes in Alexandria was last updated in 2017.

2.2 Accessibility to Heritage Sites

The potential of existing opportunities in a location for human interaction or development via various modes of transportation, taking into account the limits in the environment, is known as accessibility (Diego et al., 2024). In its entirety, cultural heritage is a collection of historical-cultural values, traditions, and knowledge that must be accessible to all (Marconcini et al., 2021). Within heritage-rich cities, while the use and exploitation of heritage assets are crucial and serve as strong economic drivers, studying mobility patterns associated with such development efforts is essential. In this regard, inefficient planning and management result in congestion issues and negative impacts on these cultural assets themselves (Diego et al., 2024). Rapid and uncontrolled urbanisation causes historic neighbourhoods to decay and lose their cultural identity. The sustainability and preservation of an urban character depend on the successful integration of newly planned regions with historic urban areas (Şahin Körmeçli, 2024).

Since heritage sites are usually arranged into clusters unevenly, transportation networks have a direct impact on the development of these sites. Transportation accessibility also helps with national heritage tourism forecasting and regulation (Liang et al., 2023). According to Liang et al. (2023), analysing the accessibility of sites can contribute to the advancement of heritage tourism through three key dimensions:

1. Destination Selection: In this regard, remote sites would consume more time, money, and even physical effort to access, which influences the travellers' decision.
2. Tourist Satisfaction: Several criteria play a role in the overall quality of tourism, including transportation speed and convenience.
3. Traffic Impact on Tourism Resources: On several occasions, traffic could impact the attractiveness of a certain site or location, weakening the potential advantages of this tourism resource development.

Therefore, proper consideration of road network connectivity and impactful mobility nodes is essential for heritage preservation on the city scale (Diego et al., 2024). In this regard, a need to improve the accessibility of heritage sites arises, where a macro-to-micro scale analysis of spatial patterns and features is required (Şahin Körmeçli, 2024).

2.3 Planning of walkable cultural routes

Due to walking's fundamental role in mobility, Guillen and Santa (2025) explore walking tours as effective tools for advocacy, recreation, and promoting tourism. Despite this, there is a critical need for research that better understands pedestrian experiences in spatial frameworks (Guillen & Santa, 2025). The article by Hijriyah et al. (2025) analyses existing research on walkability. It identifies key gaps, particularly the limited integration of psychological, socio-cultural, and technological dimensions in assessing walkable environments. Their study emphasises that most walkability research is skewed toward physical and environmental factors affecting user experience. It calls for interdisciplinary approaches to enrich the understanding of walkable urban spaces.

Furthermore, the assessment framework of Ma et al. (2025) integrates GIS technology to evaluate urban walkability. By digitising and analysing geospatial data, their study produces thematic maps indicating areas of higher or lower walkability. This GIS-based approach bridges the gap between theory and application, aiming to guide planners in creating healthier, more walkable cities. Also, Lättman et al. (2025) explore a nuanced understanding of the factors influencing walking satisfaction, such as safety, accessibility, comfort, and the presence of amenities. Their study examined overall walking satisfaction in Dortmund, Genoa, and Gothenburg, where Leisure and recreational walks yielded greater satisfaction than trips to fixed destinations. Key determinants of satisfaction across all cities included accessibility and social context (walking alone vs. in company). These findings underscore the importance of local context, trip purpose, and individual preferences in shaping user satisfaction.

The study by Russo et al. (2025) explores tourism not just as static physical access points to destinations but as dynamic systems with various forms of mobility. It argues that approaches analysing accessibility overlook how urban infrastructures actively shape tourist movements and call for a holistic approach to planning that enhances tourism experiences. While Luo et al. (2025) state that advances in mobile and location-based technologies have enhanced the ability to analyse crowd behaviour in real time. Their research argues that spatiotemporal behaviour varies daily, weekly, and seasonally, influenced by urban form and climate, and these variations offer an understanding of actual usage patterns.

Besides, Sannazzaro et al. (2025) explore strategies to revitalise less-developed inner areas in the Basilicata region in Southern Italy through cultural routes to stimulate local economies, preserve heritage, and enhance identity. Their proposed methodology unfolds in three phases: review of existing assets, collaboration with local authorities to collect visitor data, and field surveys to assess site conditions along the cultural routes. However, the authors highlight constraints, including limited financial resources among local authorities and the lack of consistent visitor data.

Moreover, Gagula et al. (2025) used GIS-based network analysis on Siargao Island, Philippines, to identify optimal routes connecting forty-one tourist destinations. Researchers introduced an interactive web map to explore routes and access tourist information. Their findings suggest adding socio-cultural and environmental factors to create a more realistic route analysis. Nevertheless, this only focuses on mobility from or to the airport or the port; it is insightful to examine how a network database is incorporated in support of connecting tourist attractions.

3. Materials and Methods

3.1 Study Design and Setting

The methodology of the research involves four main sequential steps, where a comprehensive approach ensures thorough data collection, analysis, and application. As shown in Figure 2, the methodology follows a systematic reapplied for database updates, testing interventions, or analysis of other cities beyond the case in Egypt.

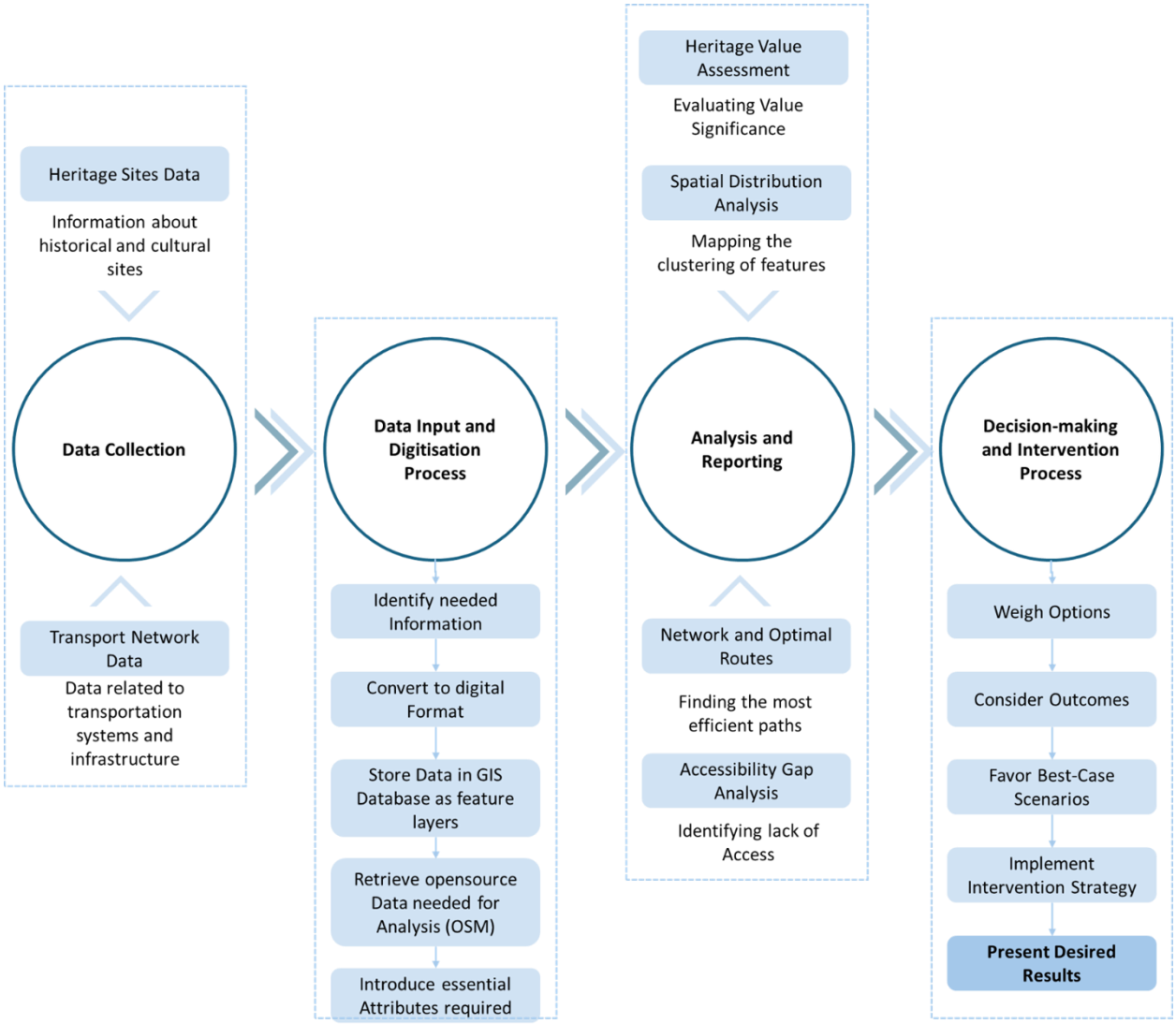

Figure 2. Methodology steps of the Study.

First, data collection involves gathering relevant information from various sources, including historical records, architectural studies, and previous research. The collected data is organised into categories such as sites' locations, architectural styles, names of sites, and heritage values and maintained into datasets for easy referencing. In this step, sampling excludes those demolished before 2024.

The second step, data input and digitisation, focuses on converting the collected data into digital formats using GIS databases. It involves adding attributes that support spatial analysis, such as relevant notes from site visits and must-see heritage assets. This includes exploring crowdsourcing tools like Google Maps to identify attractions the public associates with Alexandria to add culturally significant assets if missing from existing records. This step is concluded by creating digital maps that visualise and identify the distribution, patterns, and relationships of assets.

In the third step, analysis, and reporting, both quantitative and qualitative methods were used to examine the digitised data. These analyses provide a deeper understanding of heritage value assessment. Detailed reports, charts, graphs, and maps were generated to present notable discoveries. The ArcGIS Pro tools supporting this step include Field Calculator, Overlay, Optimised Hot Spot Analysis, Network Analyst Shortest Route, Buffer, Near, and Spatial Queries.

Finally, the fourth step involves using the analysed data to inform decisions and implement appropriate actions. This step includes proposed adjustments to optimise existing walking routes in

Alexandria as well as suggesting walkable routes that combine the competence of the heritage value assessment and network analysis.

The ultimate goal is to deploy advanced GIS algorithms to generate routes that can be later customised based on individual preferences and limitations. For example, users interested in historical sites would prioritise a route connecting nearby museums and landmarks with accessible transportation options such as bus stops or stations. Others might plan their visit based on the available time they have regardless of the type of sites they might see as long as they are of a unique value. This means that temporal aspects help assess user frequencies over time to reduce congestion and improve the overall experience. Responding to such needs, GIS spatial analysis tools can identify patterns of movement and pinpoint hotspots of heritage assets. This enables interventions, such as optimising signage placement, improving wayfinding criteria, or creating alternative routes to circulate user movement. Moreover, GIS can also consider factors like proximity to services and environmental restrictions if available (Xing, 2024).

3.2 Data Collection, Input and Digitisation

A geodatabase is a relational database schema that effectively defines spatial entities and geographical data. This structure allows for a unified management making it possible for multiple users to access and edit. In the context of this research, once a heritage geodatabase is created for Alexandria, it can be shared on a local enterprise network or online, allowing the creation of user-friendly data acquisition and mapping. Additionally, various operations can be performed including:

i. Visualisation: Displaying geographic data in formats easy to comprehend by all users.
ii. Data Overlay and Browsing: Layering different data for comparison, helping to view multiple aspects of heritage assets and their values.
iii. Data Retrieval: Extracting specific information from the database for targeted analysis in any step of the study.
iv. Analysis of Data: Organising and analysing spatial data to find trends, patterns, and relationships within the heritage assets.
v. Thematic Mapping Customisation: Customising maps to highlight themes or features, aiding in the visualisation of heritage assets and the suggested routes connecting them.

The creation of the Alexandrian Urban Cultural Heritage geodatabase is an unending process, where data acquisition and site investigations are in continuous updates. In Figure 3, resources of data in this research are displayed.

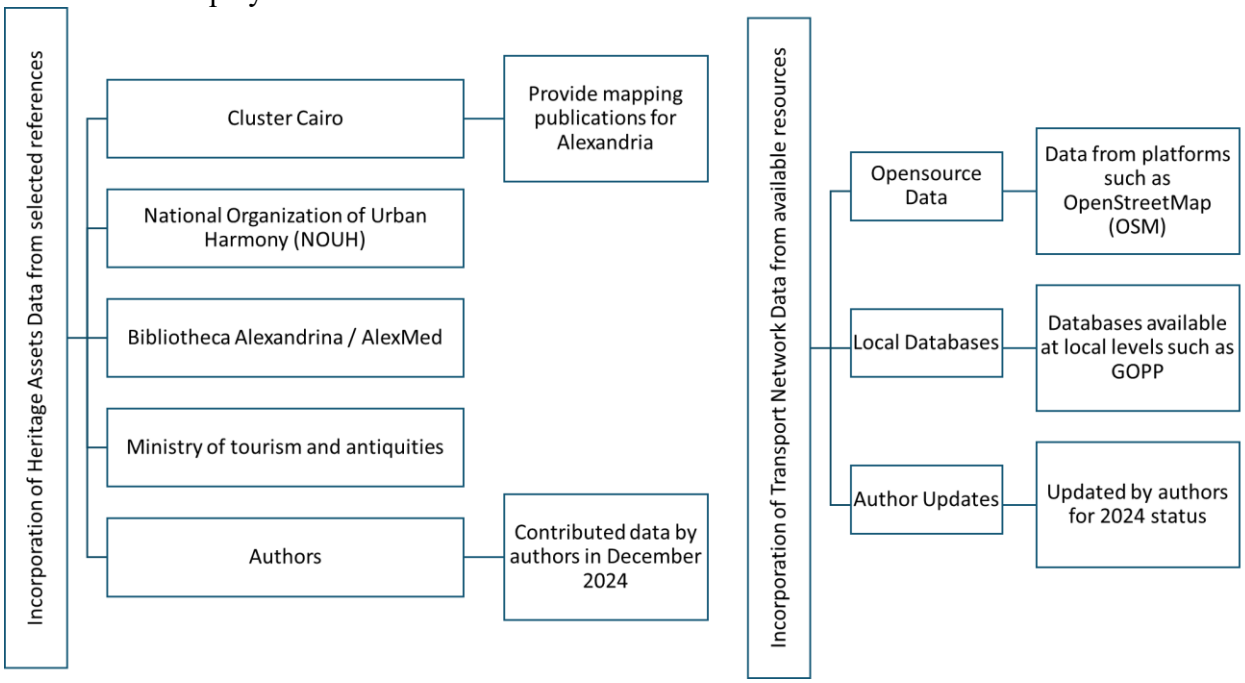

Figure 3. Research Data Collection Resources.

Local governments and cultural ministries in Egypt typically serve as the primary sources for official records on heritage sites. Additionally, academic studies, reports, and publications by archaeologists and entities interested in heritage offer other in-depth records. Also, public transportation data, such as bus routes, metro systems, and tram lines, are mapped and managed by local transportation authorities or municipal planning departments, who also provide information on routes and schedules.

Private sector reports and open-source GIS platforms, including OpenStreetMap further enhance data collection as well as mobile apps like Google Maps that can be used to track movement around heritage sites. This real-time data can offer insights into the actual experience of over-congestion at certain points. Overall, the types of data in the research were divided into two groups as follows:

i. Heritage Site Data Documentation: including location and significance of heritage sites (monuments, museums, cultural landmarks), in addition to visitor footfall data (where available) to understand demand patterns.
ii. Transport Network Data Collection: including public transportation routes (buses, metro, and trams) and stops, road networks and walking paths, including barriers to access, as well as planned or proposed transport projects (e.g., metro extensions).

The documented assets were categorised based on their local, urban, social, architectural, or historical significance. The study uses the categorisation methods developed in 2017 by CLUSTER in the Alexandria Mapping Project, highlighting the city's rich heritage with three walking tours in the Downtown area. By incorporating the assets identified by CLUSTER and the additional sources mentioned in Figure 3, a deeper understanding was achieved in terms of the heritage asset types in Alexandria in the downtown area and outside of it. The created database reveals that:

i. Approximately 65% of the assets fall under the category of Heritage Buildings.
ii. The second largest category includes vintage cafes and restaurants at around 8%, followed closely by arts and culture (6%) and parks/public spaces (5%).
iii. The remaining 16% comprises vintage stores, statues/monuments, vintage hotels, clubs/associations, vintage signs, and market spaces.

3.3 Data Analysis

3.3.1. Heritage Value Classification and Assessment

According to NOUH, values that contribute to the evaluation of heritage assets are:

1. Historical Value: Significance of a site in terms of its role in history such as past events or important personalities.
2. Architectural or Artistic Value: The aesthetic, design, and craftsmanship of a site such as uniqueness of design, materials, or architectural elements.
3. Context Value: The importance of a heritage site within its surroundings which could be social, or historical contexts for example.
4. Social and Spiritual Value: The meaning of a site for the local population, often being bound to rituals, ceremonies, or identity.
5. Cultural Value: Significance of a heritage site’s contribution to the sense of belonging, pride, or memories.

These values can overlap and influence each other, where each one plays a critical role in how heritage is conserved, understood, and valued within both local and national contexts.

A number-based scoring system assigning 0 or 1, indicating the absence or presence of NOUH values, is proposed to evaluate and rank assets based on a predefined quantitative criterion. These Criteria are seen in Table 1, while the resulting thirty-two combinations are depicted in Table 2. The visualisation of such criteria is represented in Figure 4.

Table 1: Number-Based Criteria for Heritage Value Assessment.

Value Type	**Historical Value**	**Architectural or Artistic Value**	**Context Value**	**Social and Spiritual Value**	**Cultural Value**	**Maximum Value for a single site**	**Number of Combinations available to exist in the database**
Numerical value to be assessed	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	Sum of the maximum of all previous values = 5	2^5 = 32 (31 values not equal 0)

Table 2: Combinations available to exist in the database regarding Heritage Values of Sites.

Combination	Historical Value	Architectural/ Artistic Value	Context Value	Social/Spiritual Value	Cultural Value	Overall Sum	Number of assets with the combinations in the Alexandrian Database and Possible Interpretations
0	0	0	0	0	0	0	No identified assets
1	1	0	0	0	0	1	4 Assets
2	0	1	0	0	0	1	101 Heritage Buildings
3	0	0	1	0	0	1	No identified assets
4	0	0	0	1	0	1	12 Assets including 8 Vintage Café Bars & Restaurants
5	0	0	0	0	1	1	9 Assets in the Downtown area
6	1	1	0	0	0	2	4 Assets (statues and monuments)
7	1	0	1	0	0	2	2 Vintage Café Bars & Restaurants
8	1	0	0	1	0	2	No identified assets
9	1	0	0	0	1	2	No identified assets
10	0	1	1	0	0	2	3 Heritage Buildings including Alexandria Primary Court
11	0	1	0	1	0	2	4 Assets (majority are clubs)
12	0	1	0	0	1	2	37 Assets
13	0	0	1	1	0	2	2 Public Squares
14	0	0	1	0	1	2	2 Assets
15	0	0	0	1	1	2	10 Assets all with supporting commercial activities
16	1	1	1	0	0	3	2 Assets
17	1	1	0	1	0	3	1 Heritage Building
18	1	1	0	0	1	3	8 Assets
19	1	0	1	1	0	3	No identified assets
20	1	0	1	0	1	3	No identified assets
21	1	0	0	1	1	3	3 Assets
22	0	1	0	1	1	3	2 Assets
23	0	1	1	1	0	3	No identified assets
24	0	1	1	0	1	3	No identified assets
25	0	0	1	1	1	3	No identified assets
26	1	1	1	1	0	4	No identified assets
27	1	1	1	0	1	4	2 Assets
28	1	1	0	1	1	4	7 Assets (the majority are Museums)
29	1	0	1	1	1	4	5 Assets
30	0	1	1	1	1	4	4 Assets
31	1	1	1	1	1	**5**	41 assets

The combinations correspond to available information where Architectural/Artistic Value dominates the database (101 assets). These represent buildings recognised for their physical and design merits. Also, combinations involving Architectural/Artistic Values paired with other values appear frequently, strengthening the integrated nature of heritage in Alexandria, where physical form, social, and cultural significance overlap.

Figure 4. Maps of the categorisation of heritage assets in the database, Left: by types – Right: by Uniqueness (Developed by Authors using ArcGIS Pro).

Visualisation based on value and size allows for a clear representation of data by using varying sizes to represent the magnitude of each value. In a chart of five values, it became apparent which values were witnessed in each asset, as shown in Figure 5. This visual approach helps quickly convey the relative importance of each value.

Figure 5. Maps of the Visualisation of Heritage Assets in Downtown Alexandria, Left: by Colour and size according to the type of heritage value for each asset vs. Right: by Size according to the overall heritage value of asset regardless of type (Developed by Authors using ArcGIS Pro).

3.3.2. Urban Heritage Accessibility Analysis and Identification of Proximity Gaps

The evaluation of accessibility to heritage sites has been conducted in multiple ways in previous research, for example, Liang et al. (2023) relied on "Near" analysis to acquire the distances between main traffic routes and heritage destinations. In this sense, different accessibility indices were given based on the hierarchy of the closest route in addition to the distance value itself. Moreover, Diego et al. (2024) concluded the average accessibility of the historic centre based on its connectivity to major transport hubs. Consequently, the proximity and connectivity of heritage sites to the city's transportation system determine their accessibility. For the sake of this study, the transportation accessibility study is pursued for walking and public transit as the two main modes of transportation to assess heritage accessibility for both locals and visitors.

To evaluate the proximity of heritage sites to the Alexandrian transportation network, the ArcGIS "Buffer" tool was used to identify two main isochrones for each transit node based on the two chosen modes of mobility. On the one hand, a 5-minute walking buffer was generated for all public transit nodes allocated within the database. This isochrone is considered equivalent to a 400-meter walk from each node based on the average walking speed (Barton et al., 2006; Silitonga, 2020). In this regard, the question of how far individuals are willing to walk to transit is a challenging one to answer, as the distance varies depending on the circumstance, whether it be demographic, socioeconomic, or land-use profile (Noh, Mohamad, & Hamid, 2021). Across previous research, a range between two hundred meters and eight hundred meters has been widely tested and employed. However, in terms of physical distance, the majority of previous researchers deemed a 400-meter walk to be reasonable. This was observed in ground surveys that tested the distance that bus riders were willing to walk to or from a bus stop (Noh, Mohamad, & Hamid, 2021; Hsiao et al., 1997; Murray & Wu, 2003; Zhao et al., 2003). Consequently, several thresholds were tested for this research, as shown in Table 3, leading to the selection of the more prominent value of four hundred meters (0.25 mile). Moreover, Eldeeb et al. (2024) have previously relied on the same walkability

buffer within the Alexandrian context to analyse access to public transit, which was rooted in ground and on-board surveys conducted, capturing GPS data regarding public transit modes in Alexandria. According to findings in Figure 6, heritage locations corresponding to four hundred meters and above (83 sites) were rendered unreachable within a walking distance from the public transit network. As for the public transit mode, 15-minute transit service polygons were computed for the transit stops that were found within the vicinity of heritage sites. In this context, access to city heritage sites was evaluated across all city districts. The definition of this isochrone is based on the empirical insights published by Transport for Cairo and the World Resource Institute, where the findings of on-board surveys indicate that the average vehicle speed on inner-city roads is approximately 5-15 km/hr, with some arterial roads exceeding 30 km/hr (Eldeeb et al., 2024). Coupling these findings with Alexandria's urban fabric and scale, a 15-minute isochrone is regarded as a reasonable accessibility criterion. Additionally, according to H. Seoudy et al. (2023) and within their pursuit of sustainable urban development of transit-built environment, a transport node's catchment area within the city of Alexandria is defined as a 10 - 15 minutes' drive that extends from 800 m to 6 Km.

Table 3: Variations in walking distance buffer and their corresponding impact on inaccessible heritage sites.

Isochrones Threshold Distance	**200 m**	**300 m**	**400 m**	**500 m**	**600 m**	**700 m**	**>700 m**
Number of Unserved Heritage Sites	176	126	83	47	14	2	1

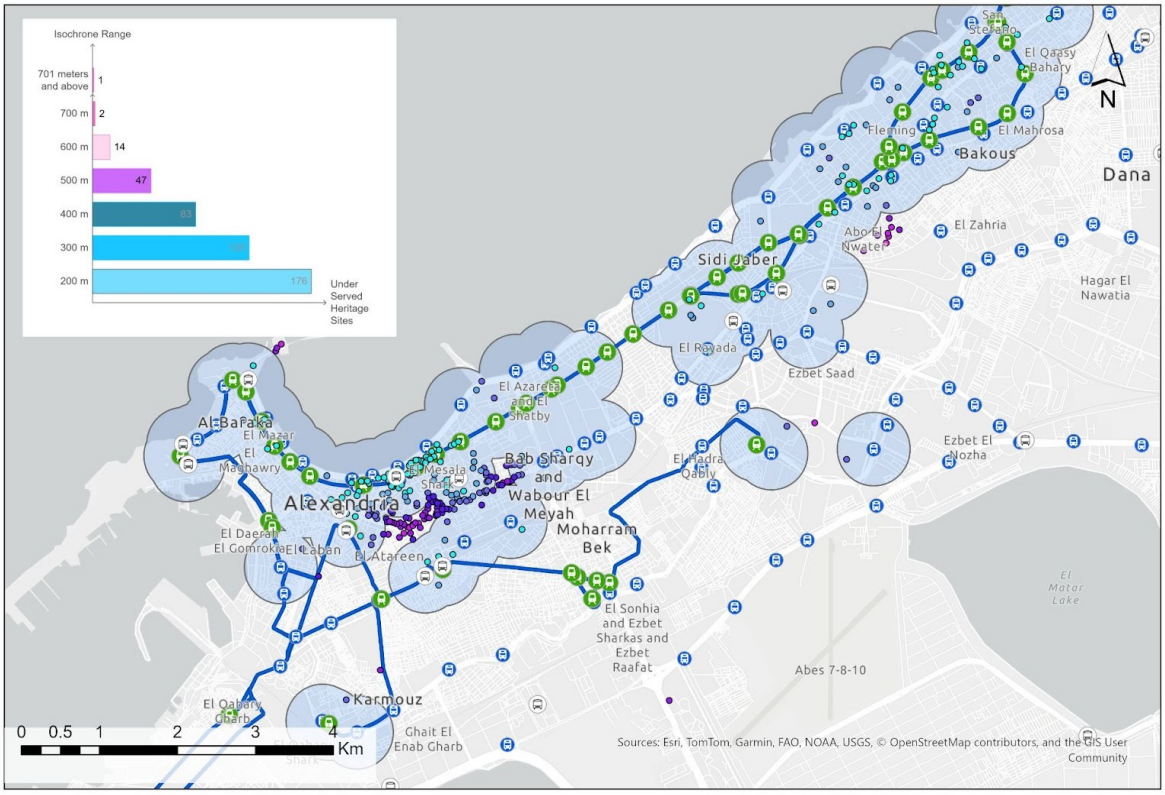

Figure 6. Accessibility analysis map (Using Buffer Tool) for the walkability mode displaying a 5-minute isochrone generated from each public tram or public bus node, where a colour ramp was visualised to identify the extent of accessibility for each site (Developed by Authors using ArcGIS Pro).

Based on the walking mode proximity analysis, an additional inspection reveals that the concluded locations were spatially distributed into three main clusters, as shown in Figure 7:

i. Foad Street Cluster (includes forty-five inaccessible sites),
ii. Kafr-Abdo Neighbourhood Cluster (includes eight inaccessible sites)
iii. Catacombs Region Cluster (includes one inaccessible site).

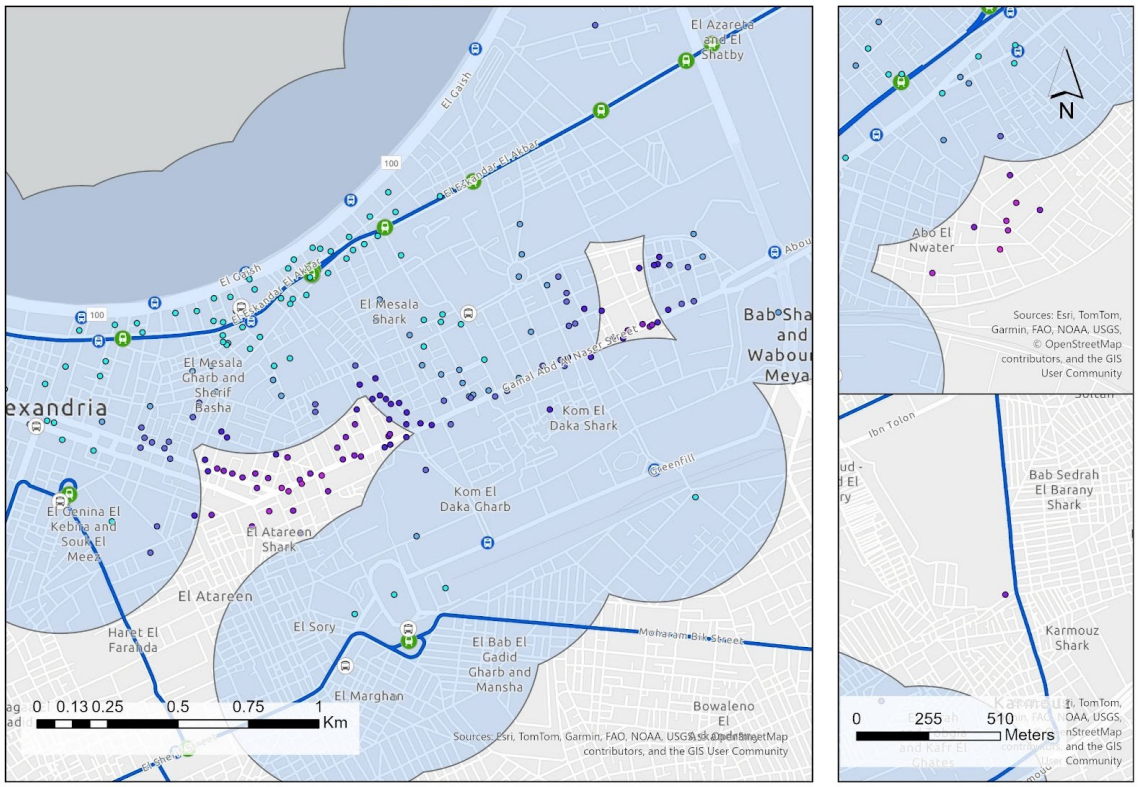

Figure 7. Map of identified proximity gaps for walkability mode based on the conducted accessibility analysis, Left: Foad Street cluster, Right: Kafr-Abdo neighbourhood and Catacombs region cluster (Developed by Authors using ArcGIS Pro).

As for the public transit mode proximity analysis, findings reveal the following:

i. Two out of seven city districts: Al-Ameriyah and Borg Al-Arab (which encompass around 22.4% of the city's population as Mohamed (2023) indicates) are located completely out of the service boundary of accessing heritage clusters.
ii. Foad Street, although considered one of the oldest axes of the Alexandrian urban morphology, is only dedicated to private vehicle transit, adding to the problem that the majority of downtown heritage sites along its axis were inaccessible within walking distance.
iii. Kafr-Abdo neighbourhood is spatially introverted, where public transportation serves along its edges rather than interfering within.

3.3.3. Network Analysis and Touristic Cultural Routes Design

Relying on the proper technologies to manage tourism would eventually lead to a smarter and more sustainable urban system (Şahin Körmeçli, 2024). In this regard, GIS has the potential to advance tourism applications upon optimal routing, closest facilities analysis, and spatial queries, all consolidated with unique map visualisation (Prameshwori et al., 2021). Among the challenges faced by users are selecting destinations based on preferences and strict time schedules. Therefore, itineraries that present heritage sites as interconnected networks rather than isolated locations serve a significant role in supporting heritage tourism (Hassanshahi et al., 2023).

In this sense, a "cultural route" is defined as a group of Points of Interest (POI) that span a region and have similar characteristics, a common theme, and unique historical or architectural elements in addition to infrastructure, buildings, and natural landscapes. From a theoretical standpoint, a cultural route is a geographical expression of continuity based on the exchange notion or movement dynamics. Thus, the primary force behind cultural routes is their placement within the territorial network (Iakovaki et al., 2023). Hence, it was important to conduct the network analysis on two scales: cluster-based routes and city-based routes, based on the spatial distribution of heritage sites in Alexandria and the varying lengths of touristic trips.

The walking tours suggested by CLUSTER in 2017 have three main advantages such as the inclusion of diverse heritage categories, a well-paced number of stops per tour, and balanced tour durations. Therefore, this research inherits CLUSTER's grouping of heritage sites into tours as a base for further analysis and optimisation according to the framework displayed in Figure 8.

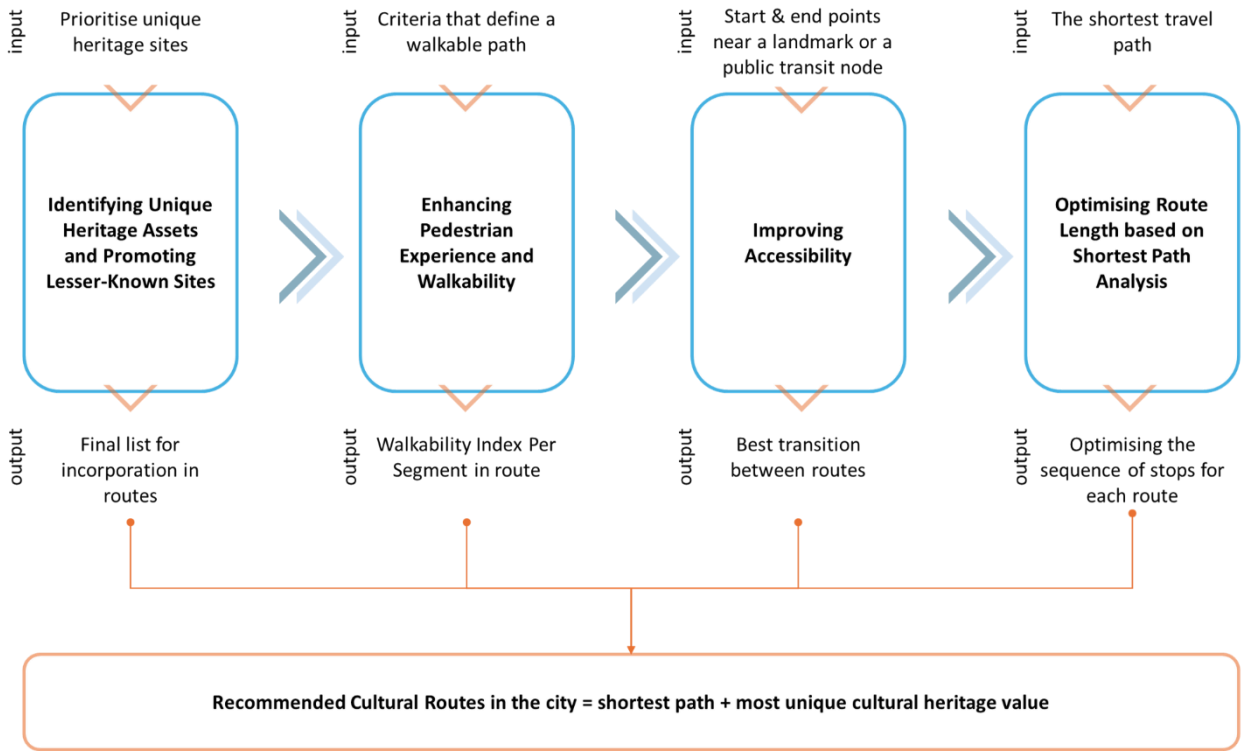

Figure 8. Framework for Cultural Routes Analysis and Optimisation.

1. Identifying Unique Heritage Assets and Promoting Lesser-Known Sites:

In this step, the authors prioritise unique heritage sites to formulate the final list for incorporation in routes. This list reveals a significant skew toward heritage buildings, which make up 80% (94 out of 117) of the unique assets in Alexandria. Statues and monuments (5%) and parks/public spaces (6%) were modestly represented but still significantly less than buildings. However, other categories (9%) were less formally documented but can be just as meaningful to local identity. According to spatial distribution, 50% of these assets were in Alexandria's Downtown (59 out of 117). This reinforces the hypothesis that cultural routes beyond the downtowns hold equivalent significance for tourism and should be given equal consideration.

2. Enhancing Pedestrian Experience and Walkability:

Mengiste et al. (2025) highlight the role of walkability in shaping sustainable and liveable urban environments. Walkable downtowns in cities are much preferred by visitors due to their flexible routing compared to other modes of transportation (Hassanshahi et al., 2023). Several researchers have investigated criteria that define a walkable path, including comfort and convenience, safety and security, proximity to public transport, imageability, environmental qualities, land use and activities, human scale, etc. (Hassanshahi et al., 2023). Convenience in the context of urban tourism

refers to minimising walking effort and includes elements like sidewalk quality, signage, a barrier-free environment, and pedestrian amenities like benches and pedestrian shades. The condition of the vegetation may also indicate that walkability is significantly influenced. Narrow walkways and heavy traffic flow negatively impact walkability, as well as a zone's crime rate. Therefore, surveillance and street lighting can be used to elevate security levels. On the other hand, cultural routes are strongly concerned with a district's imageability, where the presence of landmarks along a path positively serves its perception. Furthermore, human-scale design is defined as one of the qualities that impact the duration of a walking tour (Hassanshahi et al., 2023).

This research focuses on six main parameters to evaluate the walkability per segment along each proposed cultural route. These parameters are:

i. Sidewalks Quality,
ii. Natural Shading and Vegetation,
iii. Street lighting,
iv. Presence of Surveillance,
v. Imageability and Visual Interest,
vi. Noise Levels and Comfort.

In this regard, parameters including slope and terrain, urban shades, and seating areas were ignored in Alexandria, where the terrain is almost flat and the presence of urban furniture such as canopies, benches or signage is scarce. However, the surveillance of heritage sites in Alexandria was assessed through two primary factors: the deployment of security cameras, installed by business owners, and surrounding activity levels. As for imageability and visual interest, streets that were overlooked by a heritage building/façade were identified as visually interesting, as well as those passing by urban landmarks or green areas (Marconcini et al., 2021). Lastly, noise levels were implied from traffic levels along each street in addition to different street activities and land uses.

In this sense, each parameter was given a value of 0 or 1 (existing or not) based on field visits. Hence, each segment, as shown in Figure 9, has an overall walkability index out of 6 (W_i), where an equal weight was considered for all parameters. The index was then weighed by the segment length (l_i) to calculate the total walkability index per route (W_{Total}) as follows:

$$W_{Total} = \frac{\sum_{i=1}^{n} W_i \,.\, L_i}{\sum_{i=1}^{n} l_i}$$

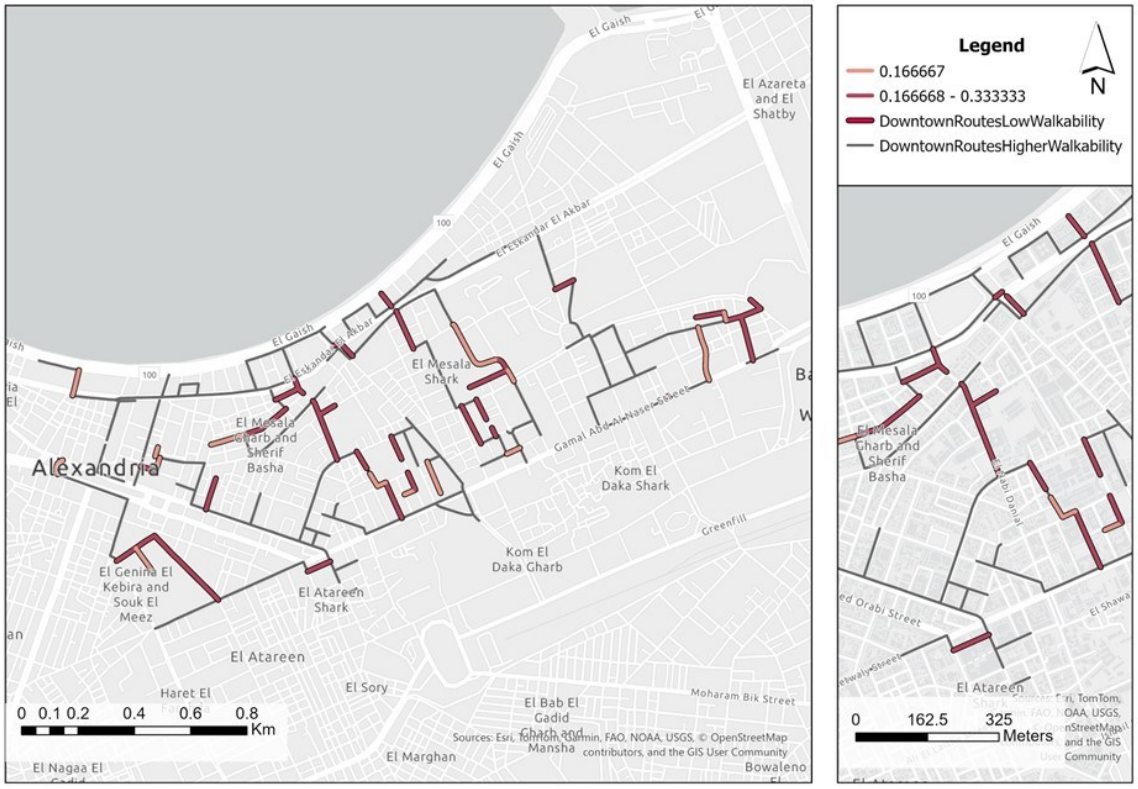

Figure 9. Map of Overall Walkability Index Per Segment for Downtown Cultural Routes (Developed by Authors using ArcGIS Pro).

3. Improving Accessibility:

Deriving from accessibility and walkability analysis, cultural routes were optimised in a way that the start and end points were selected as key points of interest based on their proximity to either a landmark or a public transit node. Additionally, the endpoint of each route was planned to seamlessly transition into the starting point of the subsequent route to ease the flow between the different tours.

4. Optimising Route Length based on Shortest Path Analysis:

The final phase of the cultural route redesign involves optimising the sequence of stops for each route by determining the shortest travel path while adhering to predefined starting and ending points. This analysis was conducted using ArcGIS Pro's Network Analyst, with "walking time" selected as the routing mode to ensure efficiency in pedestrian navigation.

4. Results

4.1 Spatial Patterns and Identification of Unexplored Clusters

Hotspot analysis tools are commonly used to identify clustering patterns, highlighting clusters of high or low values based on predetermined weights (Fischer& Getis, 2010). The optimised hotspot analysis identifies spatial clusters using the Gi_Bin field. Features with a Gi_Bin value of 0 are not significant, while other values are classified into 99%, 95% and 90% confidence levels as seen in Figure 10 (Elfadaly & Lasaponara, 2019). A hot spot was evident in the city centre, with a nearby cold spot to the east.

Additionally, the nearest neighbour index analysis was a spatial indicator of proximity between points. In this regard, if N is equal to 1, then the points are distributed randomly; however, a value less than 1 indicates clustering patterns, and a value more than one indicates uniform distribution (Liang et al., 2023). This index in Alexandria equals 0.082316 with a z-score of -30.102169, which confirms the clustering pattern of urban heritage sites, particularly within Alexandria's downtown.

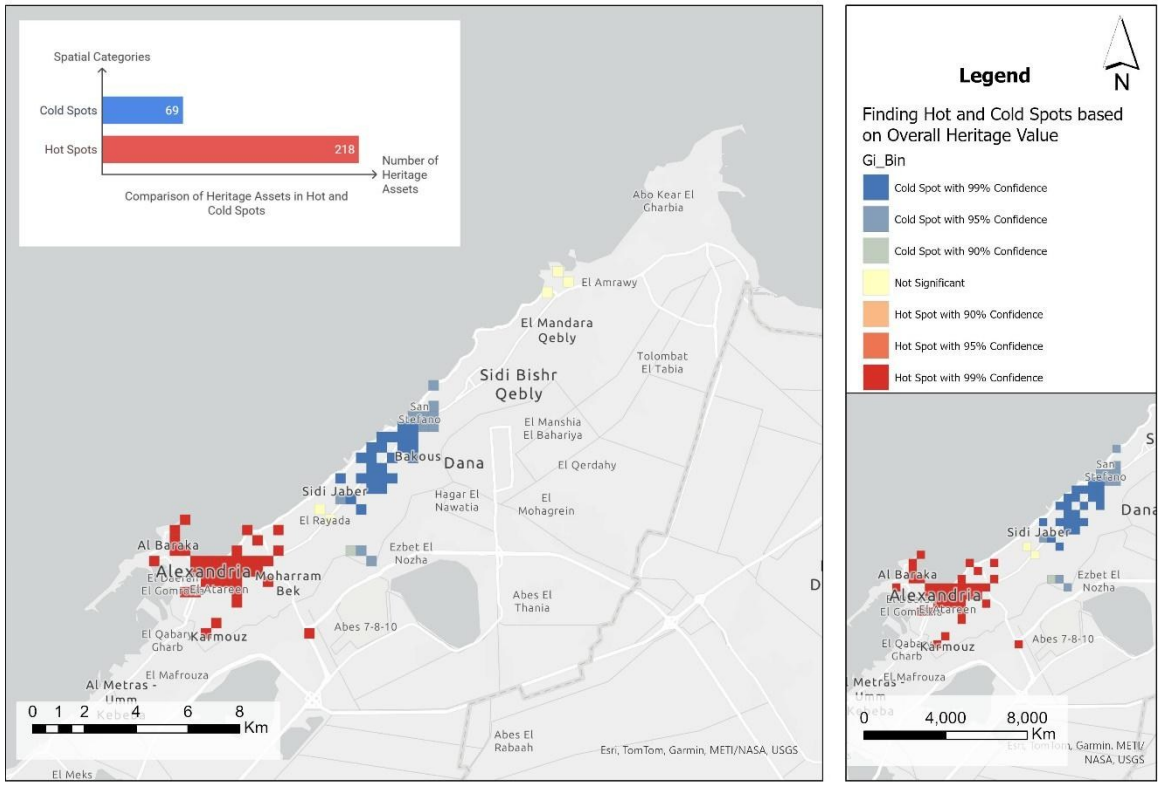

Figure 10. Map of Optimised Hotspot Analysis and Number of heritage assets contributing to each cluster (Developed by Authors using ArcGIS Pro).

It was then deduced that Alexandria's historic city centre, 'Sharq' and 'Wasat' districts, boasts the highest concentration of listed heritage assets, including residential buildings, schools, theatres, and gardens, showcasing a blend of Renaissance, Neoclassical, and Art Deco architecture.

4.2 Proximity Gaps Interventions

To minimise the limited accessibility identified within the three main clusters of heritage sites, interventions were investigated and presented in Figure 11, including:

i. Extending existing bus routes;
ii. Adding new tram stops;
iii. Integrating green mobility modes.

Firstly, for Foad Street Cluster, two existing bus routes were observed with the potential to extend in proximity to these heritage locations In this regard, an added stop along "Kafr Ashry-Mansheya" route could potentially serve 25.3% of the unserved sites, while another stop along "Abo Qir" axis could raise this percentage by 4.8%. The remaining unattended sites were more condensed towards the central part of Foad Street, as well as another critical axis of the downtown known as 'Safeya Zaghloul' Street. From a comprehensive development point of view, adding tram or bus routes within this area could contribute to negative environmental impacts and subsequently risk damage to the heritage assets themselves. Therefore, more sustainable, and eco-friendly modes were suggested to overcome this challenge, where dedicated lanes and parking zones for electric scooters or bikes could be added along those two major axes. In this regard, these modes provide an extension of the existing transport network but with a better exploration experience of the downtown.

Secondly, no possible physical alterations could be proposed for the Kafr-Abdo neighbourhood, where the fabric is planned such that it is detached from its surroundings. Therefore, relying on green alternative modes was also proposed along the neighbourhood's main road.

Thirdly, an existing dysfunctional tram line is detected surrounding the Catacombs region. Thus, a new tram stop was recommended along this route, which shall direct visitors along the main road connecting Pompey's pillar with the Catacombs, serving a seamless heritage experience.
On the other hand, for the mega-scale analysis, extending the city's road infrastructure towards the west to serve the Al-Ameriyah and Borg Al-Arab districts is indispensable.

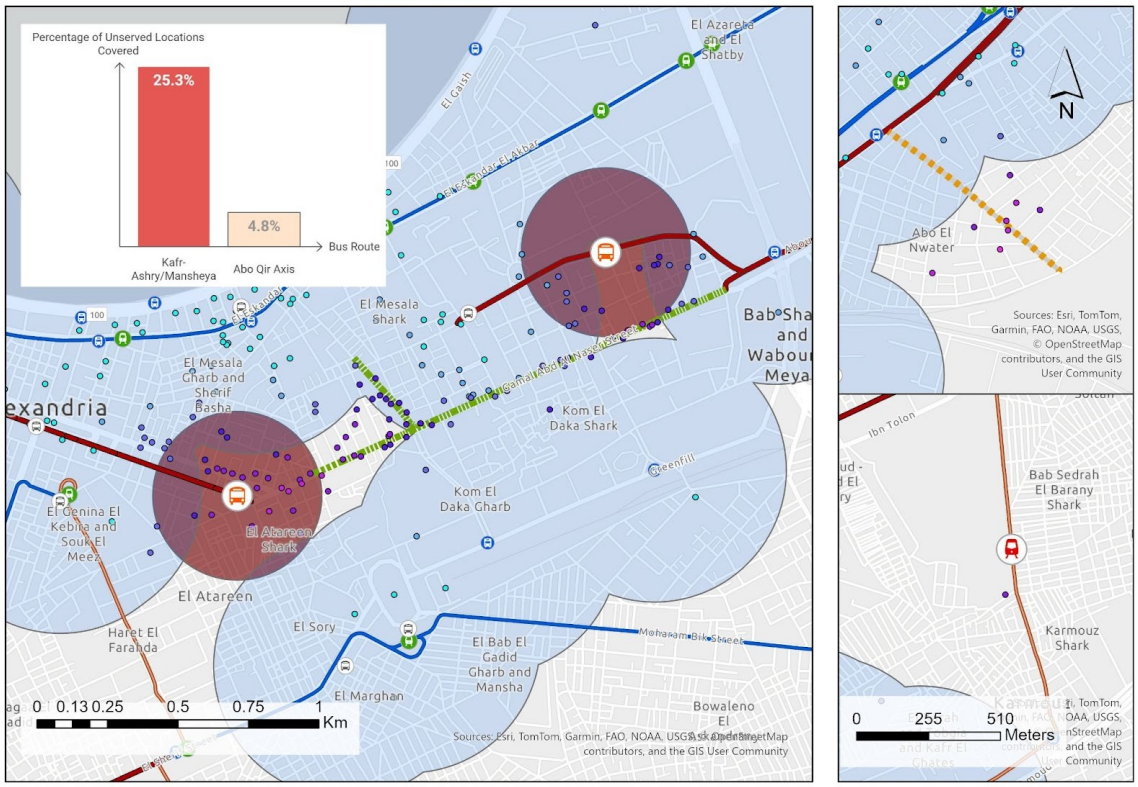

Figure 11. Map of Proximity gaps interventions based on each cluster context, Top: Foad street cluster, Bottom left: Catacombs region cluster, and Bottom Right: Kafr-Abdo neighbourhood cluster (Developed by Authors using ArcGIS Pro).

4.3 Recommended Cultural Routes and Required Interventions

4.3.1. Cluster-based Tours (Figure 12)

For the downtown area, a comparative analysis between the original tours suggested by CLUSTER and the three optimised routes resulting from network analysis includes overall path duration, average walkability index, and number of stops. The results exhibited in Table 4 reveal the superiority of the new proposed routes regarding the overall walkability indices. However, the number of stops was moderately higher for CLUSTER routes, which stems from the fact that the heritage value assessment phase filters and excludes non-unique stops. In this regard, the final three suggested routes were explored for required interventions to maximise their walkability, including improving sidewalk quality, street lighting maintenance, boosting surveillance, or adding pedestrian crossings.

Table 4: Alexandrian Downtown Cultural Routes Comparative Analysis.

Heritage Tour	Overall route Duration	Average Walkability Index	Number of Stops
CLUSTER Foad Street Tour		0.5640223656	71
Optimised Foad Street Tour	67.3 Minutes	0.5630143751	58
CLUSTER Mansheya Tour		0.5866388309	57
Optimised Mansheya Tour	71 Minutes	0.5912682825	35
CLUSTER Downtown Tour		0.4750916397	65
Optimised Downtown Tour	51.8 Minutes	0.5382871795	58

As for the newly identified cluster within the previously discovered cold spot, a new set of tours was proposed to explore this area, which includes the Gleem Tour, Roushdy Tour, and Stanley Tour. Since these tours were part of the action to promote tourism outside the downtown, they can collectively be a 3–4-hour day trip or segmented into three 1-hour trails as shown in Table 5, separated by breaks for food and rest. Additionally, the number of stops in each tour was chosen to be similar, with an average of twelve stops, some of which can be entered.

Table 5. Alexandria's newly identified Cultural Routes outside the downtown in a cold cluster.

Heritage Tour	Overall route Duration	Number of Stops
Gleem Tour	60 minutes, not including time spent inside museums, i.e., Royal Jewelry Museum & Mahmoud Saeed Museum	11
Roushdy Tour	60 minutes	13
Stanley tour	60 minutes	12

Other tours were also identified to either connect previously mentioned tours via walking or to explore important heritage outside clusters (outliers) such as Bibliotheca Alexandrina or the western District of ‘Bahari’, with a total of 12 assets that were worthy to be included, distributed equally between 3 tours as shown in Table 6.

Table 6. Alexandria's newly identified Cultural Routes outside the downtown clusters.

Heritage Tour	Overall route Duration	Number of Stops
From Downtown to Abo-il-Abbas Context Tour	17 minutes	4
Far West Walking Tour	19 minutes	4
Bibliotheca Alexandrina Tour	21 minutes	4

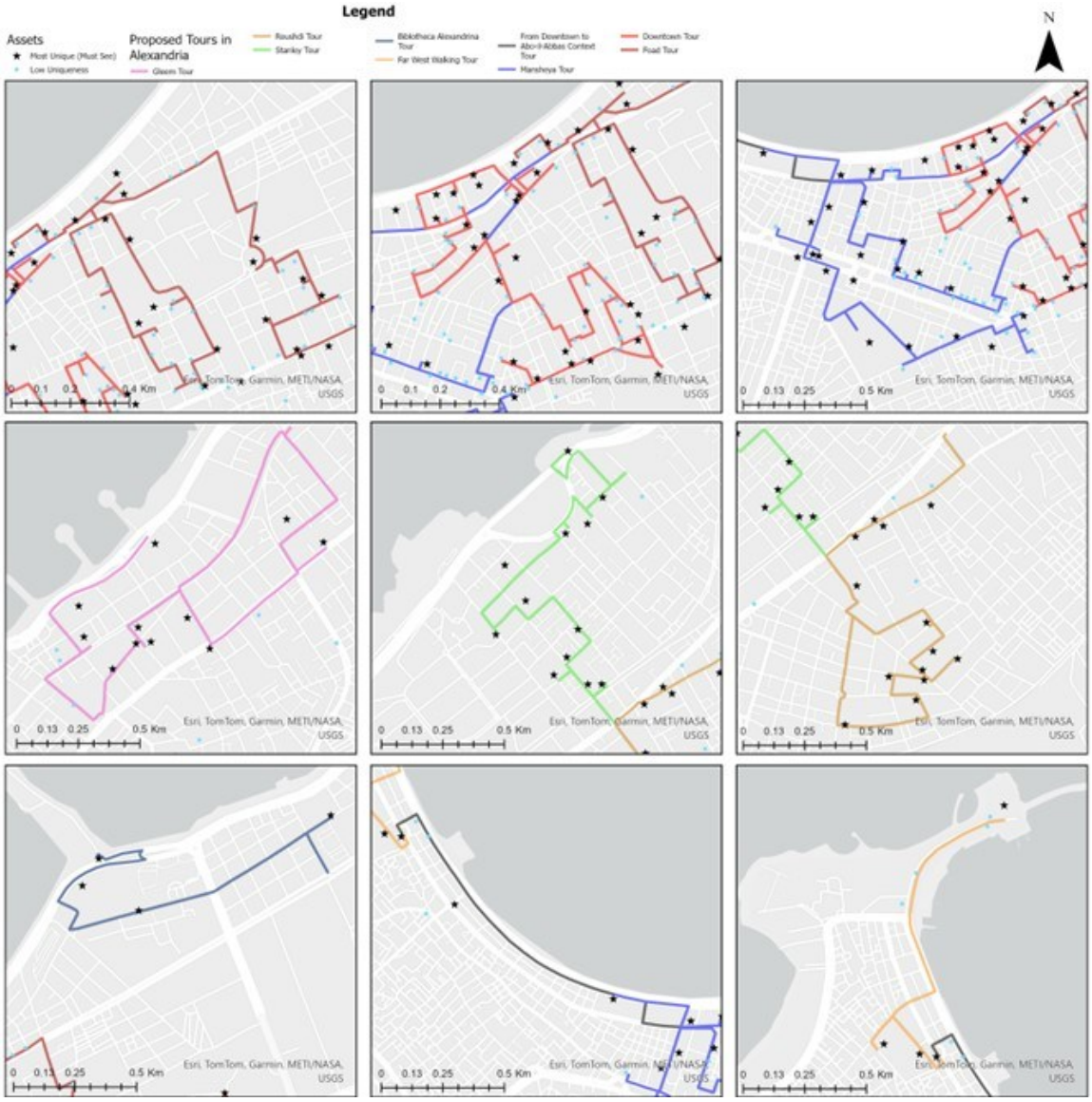

Figure 12. Map of Cluster-based tours (Developed by Authors using ArcGIS Pro).

4.3.2. City-based Tours

There is a need in Alexandria city for different mobility choices between proposed tours and clusters, not only by walking but also by using different modes of existing transportation. For example, the gardens of Montazah in the Far East can be accessed either by driving or by bus. Tours in the cold cluster can be approached by several tram stations. Additionally, Alexandria is known for Pompey's pillar and the Catacombs; however, they are situated in the 'Karmouz' district with poor access by bus or tram, but a 44-minute drive from the city centre. Table 7 and Figure 13 show these mobility options on the city scale.

Table 7. Alexandrian proposed mobility routes for touring between clusters on the city scale.

Heritage Tour	**Overall route Duration**
From East to West tram Route	65 minutes
From East to West bus Route	17 minutes
Downtown Context walking Route	94 minutes
Eastern Alexandria's main heritage assets driving route	80 minutes
Ancient Monuments driving route from nearest stops in tours, i.e., Pompey's Pillar	44 minutes

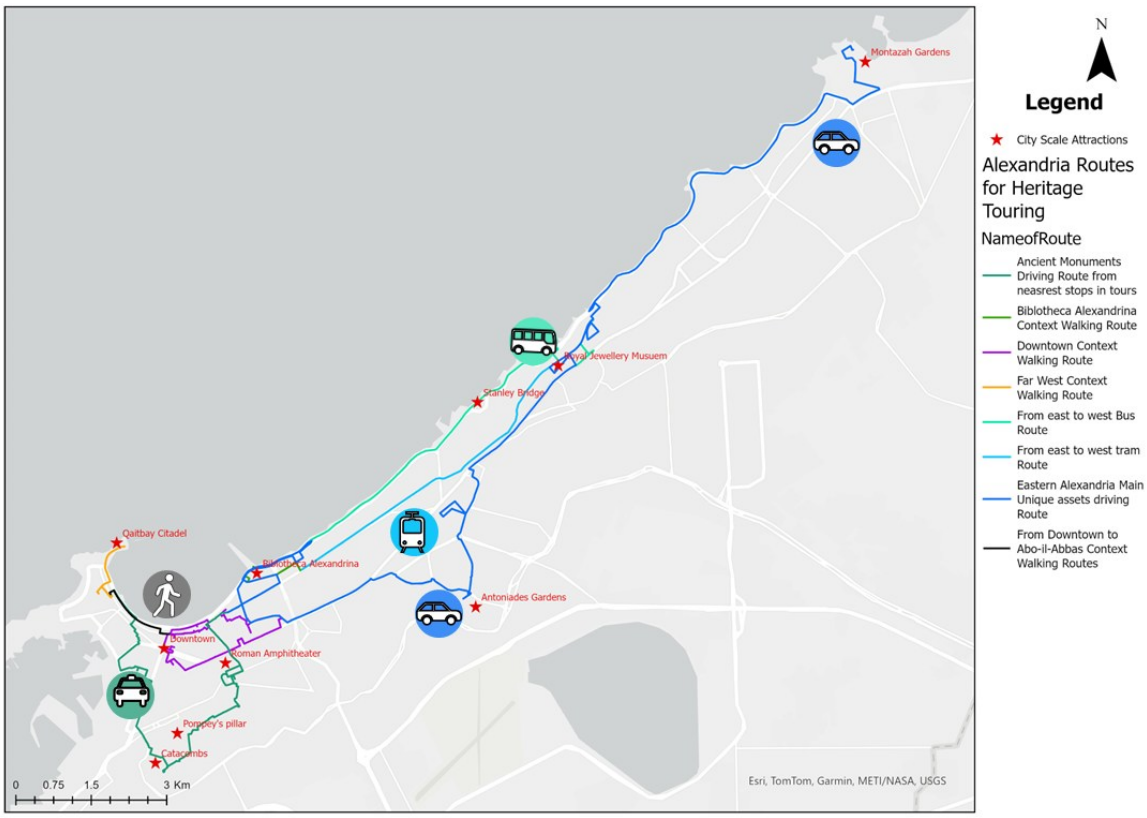

Figure 13. Map of City-based Tours and relevant mobility options (Developed by Authors using ArcGIS Pro).

4.4 Interactive Web Application

The findings support the development of an interactive web-based map application, enabling users to explore the best cultural routes. In this regard, dashboards enable interactive presentations that help communicate information between urban planners and users in the interest of improving urban quality of life. It is a tool to quantify the needs of users by easily accessing and interacting with interpretable data about their cities. Roles of dashboards in enhancing urban management include creating transparency and encouraging users to engage in decision-making processes. Technologies used in dashboards include free or commercial Web-GIS tools such as ESRI ArcGIS, which was used in this research. Dashboards can be used to display maps and charts according to several narratives. Its functionality also allows data analysis, data selection, comparison, and aggregation (Pluto-Kossakowska et al., 2022).

Since many cities still lack interactive tools that allow users to allow both users and experts to explore data (Pluto-Kossakowska et al., 2022). It was then encouraged to attempt to propose a dashboard for the findings of this research in Alexandria. The purpose of this dashboard was to become a prototype that can be later proposed to local authorities for promoting tourism in the city. The dashboard maps points and polylines of heritage assets and cultural routes that were optimised or newly introduced in the analysis in a user-friendly interface, shown in Figure 14.

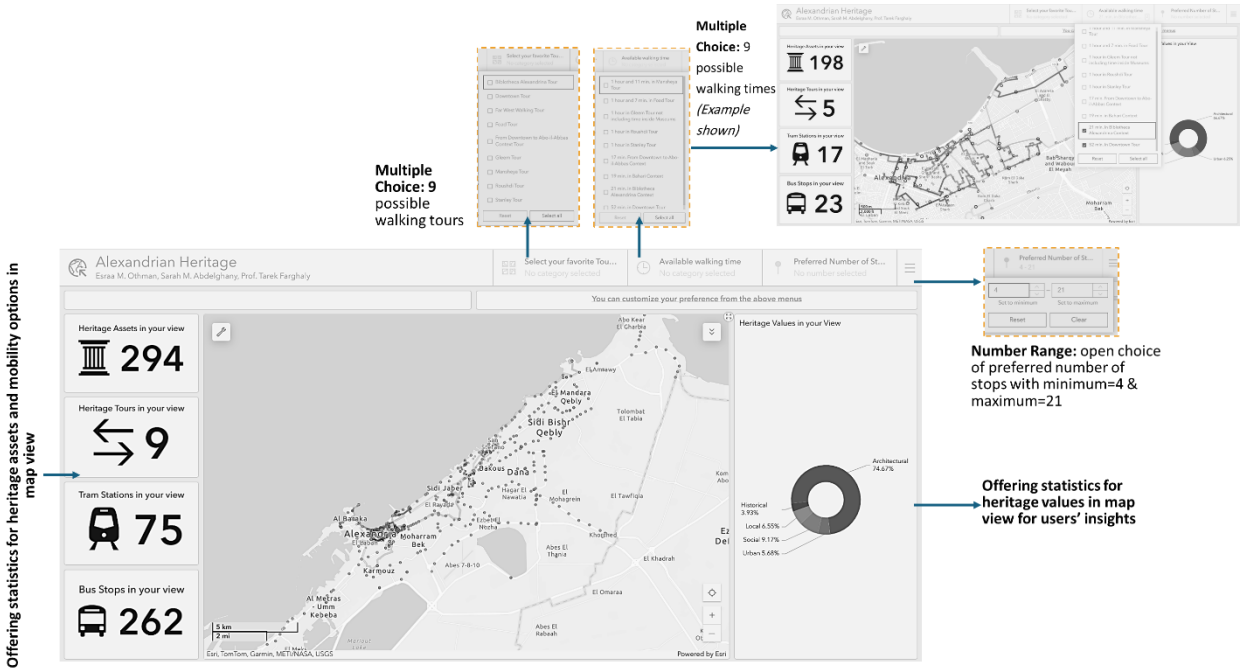

Figure 14. ESRI Online Dashboard (Developed by Authors using ArcGIS Online Applications).

These geometries can be filtered by three groups of decisions by the application user, including:

i. Preferred route based on pre-knowledge of the available route (establishing that brochures or flyers were to be distributed across heritage destinations);
ii. Available walking time;
iii. preferred number of stops to visit.

5. Discussion

5.1 Interpretation of Key Findings

Most heritage assets in Alexandria are heritage buildings that reflect the city's rich architecture and tangible history, which continue to be integral to its heritage today. Based on the spatial patterns in Alexandria, a critical need for balanced heritage promotion arises. In this regard, enhancement and maintenance of heritage clusters located outside of downtown is essential to conserve heritage as well as distribute visitor rates.

On the other hand, the accessibility analysis, as well as cultural route design phases, confirm the need for alignment between urban and heritage management endeavours. Conclusively, strategies for public realm enhancement directly affect the cultural routing experience regarding aspects of infrastructure, street design, as well as urban plazas and nodes. Additionally, implementation and enforcement of urban policy gaps can be seen in outlawed practices, such as the encroachment of sidewalks by street vendors and shops, which need to be addressed.

Moreover, accessibility to heritage sites is impacted by public transit network design. In this regard, the number and location of public transit stops should be analysed in relation to heritage clusters, as well as the potential to integrate green transit modes by adding designated lanes and stops.

5.2 Strengths and Limitations

A key strength of the research was initiating discussion on the diachronic analysis of heritage to inform decision-making by quantifying and visualising heritage value. Tourism brings economic revitalisation and increased visibility to heritage sites, triggering the urban economy (Altaba Tena, Ginés Sánchez, Querol Vicente, & García-Esparza, 2025; Lin et al., 2024). The paper also bridges spatial analysis with socio-economic research, given that:

i. Cultural routes attract both domestic and international tourists.
ii. Highlighting cultural assets along cultural routes boosts revenue for small businesses.
iii. Heritage-led developments often lead to increased land values around cultural zones, which stimulates public-private partnerships and investments in public services.

iv. Cultural tourism creates employment opportunities across service sectors.
v. Economic gains from tourism can provide local governments with funds for maintenance and restoration. Economic returns from tourism can be reinvested in maintenance.

On the other hand, challenges in collecting data for the research involve difficulty in acquiring accurate visitor rate statistics for heritage sites. Additionally, dependence on open-source data for traffic and congestion rates requires time-consuming ground truthing. Given that the focus of the study was directed towards testing GIS capabilities, collaborations with local authorities to collect data were not attempted. However, such collaborations are crucial in the long run.

6. Conclusion

This research examines the role of GIS in enhancing the cultural heritage in Alexandria, Egypt. The findings support the hypothesis that cultural heritage assessment, incorporating spatial attributes, is essential for promoting tourism. They also highlight the relevance of heritage value assessment in relation to cluster locations. This research contributes to existing knowledge across Urban Design, Socio-economic studies, Culture, Tourism, Mobility, Spatial and Statistical Analysis, Sustainability, and Architecture. Unlike prior studies that focus on the qualitative values of heritage, this research aspires to combine both qualitative and quantitative approaches in a comprehensive methodology. In this regard, quantitative analysis was assured to be as important as spatial analysis. Also, utilising mathematical equations and correlations programmed within GIS emphasises the scientific contribution to investigating cultural heritage in the 21st century.

While the case of Alexandria provides valuable insights into heritage value assessment and how to associate values with spatial distribution, the findings are also relevant to cities with rich heritage facing similar challenges. The conceptualisation of the methodology is flexible to adapt to contexts beyond Alexandria.

In conclusion, GIS technologies have proven efficient as they enable:

1. Sustainable and unified heritage documentation workflow,
2. Engaging and illustrative heritage map visualisation,
3. Comprehensive heritage management approaches through improving connectivity and spatial integration with transportation networks, qualitatively and quantitatively.

This integration exhibits the potential to include users in interactive experiences that eventually support sustainable tourism development through:

1. Providing an open-access database for Alexandrian tangible and intangible heritage.
2. Including public participation for feedback loops in the future.
3. Developing mobile applications for cultural touring and marketing.
4. Launching websites with interactive dashboards in cities for stakeholders' incorporation in decision-making.

Future work can expand on the research methodology and findings by approaching local governance to test the proposed cultural routes and employ tour guides to accompany users. Moreover, field validation of walkability scores could be of high value to refine walkability evaluation across a diverse sample representing several age, gender, and socio-economic groups, as well as national and international tourists. Furthermore, partnerships and collaborations with business sectors on the walking routes would allow the growth of the database to include commercial activities supporting tourism. Additionally, ongoing advancements in GIS technologies such as virtual reality simulations, 3D visualisations, and real-time monitoring of visitor rates and traffic can be introduced to urban interventions.

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The author(s) declare(s) no conflicts of interest.

Data availability statement
The datasets supporting this research can be obtained from the corresponding author, [E.O.], upon reasonable request.

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Wavelet Quantile Evidence on Urbanisation, Human Capital and Economic Growth Impacts on Nigeria's Ecological Footprint

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ABSTRACT

In light of growing uncertainties in the climate, it is crucial to identify what is causing environmental pressure in Nigeria. This study explores dynamic links between urbanisation, human capital accumulation economic growth and the nation's ecological footprint (EF) from 1961 to 2020. Employing Wavelet Quantile Correlation (WQC) and Quantile-on-Quantile Granger Causality (QQGC) approaches, we capture both frequency-specific and distribution-specific dependencies neglected by linear techniques. WQC results indicate that rising urban population, expanding human capital and GDP growth dampen EF in the short- and medium-term, yet predominantly amplify EF over longer horizons; negative correlations persist for lower quantiles (0.1–0.5), highlighting heterogeneous vulnerabilities. QQGC confirms significant bidirectional causality across all quantile pairs, underscoring pervasive interdependence irrespective of economic or ecological states. Policy simulations suggest that integrating environmental education into all schooling levels, promoting renewable energy within rapidly growing cities, and decoupling growth from fossil-fuel dependence are critical for sustaining long-run environmental gains. Our evidence supports context-specific, time-phased interventions that align Nigeria's urban transition and human capital strategy with its 2050 net-zero commitment. By revealing quantile-dependent effects, the study enriches environmental Kuznets literature and offers nuanced guidance for green development planning strategies.

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Highlights:

- Urbanisation lowers Nigeria's ecological footprint in the short-medium term but magnifies it long-term, per wavelet–quantile results.
- Rising human capital trims footprint at lower quantiles yet drives higher-quantile, long-horizon ecological pressure.
- Quantile-on-quantile causality confirms the bidirectional influence between urbanisation, human capital, GDP and the ecological footprint across every quantile pair.
- Policy simulation reveals renewable-energy urban growth and environmental education can decouple these drivers from Nigeria's rising footprint by 2050.

Contribution to the field statement:

Applying Wavelet Quantile Correlation and Quantile-on-Quantile Causality to Nigeria's 1961–2020 dataset, this study pioneers frequency- and distribution-sensitive evidence that urbanisation, human capital and growth alternately mitigate or magnify ecological footprints across temporal–quantile regimes. By integrating education-centred policy simulations, it reframes environmental Kuznets expectations, enriching urban sustainability economics and methodology scholarship.

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1. Introduction

At present, the global economy is characterized by different uncertainties, such as wars (physical and trade), political and economic instabilities, and climate change. Among all these concerns, climate change is at the forefront of discussions. This is because its impact is being felt globally. The discussion centred on climate change is that the way humans use their resources should not lead to the degradation of the environment. Climate change has caused frequent and severe heat waves, droughts, floods, wildfires, and storms, leading to loss of life, displacement, economic damage, and food insecurity. These problems have made environmental sustainability a major point of discussion, and this is emphasized by the United Nations (UN) Sustainable Development Goals (SDGs). Environmental sustainability is the ability to meet present needs without jeopardizing the chances of future generations from meeting their needs (UN, 1987). Therefore, due to the importance of climate change, it is essential to continually investigate the major drivers of environmental sustainability or factors that can degrade the environment.

From previous studies, different factors can affect the quality of the environment either positively or negatively, such as economic growth, urbanization, human capital, geopolitical risk, population, financial development, policy uncertainties, foreign direct investment (FDI), stringent environmental policies, and globalization (Ahmed et al., 2022; Ibrahim et al., 2023; Kamal et al., 2021; Luo & Sun, 2024; Zou et al., 2025). This study focuses on how urbanization, human capital, and economic growth influence ecological footprint. Urbanization refers to the movement of people from rural to urban areas because of the inherent economic benefits in urban areas. According to Humbal et al. (2023), in the nineteenth century, just 15% of people on earth lived in cities. The twentieth century saw a drastic shift in the situation, with the 1950s seeing a sharp increase in the pace of urban population growth. Half of the world's population is expected to live in cities sixty years from now. Furthermore, it is anticipated that 86% of industrialized nations and 64% of emerging nations will be urbanized by 2050. Urbanization is being driven by diverse social, economic, and ecological variables. Also, industrialization, employment possibilities, population increase, social concerns, and modernization were further factors that promoted urbanization. It is crucial to note that unchecked urbanization has several detrimental impacts on the global biosphere, such as increasing air pollution, slum expansion, environmental degradation, land insecurity, and problems with water and sanitation. However, when used responsibly, it has several positive effects, such as enhanced infrastructure and technology, first-rate medical and educational facilities, more substantial communication and transportation, and higher living standards. Therefore, further research is required to fully understand the dual impact of urbanization on the environment.

Human capital is also one of the factors that can contribute to economic expansion and a sustainable environment. Human capital refers to the skills, knowledge, experience, and training that individuals have, which helps them to be more productive. It is also essential to state that access to quality healthcare and individuals being in good health condition are determinants of human capital. According to Samans et al. (2017), almost no other aspect can determine a country's long–term prosperity more than how it develops its human capital. They defined 'human capital' as the abilities and knowledge that people have that allow them to provide value to the global economy. Formal education and skill development are not the only factors that determine human capital. It may be improved over the course of a person's lifetime, increasing with use and decreasing with inactivity. Samans et al. (2017) and Sarkodie et al. (2020) further argued that being educated makes individuals more socially conscious and, as a result, more ecologically conscious. Education is a fundamental component of human capital. Therefore, the argument above shows that human capital is a necessary factor in achieving environmental sustainability.

Urbanization and human capital are key components of economic progress. At the same time, economic growth is a major factor that either drives environmental quality or degrades the environment. Economic growth simply means there is an increase in the production of goods and services, which can have a significant positive impact on employment levels, income, and living

standards (Boussaidi & Hakimi, 2025). On the other hand, if this expansion is not controlled sustainably, the quality of the environment may suffer. Thus, it is important to promote sustainable practices to achieve a balance between economic expansion and environmental protection.

There are different ways in which environmental quality is measured, including using the level of greenhouse gases (GHGs). Rather than using GHGs such as carbon dioxide emissions (CO_2) to proxy for environmental quality, this research used ecological footprint. Anthropogenic activities' effects on grazing land, the ocean, agricultural lands, forest products, infrastructure (built–up land), and carbon footprint are measured by ecological footprint. The amount of land and water required to create commodities and absorb waste is measured in global hectares (Ahmed & Wang, 2019). According to current research, ecological footprints are a comprehensive and cumulative measure of how human activity affects the ecosystem (Charfeddine, 2017; Destek et al., 2018). In simple terms, ecological footprint measures how much nature is needed by people to support their way of living. A high ecological footprint is detrimental to the environment, while a low ecological footprint is beneficial.

Therefore, this research investigates the impact of urbanization (UPOP), human capital (HUMC), and economic growth (GDPR) on ecological footprint (ECOL) in Nigeria from 1961 to 2020 using methods such as the Wavelet Quantile Correlation (WQC) (Kumar & Padakandla, 2022), and the Quantile–on–Quantile Granger Causality analysis (QQGC) (Adebayo & Özkan, 2024). The WQC investigates the relationship between variables, taking into account both frequency scales and quantile dependency. This is more advantageous when compared to linear techniques. On the other hand, compared to the Granger Causality (GC) and Quantile Granger Causality (QGC) approaches, QQGC allows for a more detailed study of causation by examining causality from the quantiles of an independent variable to the quantiles of a dependent variable. Furthermore, the Quantile ADF proposed by Adebayo & Özkan (2024) is employed to test for data stationarity. This is more advanced than the traditional unit root tests, such as ADF and PP. The methods employed are some of the contributions made to existing literature. In addition, urbanization is included in this research because urbanization levels are increasing rapidly in Nigeria. In addition, it is essential to state that Nigeria is the most populous country in Africa, with a population of more than 200 million people (World Bank, 2025). Nigeria also aims to achieve net–zero by 2050. Sarkodie et al. (2020) stated that the inconsistencies that can be found across different economic variables and the degradation of the environment could be due to the absence of human capital as a moderating variable. This means the role of human capital in achieving environmental quality cannot be neglected.

2. Literature Review

Udemba (2020) used Nigeria as a case study to examine the interconnection between GDPR and ECOL. Using Nigeria is motivated by the fact that the nation's economy mostly depends on fossil fuels. According to the results of the Granger Causality (GC) and Autoregressive Distributed Lag (ARDL) methods, the *scale effect* theory is confirmed. This means that GDPR and ECOL are growing at the same rate. Likewise, using the same methodology for the Nigerian economy, Dada et al. (2022) found that while GDPR contributes to the degradation of the environment, HUMC and URB reduce ECOL. According to Akadiri et al. (2025), concerns over Nigeria's environmental sustainability have been raised by the country's drive for economic expansion, especially in light of the consequences of resource reliance, urbanization, and foreign direct investment (FDI). Results show that environmental quality continuously deteriorates by economic expansion across all quantiles, with the impacts getting worse with time. Urbanization and FDI both have detrimental ecological effects, especially at medium and high quantiles. Obekpa et al. (2025) argued that the total ECOL increases because of population growth and economic expansion.

Nathaniel (2021) argued that in addition to being the most developed and urbanized nation in Africa, South Africa is the biggest emitter of CO_2. Long–term results indicate that although HUMC supports environmental sustainability, urbanization and economic expansion raise ECOL. In addition, the relationship between urbanization and HUMC lessens environmental deterioration. The methods used

include ARDL, FMOLS, DOLS, and CCR. In Brazil and China, employing the QARDL approach, Tiwari et al. (2022) established that GDPR increases ECOL, while HUMC reduces it. Furthermore, adopting the dynamic ARDL and KRLS methods, Zhou et al. (2022) found a contradictory result regarding HUMC and that is, HUMC increases ECOL in Pakistan. In addition, GDPR drives ECOL, while urbanization undermines it. In GCC economies, Amer et al. (2022) showed how urbanization decreases ECOL and how GDPR & HUMC increase ECOL using the FGLS technique. In G–11 economies, Mehmood (2024) opined that urbanization and GDPR increase ECOL.

In recent studies, Degirmenci et al. (2025) established that URB contributes to ecological sustainability in Brazil, while it harms the environment in China. It was also found that HUMC spurs the sustainability of the environment. In BRICS economies, Liu et al. (2025) argued that the availability of natural resources and growth in the economy both increase ECOL. In addition, the study suggests a causal feedback link between HUMC, URB, and ECOL. Tunio et al. (2025) confirmed that economic expansion exacerbates environmental deterioration over time while reducing it in the short run. Also, URB has been identified as a major contributor to long-term environmental deterioration, highlighting the necessity of focused governmental responses. According to the study of Mohamed et al. (2025), GDPR and URB increase ECOL for the Somalian economy.

Conclusively, the literature, shows that GDPR (Economic Growth) leads to ecological degradation, while the impact of URB (Urbanization) and HUMC (Human Capital) on the environment can be both positive and negative. Therefore, further research is required due to the inconsistent outcomes.

Table 1: Literature Review Summary.

Author(s)	Year	Country(ies)	Methods	Outcome
Udemba (2020)	1981–2018	Nigeria	ARDL & Granger Causality	GDPR (+)
Nathaniel (2021)	1970–2016	South Africa	ARDL, FMOLS, DOLS & CCR	URB (+), GDPR (+), HUMC (–)
Zhou et al. (2022)	1980–2018	Pakistan	Dynamic ARDL & KRLS	HUMC (+), GDPR (+), URB (–)
Dada et al. (2022)	1970–2017	Nigeria	ARDL & Granger Causality	URB (–), HUMC (–), GDPR (+)
Tiwari et al. (2022)	1971Q1–2017Q4	Brazil & China	QARDL	GDPR (+), HUMC (–)
Amer et al. (2022)	1995–2017	GCC	FGLS	URB (–), GDPR (+), HUMC (+)
Mehmood (2024)	1990–2020	G–11	CS–ARDL	URB (+), GDPR (+)
Akadiri et al. (2025)	1970–2022	Nigeria	Wavelets Quantile Regression	URB (+), GDPR (+)
Obekpa et al. (2025)	1981–2020	Nigeria	Quantile Regression & KRLS	GDPR (+)
Degirmenci et al. (2025)	1991–2019	E–7	AMG	URB (+), URB (–), HUMC (–)
Liu et al. (2025)	1992–2016	BRICS	AMG, PMG, CCEMG, FMOLS & DOLS	GDPR (+)
Tunio et al. (2025)	1970–2022	34 High-Income European and Asian	VECM	GDPR (+), URB (+)
Mohamed et al. (2025)	1990–2020	Somalia	ARDL, FMOLS & CCR	GDPR (+), URB (+)

Note: *(+) denotes positive association; (–) denotes negative association.*

3. Data, Theoretical Framework, and Methodology

3.1 Data and Sources

The data employed in this research (1961–2020) and their sources are as follows: Ecological Footprint (global hectares per capita) (ECOL), which is the dependent variable, is used as a proxy for environmental progress, and its source is the g. The independent variables include Urban Population (% of total population) (UPOP), a proxy for urbanization, Index of Human Capital Per Person (HUMC), and Gross Domestic Product (constant 2015 US$) (GDPR), which is a proxy for economic expansion. UPOP and GDPR data sources are (the World Bank, 2024), while the HUMC data source is from (Feenstra et al., 2015). It is important to note that the data period stopped in 2020 because of limited data availability.

3.2 Theoretical Framework

3.2.1 Theories of Urbanization

The theoretical framework that links urbanization to ecological quality includes the Ecological Modernization Theory (EMT), Environmental Transition Theory (ETT), and Compact City Theory (CTT). According to the EMT, emissions increase as urban areas become more developed and then decrease after a specific degree of modernization is reached (Mol & Spaargaren, 2000). Examining urbanization from another perspective, ETT proposes that the impact of urbanization differs at different phases of development (Jacobi et al., 2010). Lastly, CCT asserts that urbanization can positively contribute to ecological progress due to an improvement in public infrastructure, such as hospitals, schools, water and electricity supply, and public transportation (Burton, 2000; Sadorsky, 2014).

3.2.2 Environmental Kuznets Curve

The EKC hypothesis, posited by Grossman & Krueger (1991), argues that economic growth can be grouped into three (3) phases. The initial phase is the *scale effect*, which is related to the early stages of economic growth and is marked by high competitiveness. During this stage, governments are more concerned with economic performance than with ecological performance. This stage is primarily linked to developing countries that want to be like industrialized nations, and to accomplish this, competitive economic growth is implemented, which has a negative impact on the environment. The *technological expansion effect stage* is the second phase. The shift from the scale effect to a more enlightened stage is what defines this stage when people will begin to understand how their activities affect the environment and their health and will begin to advocate for a high–quality environment. The final stage is the *composite effect stage.* At this point, a complete understanding of the necessity of excellent environmental quality and clean economic operations is observed and implemented. Most economic operations will be more sophisticated, with cutting–edge technology that will ensure both economic and environmental sustainability. Service sectors and R&D activities will drive economic progress.

3.3 Methodology

The Quantile ADF (QADF) test proposed by Adebayo & Özkan (2024) was carried out as a preliminary assessment to test for stationarity conditions. Once the stationarity results have been obtained, we proceed to adopt the next method, which is the Wavelet Quantile Correlation (WQC) proposed by (Kumar & Padakandla, 2022). According to previous empirical research, the connections between variables can change over time. Nonetheless, the classic Quantile Regression (QR) technique does not account for the potential of separate impacts of the independent variable on the conditional quantiles of the dependent variable over several temporal dimensions. To solve this restriction, the WQC technique was adopted. In addition, for results confirmation and robustness check, the Quantile on Quantile Granger Causality (QQGC) proposed by Adebayo & Özkan (2024) was adopted. Compared to the Granger Causality (GC) and Quantile Granger Causality (QGC) approaches, QQGC

allows for a more detailed study of causation by examining causality from the quantiles of an independent variable to the quantiles of a dependent variable.

4. Results and Discussions

4.1 Descriptive Statistics

The first preliminary investigation carried out is the descriptive statistics. We found an unequal distribution in the dataset for the majority of the variables since their mean values surpassed the values of the standard deviation. In addition, ECOL and UPOP are skewed to the left (negatively skewed), while GDPR and HUMC are skewed to the right (positively skewed). Aside from ECOL, all other variables exhibit non–normal distribution because the p-values are less than 5%.

Table 2: Descriptive Statistics.

	ECOL	GDPR	HUMC	UPOP
Mean	0.001261	2.810756	0.034534	0.363637
Median	0.002163	2.797440	0.022652	0.369119
Maximum	0.023713	2.926920	0.073959	0.429534
Minimum	–0.026550	2.700024	0.015279	0.297930
Std. Dev.	0.010096	0.065298	0.020197	0.040755
Skewness	–0.106260	0.351242	0.698096	–0.054668
Kurtosis	2.718179	2.194047	1.928865	1.686894
Jarque–Bera	1.245875	11.43042	30.96683	17.36201
Probability	0.536366	0.003295*	0.000000*	0.000170*

* denotes < p–value of 1%

4.2 Nonlinearity Test

To examine the series' nonlinear patterns, Broock et al. (1996) nonlinearity test is adopted. As shown in Table 3, the results of nonlinearity tests confirm the presence of nonlinearity in each variable under examination, demonstrating that the quantile-based technique is appropriate for this study.

Table 3: Result of the Nonlinearity Test.

	ECOL	GDPR	HUMC	UPOP
DIM2	0.176495*	0.202384*	0.205072*	0.208327*
DIM3	0.291713*	0.342204*	0.346645*	0.353975*
DIM4	0.365823*	0.439496*	0.445041*	0.456302*
DIM5	0.412253*	0.507715*	0.513889*	0.528617*
DIM6	0.440993*	0.555877*	0.562402*	0.580003*

* denotes < p–value of 1%.

4.3 Stationary Test

The QADF test, proposed by Adebayo & Özkan (2024), was performed to investigate the data's stationarity over different quantiles. Unlike traditional ADF and PP tests, which presume consistent distributional features across the whole range, the QADF test takes into account probable distributional changes at different points within the distribution. This method adds to a more thorough knowledge of the data characteristics (Adebayo & Özkan, 2024). Figure 1 shows that all the variables are stationary at the level.

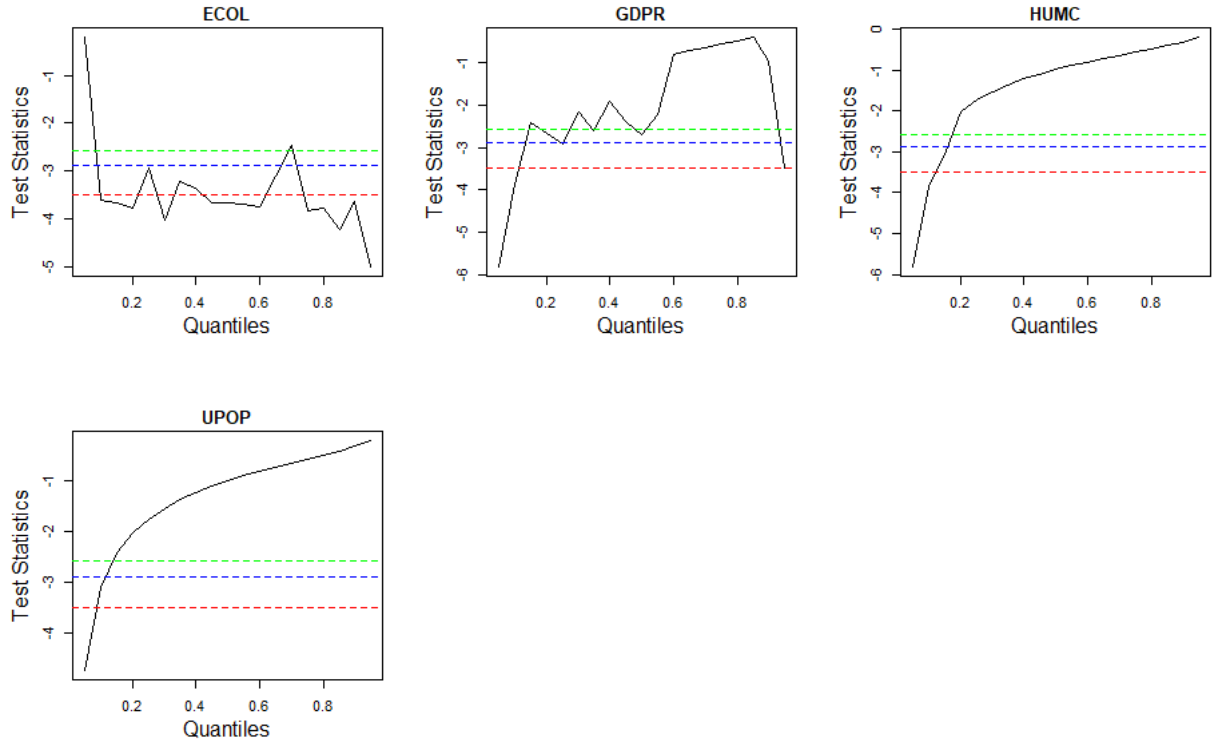

Figure 1. Quantile ADF Unit Root Test.

4.4 Wavelet Quantile Correlation (WQC)

The WQC is a reliable method for dealing with difficulties involving patterns that are tail–dependent. This approach fully investigates the relationship between variables, taking into account both frequency scales and quantile dependency. Figures 2, 3 & 4 depict the asymmetric behaviour between GDPR, HUMC, UPOP, and ECOL over various periods and quantiles. The Y–axis displays the distinct periods, namely short, medium, and long term, while the X–axis displays the various quantiles (0.1–0.9).

The outcome of the WQC analysis shows that the relationship between GDPR, HUMC, UPOP, and ECOL in the short and medium term is negative. However, in the long run, the association is mainly positive, although, between the quantiles 0.1 and 0.5, there exists a negative link.

The negative short-run and positive long-term association between GDPR and ECOL can be justified. Nigeria's short–term ecological footprint reduction with initial GDP growth may be explained by a move away from traditional, highly resource-intensive practices and toward somewhat more efficient, albeit still basic, technologies and consumption patterns linked to the country's early phases of industrialization and urbanization. This outcome corresponds with the study of Wang et al. (2022) for 166 economies. However, Nigeria's dominant resource extraction (particularly oil), weak environmental regulations and enforcement, rapid population growth that increases demand for consumption, and an economic development trajectory that has historically placed expansion above environmental sustainability are likely the main causes of the country's overwhelming long-term trend of growing ecological footprint. This corresponds to the studies of (Dada et al., 2022; Udemba, 2020). It is important to note that the EKC is not confirmed in this research. This is because the short and medium-term results are negative, while the long-run result is positive.

Secondly, the relationship between HUMC and ECOL in the short and medium term is negative, and this corresponds to the study of (Dada et al., 2022; Nathaniel, 2021; Tiwari et al., 2022). However, in the long run, the association is mainly positive. This means the approach of using human capital to solve the environmental crisis in Nigeria is not sustainable. The outcome of this research is justifiable. As human capital develops, which involves the development of skills, knowledge, education, and

experience, it should lead to better choices, which should contribute to ecological quality. However, this is not always the case in the real world. Human capital could develop, and yet people can still live below the poverty line. Therefore, their actions will be centred on making use of the resources around them to survive, and this includes the use of fossils. This positive association in the long run corresponds to the studies of (Akadiri et al., 2025; Amer et al., 2022; Mehmood, 2024; Zhou et al., 2022).

Lastly, the negative short-run association (Amer et al., 2022; Dada et al., 2022) between UPOP and ECOL in Nigeria could be attributed to initial efficiency gains from urbanization, such as improved infrastructure use, shared public services, and more compact living, which reduces per capita resource use. However, a long-term positive link is predicted to emerge as urban populations grow, increasing energy use, transportation use, waste output, and pressure on natural resources. Over time, rapid urban growth can outrun sustainable planning and infrastructure development, resulting in a bigger environmental impact. This aligns with the studies of (Akadiri et al., 2025; Mehmood, 2024; Nathaniel, 2021).

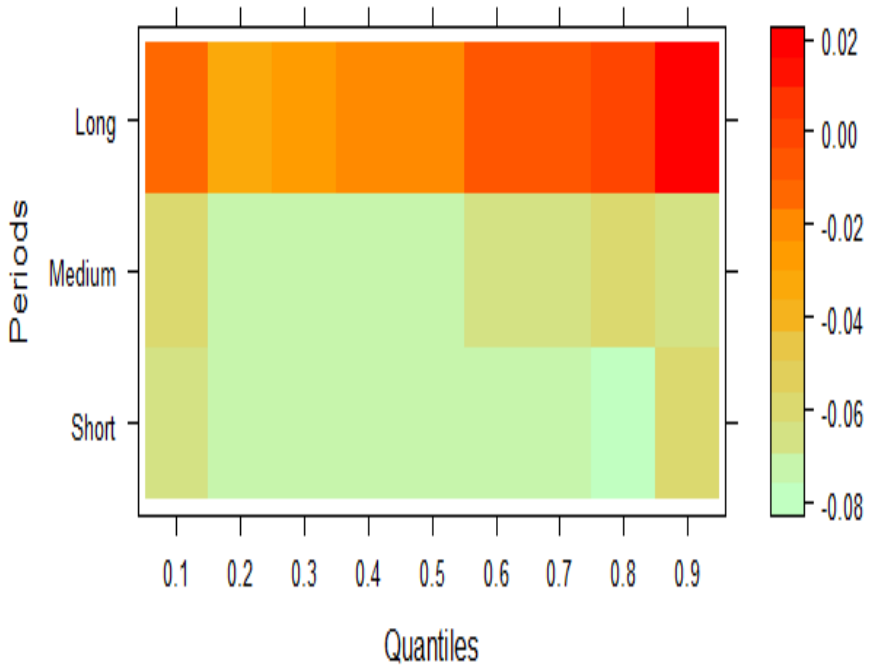

Figure 2. The impact of GDPR on ECOL.

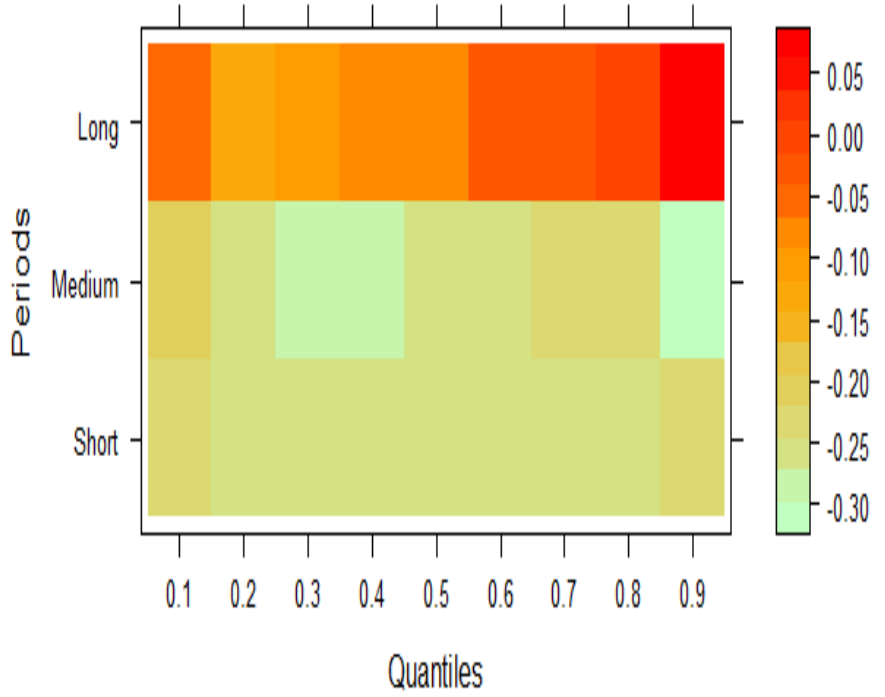

Figure 3. The impact of HUMC on ECOL.

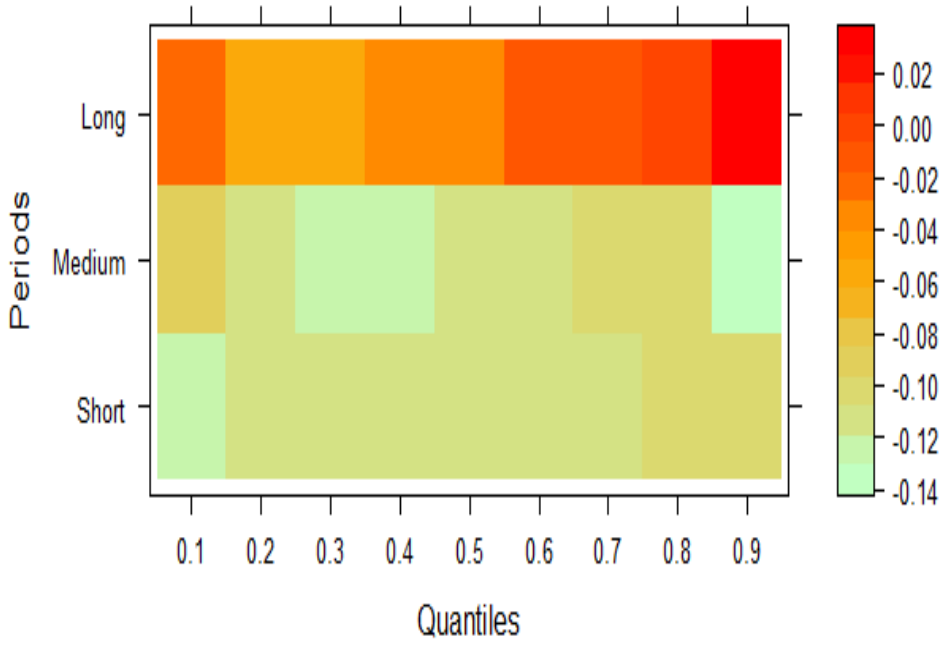

Figure 4. The impact of UPOP on ECOL.

4.5 Quantile–on–Quantile Granger Causality Analysis (QQGC)

The QQGC results in Figures 5, 6, & 7 revealed that UPOP, HUMC, and GDPR all have a substantial impact on ECOL across all quantiles. This can be seen in the orange and red colours with asterisks.

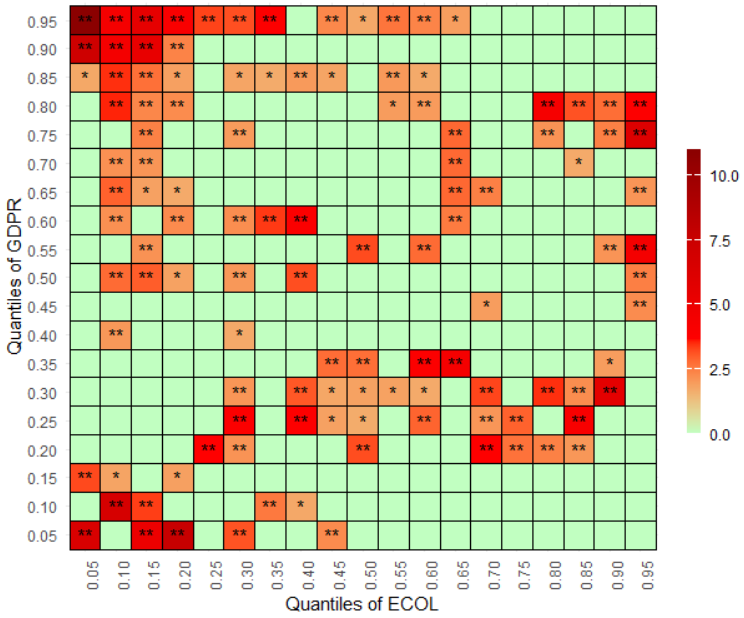

Figure 5. Causality from GDPR to ECOL.

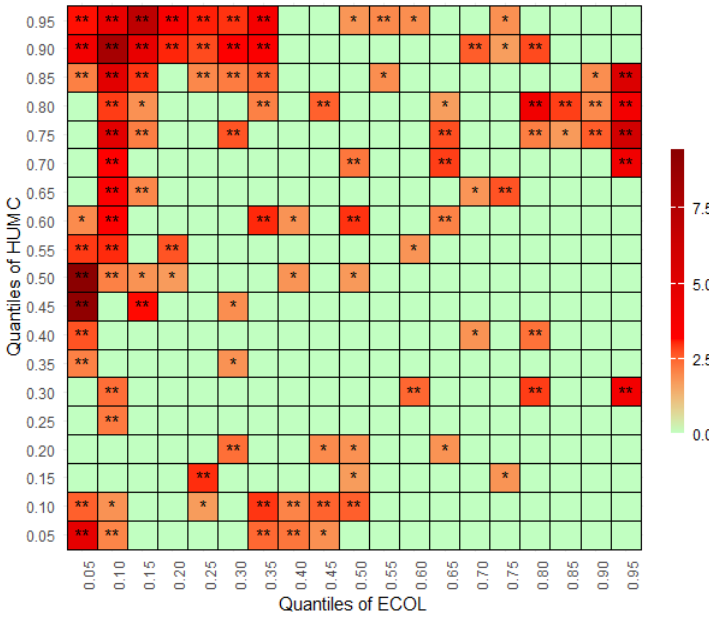

Figure 6. Causality from HUMC to ECOL.

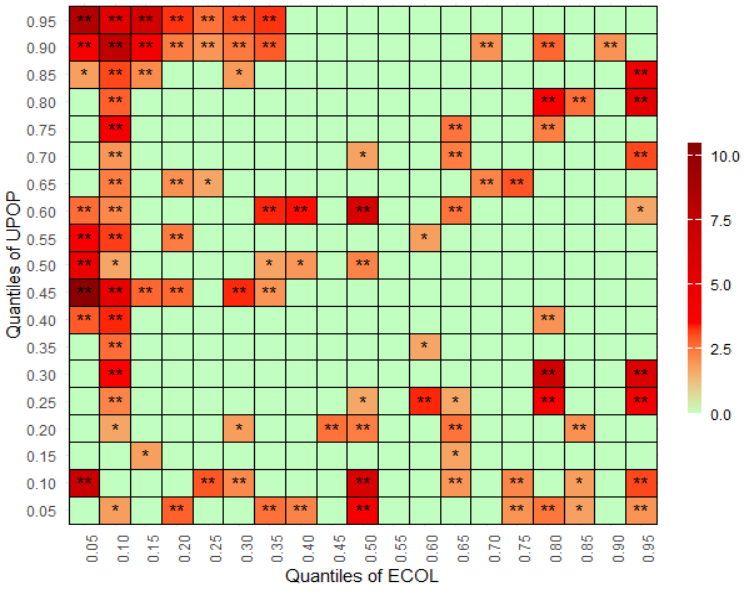

Figure 7. Causality from UPOP to ECOL.

5. Conclusion and Recommendations

This study investigates how urbanization, human capital, and economic growth affect ecological footprint from 1961–2020 using the Wavelet Quantile Correlation (WQC), and the Quantile–on–Quantile Granger Causality analysis (QQGC) methods. The WQC outcomes show that urban population, human capital, and economic growth reduce the ecological footprint in the short and medium term, while in the long term, the findings are predominantly positive. However, within the quantiles 0.1 and 0.5, there exists a negative link. In addition, the QQGC confirms the WQC across all quantiles.

The study recommends the following: (1) To strike a balance between HUMC and ECOL, and guarantee long–term environmental preservation, it is essential to incorporate environmental education into all educational levels, encouraging green innovation, and coordinating human capital development with sustainability objectives. (2) To manage urban growth without adding to ecological pressure, boosting the use of renewable energy, investing in green infrastructure, enforcing environmental legislation, and promoting sustainable urban planning is crucial. (3) Decoupling

economic growth from ecological decline also entails the adoption of clean energy sources, mixed with stringent environmental policies to discourage the use of unclean energy.
The study has some limitations, such as, it only focuses on Nigeria. Other studies can use a group of other countries or individual countries and investigate similar research questions. In addition, other econometric methods can be adopted for more robust findings.

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The authors declare no conflicts of interest.

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The authors confirm that the data supporting the findings of this study are available within the article, and data is available upon request.

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Abbreviations:

ADF:	Augmented Dickey Fuller
AMG:	Augmented Mean Group
ARDL:	Autoregressive Distributed Lag
CCEMG:	Common Correlated Effects Mean Group
CCR:	Canonical Cointegrating Regression
CCT:	Compact City Theory
DOLS:	Dynamic Ordinary Least Squares
EKC:	Environmental Kuznets Curve
EMT:	Ecological Modernization Theory
ETT:	Environmental Transition Theory
FGLS:	Feasible Generalized Least Squares
FMOLS:	Fully Modified Ordinary Least Squares
KRLS:	Kernel–based Regularized Least Squares
NARDL:	Non–linear ARDL
PMG:	Pooled Mean Group
PP:	Phillips Perron
QADF:	Quantile Augmented Dickey Fuller
QARDL:	Quantile Autoregressive Distributed Lag

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Smart Technologies for Socioeconomic Sustainability in Urban Housing: A Southeast Asian Perspective

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ABSTRACT

Rapid urbanisation across Southeast Asia intensifies the demand for housing that is simultaneously affordable, sustainable, and socially inclusive. This study investigates how smart technologies—Artificial Intelligence, Internet of Things devices (IoT), Building Information Modelling, and passive cooling innovations—can advance socioeconomic sustainability in urban housing. A three-phase methodology combined a scientometric analysis of 454 Scopus-indexed papers, a systematic literature review of eight rigorously screened studies, and a qualitative content analysis of practice-based sources. The scientometric mapping reveals growing scholarly attention to energy efficiency and climate resilience, yet affordability and social equity remain peripheral themes. Evidence from Malaysia, Indonesia, the Philippines, Singapore, and Thailand shows that smart sensors, digital simulations, and value-management frameworks can reduce cooling energy by up to 18,000 kWh annually, cut construction costs, and enhance thermal comfort in low-income settings. However, adoption is uneven owing to high capital costs, limited policy incentives, and skills gaps. The study proposes an integrated framework linking environmental performance, housing affordability, and social inclusion through appropriate digital tools. Policymakers and urban planners are urged to embed financing mechanisms, capacity-building, and participatory design into housing programmes to mainstream technology-enabled, equitable sustainability across the region within the next decade.

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Highlights:

- Proposes an Integrated Framework for Sustainable Affordable Housing in Southeast Asia combining digital technologies, affordability, and inclusion.
-Applies a triangulated methodology: scientometric analysis, systematic literature review (SLR), and content analysis to explore regional housing trends.
-Identifies BIM, IoT, passive cooling systems, and digital simulations as effective tools for enhancing housing sustainability and affordability.
-Reveals limited but promising implementation of smart housing solutions in Malaysia, Indonesia, the Philippines, Singapore, and Thailand.
-Highlights the gap between technological innovation and policy adoption in low- to middle-income urban housing contexts.

Contribution to the field statement:

This study proposes an original Integrated Framework for Sustainable Affordable Housing in Southeast Asia, grounded in scientometric, SLR, and content analysis. It fills a research gap by aligning digital technologies with affordability, inclusion, and urban resilience, offering actionable insights and a structured approach to future-proof, equitable housing policy in rapidly urbanising contexts.

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1. Introduction

1.1 Background and Context

Housing plays a pivotal role in the broader framework of sustainable development, where environmental stewardship, economic resilience, social equity, and cultural integrity intersect (Ebrahimigharehbaghi et al., 2022; Haruna et al., 2023). The sustainability of housing has evolved beyond physical structures to encompass the quality of one's living environment (Fatourehchi & Zarghami, 2020), equitable access to shelter (Ismail et al., 2024), and the promotion of inclusive and liveable communities (Ibrahim, 2020). This integrative understanding has been echoed by a range of scholars who stress that sustainable housing must address affordability, long-term energy performance, community well-being, and spatial justice (Jiahao et al., 2022). Earlier foundational work by Chiu (2004) laid the groundwork by arguing for the inclusion of social and cultural dimensions alongside environmental design in sustainable housing discourse. However, more recent studies have extended this by examining how housing acts as a vehicle for achieving broader sustainable development goals, particularly in the rapidly urbanising contexts across Southeast Asia and the Global South. These works position housing as not only a physical asset but also a dynamic system that responds to evolving demographics, including low-income earners (Wesonga et al., 2023), and technological integration (Atta et al., 2021). Accordingly, sustainable housing is now widely regarded as a multi-dimensional process that must align economic viability (Ahmed & Salam, 2022; Squires & Hutchison, 2021), technology integration (Atta et al., 2021; Guarini et al., 2019), climate resilience (Ruíz & Mack-Vergara, 2023), and social inclusion (Bresson & Labit, 2020) to foster long-term urban resilience and quality of life, especially for low-income earners.

The integration of digital technologies into sustainable housing has emerged as a transformative strategy for addressing the complex challenges of 21st-century housing provision (Moghayedi et al., 2021, 2023). Technologies such as BIM, the IoT, smart metering, and digital design simulation tools have shown significant potential in enhancing energy efficiency, reducing waste, and optimising the performance of residential buildings (Asif, Naeem, & Khalid, 2024). These tools enable real-time monitoring and predictive analysis, allowing for data-driven decision-making in building operations and maintenance. Importantly, smart technologies are increasingly seen as tools for not only reducing carbon footprints but also enhancing the livability and affordability of housing. They also have an economic role by allowing better resource management (Rock et al., 2024). However, their integration into affordable housing development remains largely underexplored across Southeast Asia. Existing studies have tended to focus on high-end or green-certified housing, with limited evidence presented to show how such technologies can be scaled and adapted to meet the needs of cost-constrained, densely populated urban communities, especially low-income earners.

Moreover, the rise of Industry 4.0 has begun to influence the housing construction and supply chain ecosystem. Tanko et al. (2024) highlighted the integration of automation, digital fabrication, and AI into housing design and delivery, which holds the dual promise of increasing productivity and reducing construction time and costs. These technological advancements offer scalable solutions for sustainable housing, particularly in contexts where demand for housing outpaces traditional construction capabilities.

In Southeast Asia, where much of the urban population falls within the lower- to middle-income brackets, the affordability of construction technologies and long-term cost savings are critical factors. While innovation is accelerating, the degree to which these advancements translate into real affordability for vulnerable populations remains uncertain, warranting further investigation.

Despite its promise, several challenges inhibit the widespread adoption of technology in sustainable housing. These include high upfront capital costs and limited financing options for lower-income buyers. Importantly, without financial schemes that explicitly consider long-term affordability, such as energy cost savings, we may risk widening existing socioeconomic gaps rather than narrowing them. For these innovations to be relevant and equitable, urban planning frameworks must integrate digital

tools alongside socioeconomic support mechanisms, inclusive policy design, and public awareness campaigns (Atta et al., 2021; Luo et al., 2020).

In regional case studies, particularly in Southeast Asia, there is growing evidence of initiatives aimed at embedding smart technologies into affordable and sustainable housing models. For instance, the use of BIM for energy-efficient retrofitting in Malaysia and the application of passive cooling systems with phase change materials in Indonesia showcase how local innovations can address context-specific environmental challenges (Motalebi et al., 2022). Moreover, sustainable housing development in Southeast Asia continues to face significant limitations, primarily because national efforts are heavily focused on addressing housing affordability for low- and moderate-income groups. In many urban and peri-urban areas, a considerable proportion of the population struggles with the basic issues of securing homeownership or even rental housing due to rising costs and stagnant wages. This persistent affordability crisis renders the pursuit of environmentally sustainable housing features a distant goal for many, with economic survival taking precedence over ecological considerations. Hence, while sustainability remains a critical aspiration, its integration into mass housing schemes in the region is still constrained by structural socioeconomic realities. These include income disparities, a lack of home financing instruments for informal workers, and rising urban land costs. Addressing these challenges will require not only technical innovation but also deeper alignment between housing policy, fiscal support mechanisms, and inclusive urban planning, with both affordability and liveability placed at the centre of sustainable housing models.

1.2 Problem Statement and Research Gap

Sustainable housing has emerged as a vital component of urban development, given the increasing environmental, social, and economic challenges confronting cities worldwide. Broadly defined, sustainable housing refers to the planning, design, construction, operation, and maintenance of residential environments that minimise ecological footprints, promote resource efficiency, and enhance the well-being of both occupants and communities (Olubi & Aseyan, 2022). As a multidimensional concept, sustainable housing extends beyond energy efficiency and carbon reduction to include the responsible use of materials, waste minimisation, climate resilience, and long-term affordability (Adabre et al., 2023; Adabre & Chan, 2021). It also embodies principles of liveability by incorporating elements such as comfort, safety, accessibility, and social integration to enhance quality of life (Koçak Güngör & Terzi, 2024). Furthermore, it reflects the evolving aspirations of urban populations, particularly younger demographics, by addressing lifestyle preferences, economic capacities, and the demand for socially and environmentally responsible living environments (Winston, 2022).

According to recent studies, although sustainability is commonly mentioned in discussions about housing, its actual implementation is usually dispersed, especially in metropolitan areas where many residents have low or intermediate incomes. Instead of being viewed holistically, important issues like affordability, energy consumption, and liveability are usually addressed separately (Hartono et al., 2020; Larson & Zhao, 2020). Although new digital technologies like smart sensors, building information modelling (BIM), and the Internet of Things (IoT) have considerable potential to improve building performance, lower energy costs, and boost resilience to climate hazards (Elnour et al., 2024), their incorporation into affordable housing in Southeast Asia is still not widely studied in either academic research or real-world applications. Regarding the successful integration of smart technologies into affordable housing solutions in these low- to middle-income urban contexts, there is a crucial knowledge gap. A large percentage of the literature is disjointed, technologically isolated, or overly centred on high-income environments. Addressing this gap is especially urgent for the urban planning profession, which is increasingly struggling to strike a balance between affordable housing, environmental resilience, and fast urbanisation. Planners must incorporate social justice, technological innovation, population growth, and spatial efficiency into their decisions as Southeast Asia cities continue to rise. By providing a comprehensive, evidence-based examination of how digital

technologies, when strategically aligned with affordability and policy frameworks, can support resilient housing delivery, this study addresses a significant disciplinary need. The findings, including regional case studies, offer actionable insights that urban planners can leverage to develop more inclusive, efficient, and sustainable urban housing models. As such, the study contributes to closing a major conceptual and empirical gap in planning practice, housing policy, and urban studies. The core research gap lies in the lack of empirical and integrative studies examining how digital technologies can be embedded into affordable housing strategies without compromising economic feasibility, especially in the Southeast Asia context. In particular, there is limited understanding of how smart innovations intersect with local affordability challenges, implementation constraints, and sociocultural factors. Moreover, prior research often fails to synthesise the existing technological landscape through a systematic or scientometric lens. Therefore, this study aimed to investigate the evolving landscape of sustainable housing in Southeast Asia by mapping key research trends, analysing the role of digital technologies in enhancing sustainability and examining alternative housing approaches that have been implemented across the region.

1.3 Objectives and Hypotheses

A comprehensive methodological framework was employed, integrating scientometric analysis, SLR, and content analysis. To address Research Objective 1, a scientometric approach was utilised to explore recent trends in sustainable housing research in the Southeast Asia context. In relation to Research Objective 2, the SLR method was applied to critically examine the existing body of literature, focusing particularly on the impact of digital technologies on sustainable housing. Meanwhile, Research Question 3 was addressed using qualitative content analysis to examine alternative sustainable housing approaches across Southeast Asia countries. This method enables the systematic review and interpretation of diverse textual sources, including policies, reports, and grey literature. It helps identify key themes, innovations, and contextual practices that reflect each country's unique strategies for sustainable housing development. Therefore, this detailed review aims to deepen the understanding of the current research landscape and identify gaps that require further investigation. This study presents three clear objectives, each requiring a specific method for comprehensive analysis, as detailed in Table 1.

Table 1: Outline of Research Objectives and Analytical Approaches.

Research Objectives	*Type of Analysis*
● To explore sustainable housing trends in Southeast Asia	● Scientometric analysis
● To analyse the impact of digital technologies on sustainable housing in Southeast Asia	● Systematic literature review analysis
● To examine alternative sustainable housing approaches adopted across other Southeast Asia countries	● Scoping technique and content analysis

1.4 Significance and Structure of the Paper

In the context of a rapidly urbanising Southeast Asia, this paper bridges a critical knowledge gap by analysing how digital technologies can be successfully incorporated into affordable and sustainable housing. This integration is still under-represented in both the academic and practical domains. Through the use of a triangulated methodology—scientometric analysis, content analysis, and systematic literature review (SLR)—the study provides an interdisciplinary viewpoint that connects

the fields of urban planning, housing affordability, and technology innovation. For scholars, housing professionals, and urban policymakers looking to improve socioeconomic inclusion and climate resilience in housing policy, this multi-layered approach produces useful insights.

The paper is structured as follows: the methodological framework and analytical techniques applied in all three phases are described in Section 2. The results are shown in Section 3 in accordance with the three research goals. The findings' theoretical contributions, ramifications, and contextual relevance are covered in Section 4. A summary of the main findings and suggestions for future study directions are presented in Section 5.

2. Materials and Methods

2.1 Study Design and Setting

The research process, as outlined in Figure 1, began with the identification of the research problem, followed by the formulation of research aims, which were divided into three distinct research objectives. Each objective guided a corresponding analytical approach: scientometric analysis for mapping sustainable housing research trends (Objective 1), SLR for assessing the impact of digital technologies (Objective 2), and content analysis for examining alternative housing practices across Southeast Asia (Objective 3). After setting the objectives, the process continued with data collection and data cleaning to ensure quality and consistency. Each method was then applied to its respective objective, and the combined insights were synthesised into the findings, offering a comprehensive and multi-layered understanding of sustainable housing in the context of urban Southeast Asia.

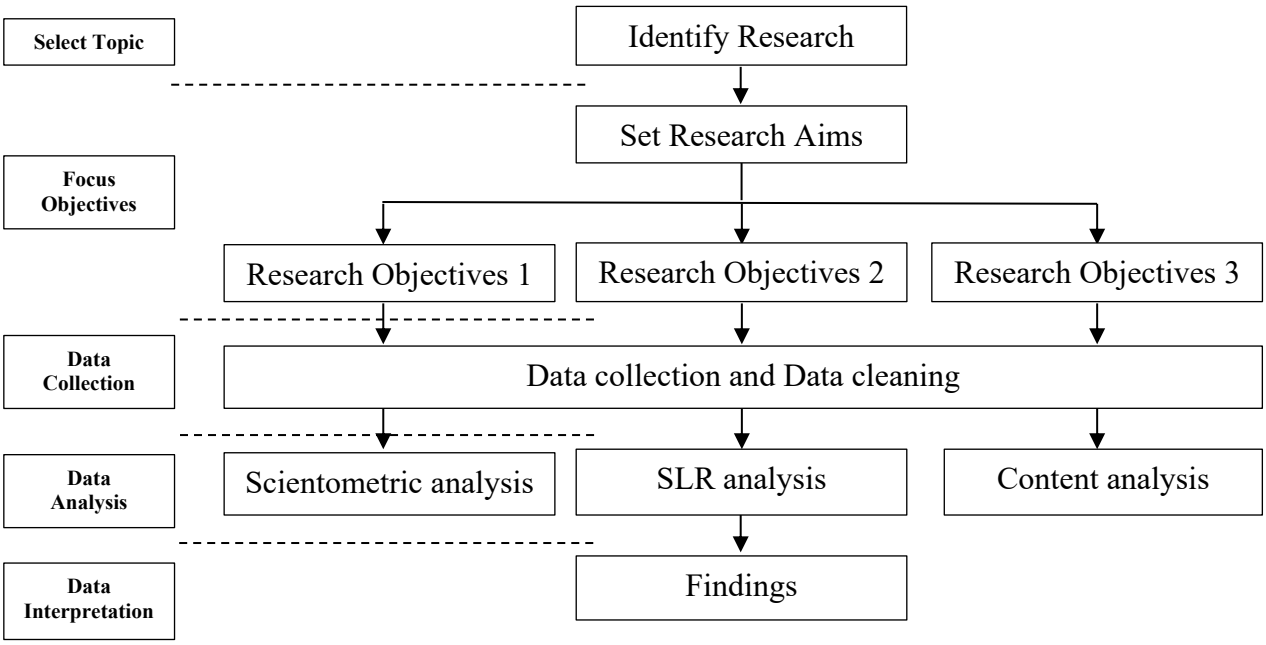

Figure 1. Diagram outlining the research process.

2.2 Scientometric approach

A screening process was applied to determine suitable search terms for retrieving relevant articles. An initial search conducted through the Scopus database produced a total of 487 articles. The search was subsequently refined to concentrate on the terms "sustainable housing" or "green home" or eco-home" or "eco-smart homes" in conjunction with "housing affordability", aligning with the study aims. As a result, the number of articles was reduced to 454. Further filtering was carried out to retain only those papers written in English. The overall search strategy is illustrated in the flow diagram shown in Figure 2.

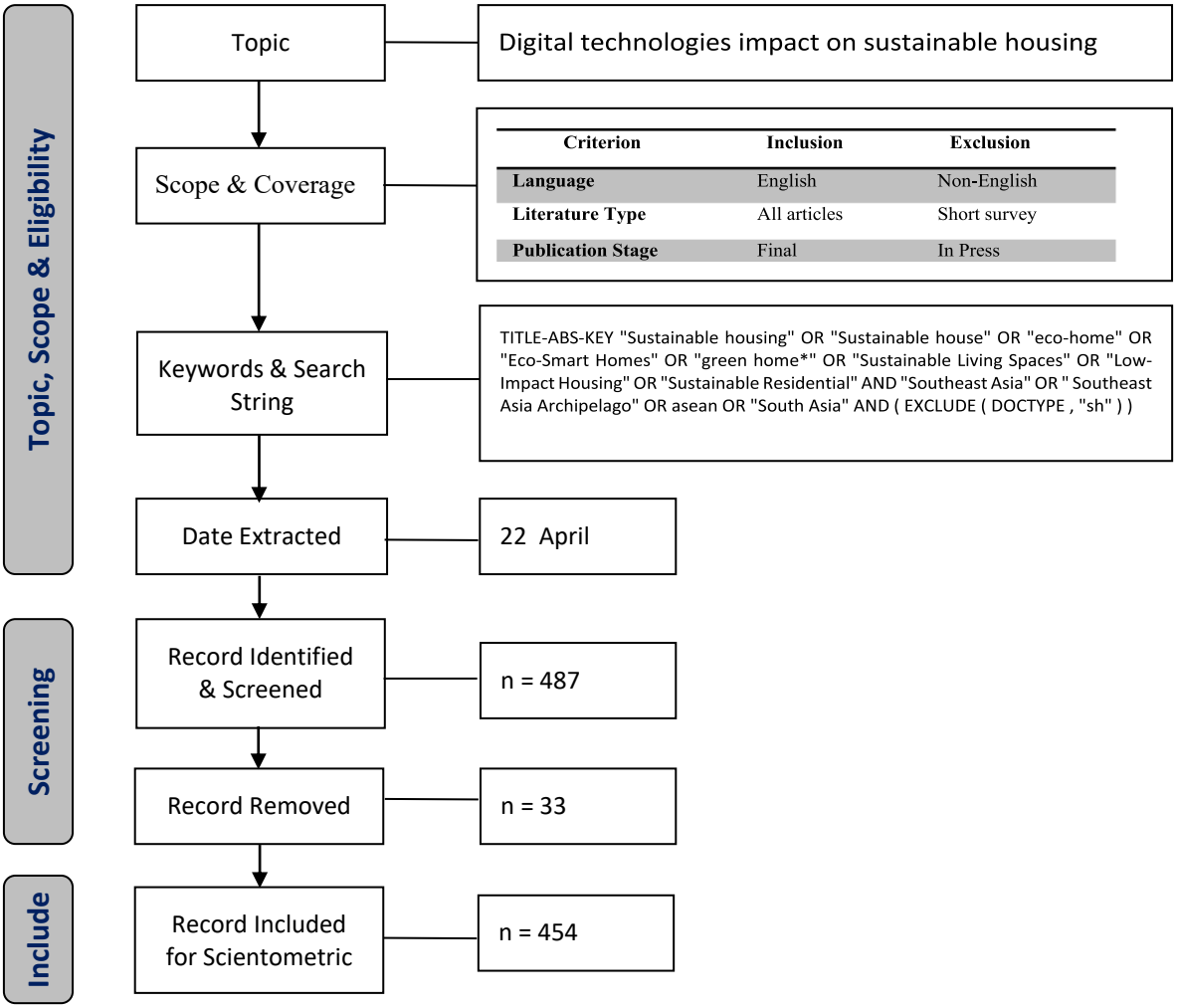

Figure 2. Diagram outlining the search process used for the scientometric analysis.

2.3 SLR approach

The SLR utilised two major databases, Scopus and Mendeley. This section outlines four key phases of the review process: identification, screening, eligibility, and data extraction. Furthermore, only articles published in reputable, peer-reviewed academic journals were included in the analysis, while books and lecture notes were excluded to ensure a high standard of publication quality.

2.3.1 Identification

Following the identification of all pertinent keywords (as outlined in Table 2), search queries were constructed for use in both the Scopus and Mendeley databases. During the preliminary phase of the systematic review, a total of 3,378 scholarly records were successfully retrieved from these two sources.

Table 2: Search String Using Scopus and Mendeley Databases.

Data Based	Query String
Scopus	TITLE-ABS-KEY (("Sustainable housing" OR "Sustainable house" OR "eco-home" OR "Eco-Smart Homes" OR "green home*" OR "Sustainable Living Spaces" OR "Low-Impact Housing" OR "Sustainable Residential") AND ("Southeast Asia" OR " Southeast Asia Archipelago" OR asean OR "South Asia") AND ("Technologies impact*" OR "Technology impact*" OR "Digital impact*" OR "Digital benefit*" OR "Technology benefits" OR technology OR technologies OR digital))
Mendeley	Sustainable Housing AND Technologies

2.3.2 Screening

During the screening phase, the pool of potentially relevant research materials was assessed for content aligned with the established research questions. A commonly applied content-related criterion at this stage involved the selection of studies based on themes pertaining to sustainable housing. At this point, the dataset was also refined by removing duplicate records. Following the exclusion of 3,323 articles after the initial screening, a total of 55 documents proceeded to a second round of evaluation, during which various inclusion and exclusion criteria were applied (refer to Figure 3). The primary inclusion criterion focused on peer-reviewed research articles, regarded as key sources of scholarly insight. Conversely, reviews, meta-syntheses, meta-analyses, books, book series, book chapters, and conference proceedings previously omitted in related studies were excluded. Moreover, only articles published in English were considered, with the review limited to literature produced between 2020 and 2025.

2.2.3 Eligibility

A total of fifty-five (55) articles advanced to the third stage of the eligibility assessment. At this level, all the article titles and key content were meticulously reviewed to confirm their alignment with the inclusion criteria and overarching objectives. As a result, 47 articles were excluded due to their lack of relevance to the research topic; inconsistencies between titles and abstracts; or the unavailability of full-text versions supported by empirical evidence. Consequently, eight articles were deemed suitable and retained for detailed analysis.

2.2.4 Data Abstraction and Analysis

The objective of this expert-driven analysis was to identify relevant themes and subthemes related to the research focus. The thematic development began during the data collection phase, wherein the authors closely examined a selected eight publications (as illustrated in Figure 3) to extract content pertinent to the study objectives. In the subsequent stage, major thematic categories were identified and refined, with particular attention given to the impact of digital technologies on sustainable housing in Southeast Asia. This process resulted in the formulation of four overarching themes: cooling performance, energy efficiency, cost efficiency, and climate and geological adaption.

The development of themes was undertaken collaboratively by the lead author and co-authors, drawing upon evidence within the literature. The authors regularly compared findings to identify any inconsistencies in the thematic development. Any conceptual differences encountered were addressed through collaborative discussion and resolved through consensus. Over time, the emergent themes were refined to ensure coherence and consistency across the dataset. To validate the thematic structure, the study incorporates an expert review involving two specialists, one with expertise in engineering and the built environment. This expert evaluation was conducted to ensure domain validity, thereby confirming the clarity, relevance, and applicability of each subtheme. The authors subsequently revised their findings in accordance with the feedback and recommendations from the expert reviewers.

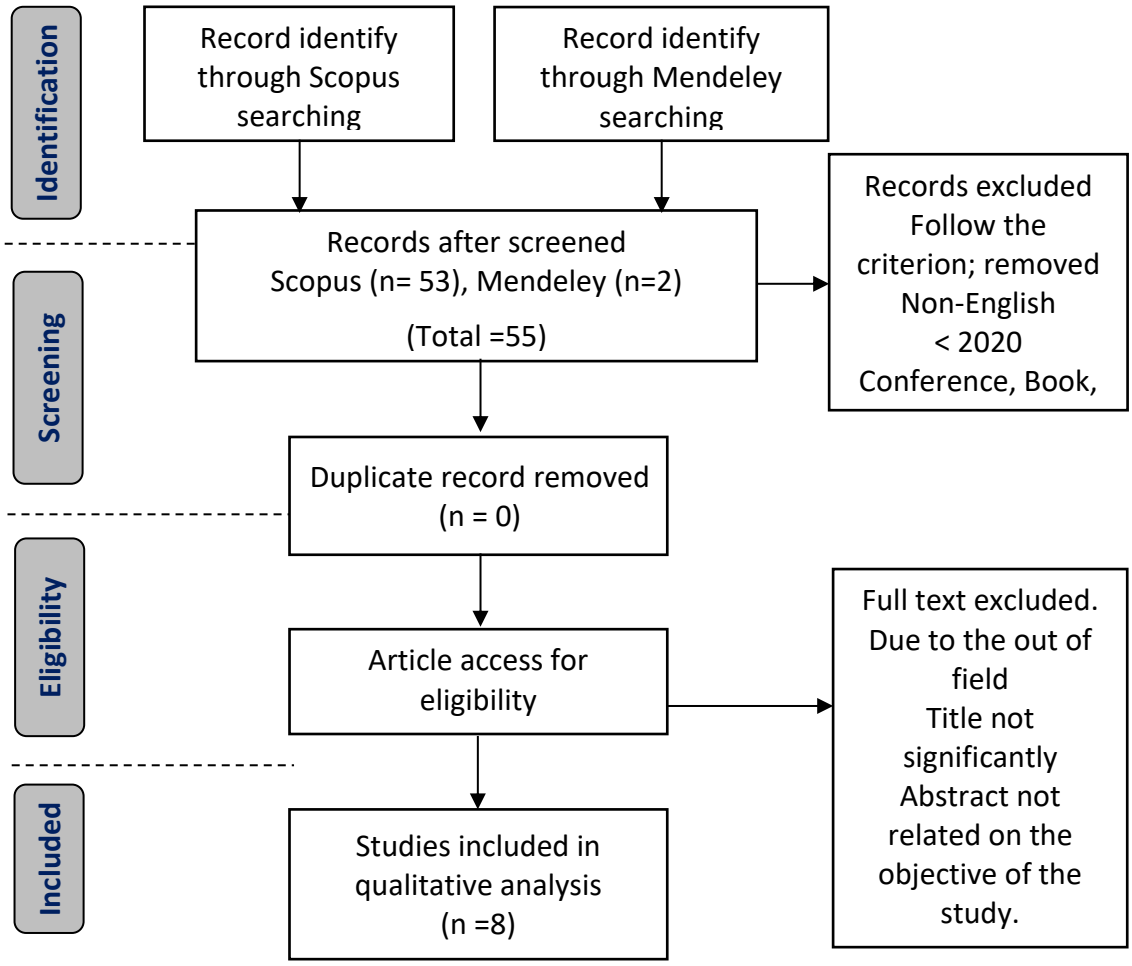

Figure 3. Diagram outlining the search process used for the SLR analysis

2.3 Content analysis approach

Content analysis is a qualitative research method used to systematically interpret textual data by identifying patterns, themes, meanings, or trends within documents, reports, policies, or other written or visual materials (Kleinheksel et al., 2020). In this study, content analysis was employed to examine alternative sustainable housing approaches adopted across Southeast Asia countries. This method was appropriate given the diverse and largely non-standardised nature of the data. By analysing this variety of sources, content analysis enabled the identification of key strategies, innovations, and context-specific practices that reflect each country's unique response to sustainable housing challenges.

3. Results

3.1 Sustainable housing trends in urban Southeast Asia

This scientometric section presents the thematic structure of sustainable housing research, as illustrated in Figure 4. Each cluster is colour-coded to represent a distinct thematic focus within the broader sustainability discourse in Southeast Asia housing research. The energy-focused sustainability cluster, represented by the red grouping, highlights the strong interconnection between sustainability, energy, innovation, circular economy, and the environment. This cluster underscores the critical role of energy systems and resource-efficient practices in shaping sustainable housing narratives in Southeast Asia. The emphasis on innovation and environmental considerations points to a growing recognition of the need for integrated solutions that go beyond conventional housing design. Notably, the prominence of circular economy principles suggests an emerging shift towards waste reduction, material reuse, and lifecycle thinking in the built environment. This trend also

reflects the region's increasing interest in smart technologies, low-carbon alternatives, and renewable energy integration within housing developments. As Southeast Asia nations strive to meet climate commitments and urban sustainability goals, this cluster indicates a broader movement towards embedding green energy systems and technological advancement into the fabric of housing policy and practice.

The green cluster, centred around climate change, renewable energy, and energy efficiency, reflects a strong emphasis on the intersection between climate resilience and sustainable energy use in Southeast Asia. This cluster illustrates how researchers are increasingly linking climate change mitigation strategies with the integration of renewable technologies in housing development. The adoption of solar panels, passive cooling systems, and energy-saving appliances is regarded as vital in reducing the environmental footprint of residential buildings. Moreover, the cluster reveals an underlying narrative that sustainable housing must not only address shelter needs but also contribute to national and regional climate goals. However, the connections suggest that while the technological potential is acknowledged, there remains a significant policy gap in embedding these solutions into mainstream housing frameworks. This indicates a timely opportunity for governments and urban planners to incorporate climate-adaptive design standards and renewable energy incentives into housing policies to build future-proof and environmentally responsive communities across the region.

The yellow cluster, defined by the keywords 'sustainable development' and 'affordable housing', reflects a development-oriented perspective that positions sustainable housing within the broader goals of social inclusivity, economic equity, and long-term urban planning. This cluster suggests that researchers in Southeast Asia are beginning to acknowledge the importance of aligning sustainability objectives with the housing needs of low- and middle-income communities. However, the limited spread and lower density of this cluster in comparison to energy- or climate-related themes indicates that affordability, while recognised, remains relatively underexplored in the sustainable housing discourse. This gap indicates an urgent need for further research into practical, cost-effective housing models that do not compromise environmental goals. Specifically, future studies should explore financing mechanisms, material innovations, and community-led approaches that can enable sustainable development to reach vulnerable populations. Integrating affordability more deeply into sustainability frameworks would not only enhance housing accessibility but also support inclusive urbanisation and social resilience across the region. As Southeast Asia continues to urbanise rapidly, placing affordability at the core of sustainable housing strategies will be essential in ensuring that the benefits of green development are equitably distributed.

The blue cluster, represented by the core keyword 'energy consumption', signifies a niche but increasingly relevant area of research within the sustainable housing landscape in Southeast Asia. This cluster highlights a growing awareness of the energy demands associated with urban housing, particularly as cities in the region expand and modernise. While the focus on energy consumption is not as prominent as broader themes like climate change or renewable energy, its emergence signals a shift towards understanding the real-time implications of energy use within households. However, the current body of research appears limited in scope, often lacking disaggregated data that captures variations across different cultural, climatic, and socioeconomic contexts. This underscores the need for more granular, location-specific studies that examine energy behaviour and consumption patterns at the household level. Such insights are crucial for informing policy decisions and designing targeted interventions that can improve energy efficiency, reduce utility costs for residents, and support sustainable urban living tailored to the diverse realities of Southeast Asia communities.

The purple node, centred on the core keyword 'sustainable housing', stands out as a peripheral topic with relatively fewer direct connections to other dominant themes in the network. This is particularly notable given that sustainable housing is the overarching context of the research field. Its isolation suggests that while many studies refer to sustainable housing, they often do so as a broad backdrop or intended outcome, rather than treating it as the main subject of investigation. This indicates a conceptual gap, with the term used frequently but not sufficiently unpacked or critically analysed in its own right. There is, therefore, a strategic opportunity for scholars to re-centre sustainable housing

as a primary focus by investigating its specific components, such as the use of local and low-impact building materials, culturally responsive design approaches, the enforcement of sustainability-related housing policies, and the lived experiences and behaviours of residents. Strengthening this core would not only help clarify what constitutes sustainable housing in the Southeast Asia context but also ensure that future policies and practices are informed by grounded, holistic research. Addressing this gap could contribute to a more integrated and actionable body of knowledge that bridges the technical, social, and regulatory dimensions of sustainable housing development.

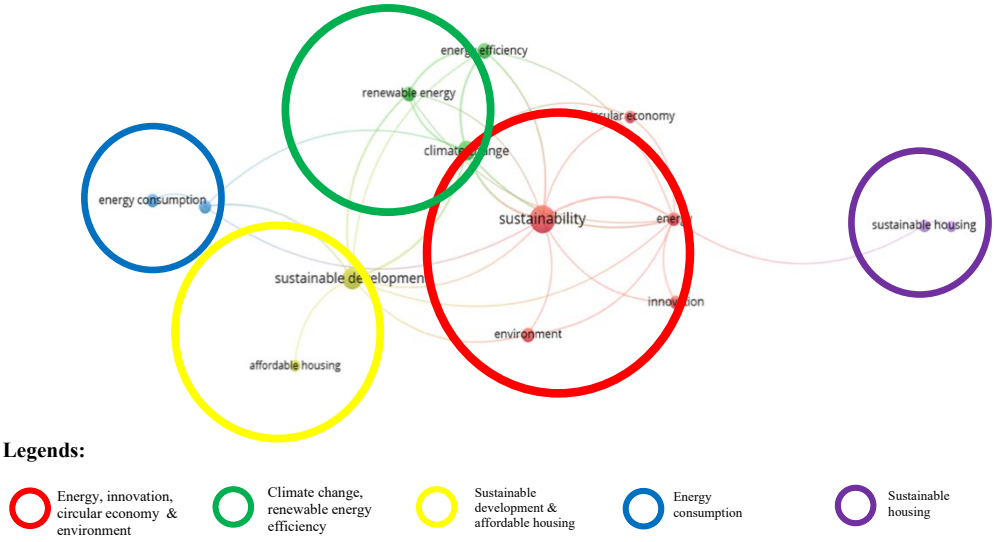

Figure 4. Thematic linkages in Sustainable housing research.

3.2 The impact of digital technologies on sustainable housing in Southeast Asia

Digital technologies are pivotal in advancing sustainable housing initiatives across Southeast Asia by addressing the region's distinct climatic, economic, and environmental challenges (see Table 3). Tools such as BIM, smart sensors, Geographic Information Systems (GIS), and the IoT have enabled significant improvements in housing design, construction, and performance. These technologies enhance cooling performance through passive design simulations, automated shading systems, and advanced ventilation strategies crucial for ensuring thermal comfort in tropical climates. Energy efficiency is promoted via real-time monitoring, smart metering, and renewable energy integration, contributing to lower consumption and compliance with green building standards. Cost efficiency is achieved through digitalised construction processes, prefabrication, and resource optimisation, which reduce project costs and support affordable housing delivery. Furthermore, digital tools aid in climatic and geological adaptation by allowing planners to assess environmental risks and develop resilient housing that can withstand floods, heat, and seismic events. Despite their growing relevance, the implementation of these innovations remains fragmented; they are mostly confined to pilot projects or academic research in countries like Malaysia and Indonesia. Therefore, broader adoption requires policy support, capacity-building, and inclusive planning to ensure that sustainable housing technologies benefit all segments of society.

In terms of cooling performance, Indonesia has emerged as a testbed for innovative thermal regulation solutions. Kitagawa et al. (2021, 2022) introduced radiant floor cooling systems combined with phase change materials (PCMs) and night ventilation techniques. These technologies have proven effective in reducing indoor temperatures, improving thermal comfort, and enhancing energy efficiency without overreliance on mechanical air conditioning. For example, their studies achieved a floor surface temperature reduction of up to 1.5 °C and 95% PCM thermal storage efficiency. These results are promising for regions with hot-humid climates, although scaling such solutions to low-income housing developments remains a challenge.

Malaysia, on the other hand, has focused on energy efficiency through digital design tools and retrofitting strategies. Mohsenzadeh et al. (2021) applied DesignBuilder simulations to determine optimal building forms for tropical climates, identifying circular structures and specific window configurations as the most energy-efficient. Complementing this, Ali et al. (2022) demonstrated how BIM (via ArchiCAD) could be used to guide retrofitting decisions in high-rise buildings, resulting in energy savings of over 18,000 kWh annually, reduced carbon emissions, and financial cost savings. These studies affirm the role of digital simulation tools in guiding sustainable architectural practices, particularly in high-density urban settings.

Cost efficiency is another area where digital tools are making an impact. Rostiyanti et al. (2023) developed a Value Management (VM) framework for design-and-build (DB) projects in Indonesia, identifying stage-specific success factors and the importance of stakeholder collaboration. This framework enhances cost-effectiveness and implementation efficiency, which are critical for public housing programmes with tight budget constraints. However, the incorporation of such tools into actual housing policy and construction workflows remains limited, often due to a lack of technical capacity or regulatory support.

Climatic and geological adaptation also plays a crucial role in housing resilience in Southeast Asia. Traditional architectural methods, when assessed using digital tools, show strong alignment with sustainability principles. For instance, in North Maluku, Indonesia, passive designs based on local wisdom have proven adaptable to extreme weather and geological risks. Ecotect simulations by Guntur et al. (2023) also revealed that stilted wooden homes offer significant thermal comfort and flood resilience. This integration of indigenous knowledge with digital simulations underscores the potential for hybrid approaches that are both sustainable and culturally grounded.

Finally, Manzoor et al. (2021) outlined strategic clusters for promoting BIM in Malaysia's construction sector, including economic, environmental, and awareness-based strategies. Public engagement and cost-benefit analysis of green materials are key to ensuring the wider adoption of sustainable practices. However, despite these promising developments, the region faces a fundamental constraint: the overarching focus of housing policies is still on affordability rather than sustainability. With many low- and moderate-income households struggling to rent or own homes, the integration of sustainability features into housing remains a secondary concern.

In brief, digital technologies are playing an increasingly significant role in advancing sustainable housing in Southeast Asia, although progress is uneven in certain countries. Technological innovation must be coupled with systemic policy reform, capacity-building, and inclusive financing mechanisms to ensure that sustainable housing is not a luxury but a norm accessible to all, particularly the most vulnerable populations.

Table 3: Technological Innovations in Sustainable Housing from Southeast Asia.

Benefit	Authors	Country	Type of technology	Impact
Cooling Performance	(Kitagawa et al., 2021)	Indonesia	Radiant floor cooling system with phase change material (PCM) and horizontal pivot windows for ventilative cooling	Improved thermal comfort with SET* reduced by ~0.79 °C and floor heat transfer coefficient reduced by ~1.52 W/m²K.
	(Kitagawa et al., 2022)	Indonesia	Radiant floor cooling system using phase change materials (PCMs) with night ventilation and forced airflow.	Improved floor temperature control and thermal comfort; achieved floor surface temperature reduction of up to 1.5 °C and 95% PCM thermal storage efficiency, even in climates with a narrow diurnal temperature range.
Energy Efficiency	Mohsenzadeh et al. (2021)	Malaysia	Building form optimisation using DesignBuilder	Identified circular building form and specific window extension (Case 3) as the most energy-efficient and

			simulation (circular and extended forms)	daylight-optimised design for tropical climates.
	Ali et al. (2022)	Malaysia	BIM via ArchiCAD for retrofitting analysis in high-rise buildings	Achieved 0.8% annual energy savings, reduced cooling load by 3%, saved 18,133.9 kWh, RM 6,618.88, and 1,265.16 kg CO_2 emissions through optimal window system retrofitting.
Cost Efficiency	Rostiyanti et al. (2023)	Indonesia	Value Management (VM) framework for design-and-build (DB) infrastructure projects	Identified stage-specific critical success factors (CSFs) and a supporting stakeholder cooperation factor, enhancing cost-effectiveness, design constructability, and implementation efficiency in DB projects.
Climatic and geological adaption	Rostiyanti et al. (2023)	Indonesia	Traditional sustainable architecture using passive design strategies (e.g., button system, natural materials, and spiritual-human-nature design philosophy)	Demonstrated that traditional architecture in North Maluku adapts effectively to extreme environments (earthquakes and volcanic activity), providing sustainable and comfortable housing through local techniques and ecological harmony.
	Guntur et al. (2023)	Indonesia	Climate-adaptive traditional housing using wood materials and stilt-based design (Ecotect simulation)	Identified optimal stilt house design (Type 2) for thermal comfort in riverine climate; emphasised the role of floor height (>1.2 m) in improving natural ventilation and climate resilience
	Manzoor et al. (2021)	Malaysia	BIM adoption strategies for sustainable buildings	Identified four strategic clusters (standardisation, economic, awareness, and environmental); key strategies include public awareness campaigns, sustainable material cost-benefit analysis, and strengthening sustainable development to promote BIM integration in green projects.

3.3 Sustainable Housing Practices in Other Southeast Asia Countries

As presented in Section 3.2, the analysis of technological innovations in sustainable housing based on literature retrieved from the Scopus and Mendeley databases demonstrates a predominance of research contributions from Malaysia and Indonesia. While this trend suggests a strong scholarly presence in these two countries, it should not be misconstrued as an indication that sustainable housing practices are absent from other Southeast Asia nations. Rather, it highlights the asymmetry in academic visibility within indexed databases. A complementary scoping review employing broader search strategies, including grey literature and open-source platforms (e.g., Google search using the phrase "sustainable housing in Southeast Asia"), revealed that other countries in the region, such as the Philippines, Singapore, and Thailand, have also been actively engaged in sustainable housing efforts. These findings indicate the need for a more inclusive and diversified evidence base that accounts for both peer-reviewed research and practice-based initiatives, thereby offering a more holistic understanding of sustainable housing developments across Southeast Asia.

Primavera Residences in Cagayan de Oro City, Philippines, exemplifies sustainable housing through its innovative design inspired by biomimicry. Developed by Italpinas Development Corporation (IDC), this mixed-use condominium integrates passive cooling strategies and renewable energy

technologies to enhance environmental performance and affordability (Salzer et al., 2016). The building's architecture draws inspiration from termite mounds, featuring a central atrium that facilitates natural ventilation. This design allows warm air to rise and exit through the roof, while cooler air is drawn in at lower levels, reducing reliance on mechanical cooling systems. Additionally, the façade incorporates brise soleil elements that provide shade, minimising solar heat gain and further decreasing indoor temperatures. These features collectively contribute to an estimated 32% reduction in energy consumption for residents (Salzer et al., 2016). Primavera Residences has achieved Excellence in Design for Greater Efficiencies (EDGE) certification from the International Finance Corporation, recognising its commitment to resource efficiency. Compared to conventional buildings, the development demonstrates predicted savings of approximately 33% in energy, 37% in water usage, and 32% in embodied energy of materials (Salzer et al., 2016).

Sustainable housing practices across Southeast Asia reflect a diverse array of strategies tailored to local climates, cultures, and socioeconomic contexts. These initiatives encompass green building certifications, passive design techniques, community-driven developments, and the integration of renewable energy technologies. Singapore has established itself as a regional leader in sustainable housing through its Green Mark Scheme, launched by the Building and Construction Authority (BCA) in 2005 (Joy, 2023). This certification promotes energy efficiency, water conservation, and sustainable construction practices. Notably, the Keppel Bay Tower, shown in Figure 5, became Singapore's first zero-energy commercial building after a retrofit that included smart lighting systems, efficient cooling, and photovoltaic installations, resulting in a 30% reduction in energy usage (Joy, 2023).

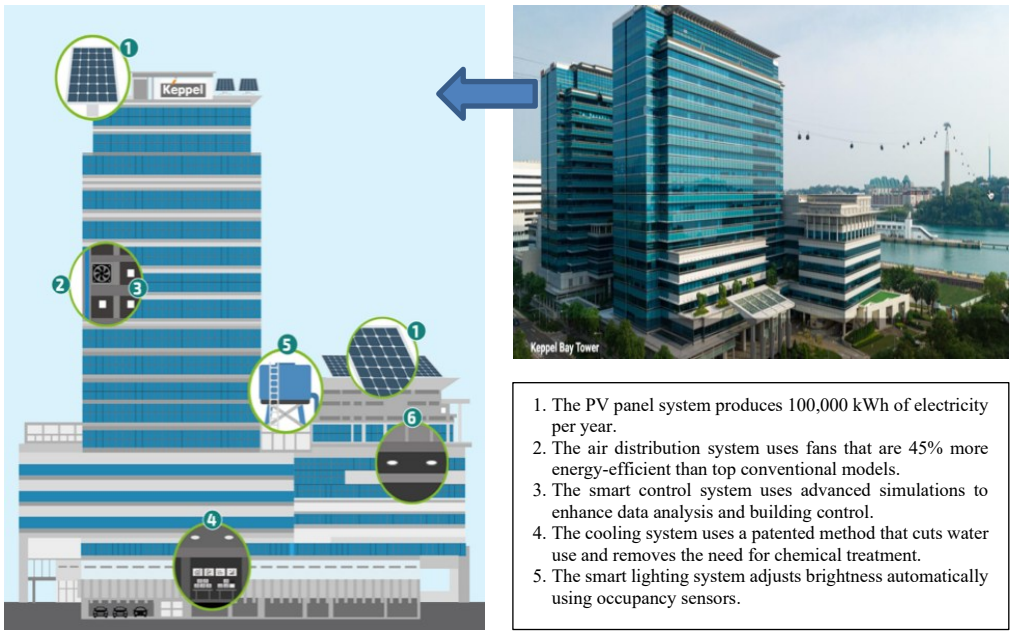

Figure 5. Keppel Bay Tower, Singapore's first Green Mark Platinum.

Meanwhile, Thailand has been at the forefront of integrating technologies into sustainable housing practices, with a strong emphasis on community participation, traditional knowledge, and innovative design. One significant initiative has been led by the Community Architects for Shelter and Environment (CASE), which has adopted participatory design processes to ensure that residents are actively involved in both the planning and construction of their homes. A notable example is the Ten House Project in Bangkok, which demonstrates the effective integration of traditional construction techniques with modern sustainability principles. The project employed locally sourced materials and passive design strategies such as natural ventilation and shading to create thermally comfortable living environments while reducing environmental impact (Jareemit & Canyookt, 2021; Yimprayoon

et al., 2022) . The success of this project highlights the value of combining indigenous knowledge with contemporary sustainable design approaches.

4. Discussion

4.1 Interpretation of Key Findings

This triangulated methodology of scientometric analysis, SLR, and content analysis offers a holistic understanding of sustainable housing in Southeast Asia. The scientometric analysis revealed that while themes like energy efficiency and climate resilience dominate scholarly discourse, the concept of sustainable housing remains underexplored as a central subject. The term is often cited peripherally, suggesting a need to re-centre it in academic inquiry, particularly within affordability frameworks.

The SLR uncovered the fragmented yet promising application of digital technologies such as BIM, passive cooling systems, and IoT tools in Malaysia and Indonesia. These innovations have demonstrated measurable impacts on energy savings, thermal comfort, and cost efficiency. However, their implementation has been largely confined to experimental or small-scale contexts, highlighting a significant gap between technological potential and mainstream application.

The insights from the content analysis extended to other Southeast Asia countries like the Philippines, Singapore, and Thailand. It revealed the successful integration of traditional wisdom and modern technologies in projects such as Primavera Residences, Keppel Bay Tower, and the Ten House Project. These examples underscore the potential of hybrid models that fuse local context with technological innovation.

The findings underscore the necessity of bridging the gap between digital innovation and housing affordability. While sustainable technologies are available, they are rarely incorporated into mass housing schemes due to economic, institutional, and technical constraints. Integrating digital technologies into sustainable housing not only enhances environmental performance but also delivers tangible socioeconomic benefits for urban populations in Southeast Asia. Smart design features such as passive cooling, real-time energy monitoring, and efficient building envelopes can significantly reduce household energy costs, freeing up income for other essential needs.

Meanwhile, the rise of digital construction methods, including BIM and prefabrication, is creating new employment opportunities in urban areas, particularly for digitally skilled workers aligned with Industry 4.0 demands. These advancements contribute to improved quality of life by offering more comfortable, resilient, and cost-efficient living environments. Over the long term, residents benefit from lower operational and maintenance costs, reinforcing housing affordability beyond the point of purchase. In response to escalating urban housing demands, national economic strategies are beginning to shift, as evident in policies that promote green building standards, smart city frameworks, and sustainable urban planning as tools for inclusive economic growth. Thus, sustainable housing is not only an environmental imperative but also a socioeconomic catalyst for equitable urbanisation.

4.2 Comparison with Previous Studies

Prior research demonstrating the revolutionary potential of digital technology in sustainable housing, especially through tools like BIM, IoT, and passive cooling systems, is supported and expanded upon by this study. However, in contrast to previous research, which mostly focuses on high-income or experimental housing conditions, this study offers a unique regional viewpoint by investigating their relevance in Southeast Asia-wide urban contexts characterised by low and intermediate incomes. This study also builds on previous research by using a triangulated approach that combines text analysis, SLR, and scientometric mapping to provide a thorough investigation of both scholarly discourse and practical applications.

4.3 Strengths and Limitations

One of this study's main strengths is the methodological triangulation blending scientometric analysis, SLR, and content analysis. This offers a multi-layered knowledge of Southeast Asia's contextual practices, digital technology adoption, and sustainable housing trends. This integrated approach permits theoretical and practical contributions that are both globally transferable and regionally relevant, enhancing the credibility and depth of the findings. The interdisciplinary approach, which connects socioeconomic inclusion, urban planning, and technology, is another asset. Nevertheless, limitations exist. The scientometric and SLR relied heavily on indexed literature from Scopus and Mendeley, excluding valuable grey literature. Furthermore, the absence of empirical fieldwork means that the lived experiences of end-users remain unexamined. These limitations suggest the need for future research incorporating primary data and policy evaluation. Stakeholder interviews, questionnaires, and case-based field evaluations should be used in future research to overcome these constraints.

4.4 Implications and Future Directions

By expanding the knowledge of how digital technologies might be incorporated into affordable housing frameworks in Southeast Asia towns that are quickly urbanising, this study makes important theoretical and practical contributions. By emphasising the necessity of inclusive policies that encourage the adoption of technology in low- and middle-income housing complexes, the findings help shape policy. In practical terms, the study offers solutions to include smart technologies like BIM, IoT, and passive design systems to improve resilience, cost, and energy efficiency. In theory, it bridges the gaps between the literature on urban planning, technology innovation, and sustainable housing. With an emphasis on user experience, community involvement, and post-occupancy performance, future researchers should undertake empirical evaluations through field investigations. Furthermore, cost-benefit assessments and lifecycle analyses could confirm long-term scalability and affordability. Transforming creative design into fair housing solutions requires interdisciplinary cooperation. Ultimately, this study advocates more research to promote scholarship and practical solutions while laying the foundations for a more socially inclusive, digitally connected housing policy.

Figure 6 presents the comprehensive framework developed in this study, illustrating how theoretical foundations, digital technologies, and performance indicators converge to support sustainable affordable housing in Southeast Asia. The framework begins with core theoretical indicators—environmental sustainability, housing affordability, and social inclusion—which form the guiding principles for resilient housing strategies. These are operationalised through enabling digital technologies such as BIM, IoT, passive cooling systems, simulation tools, and AI-driven design applications. These tools contribute to measurable outcomes classified under four key performance indicators: cooling performance, energy efficiency, cost efficiency, and climatic or geological adaptability. By aligning these dimensions, the framework provides a structured, interdisciplinary approach for planning and assessing context-sensitive, future-proof housing solutions in rapidly urbanising environments, especially within low- and middle-income settings across the Southeast Asia region.

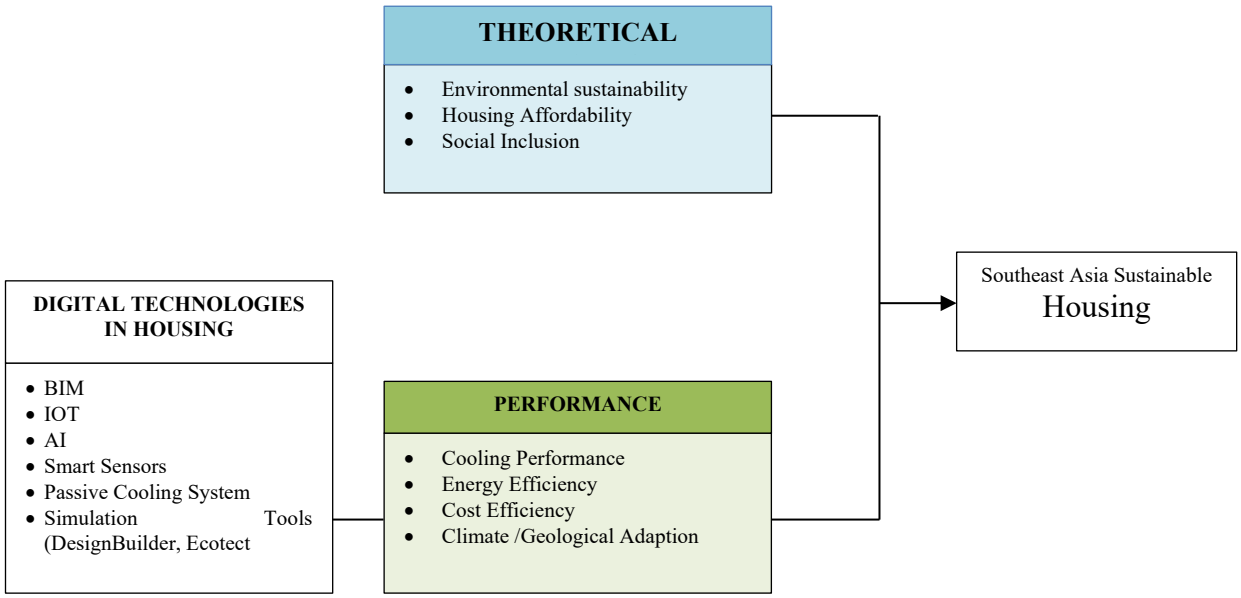

Figure 6. Proposed Integrated Framework for Sustainable Affordable Housing in Southeast Asia.

5. Conclusion

This study employed a triangulated methodology—a scientometric analysis of 454 Scopus-indexed papers, a systematic literature review (SLR) of eight rigorously screened studies, and practice-based content analysis—to clarify how smart technologies can underpin an integrated framework for sustainable, affordable, and socially inclusive housing in Southeast Asia. Publication trends reveal a 240 % rise in digital-housing research since 2020, yet only 22 % of papers explicitly address socioeconomic equity. Quantitatively, BIM-guided retrofits in Kuala Lumpur save 18 133 kWh and 1 265 kg CO_2 per block each year; phase-change cooling in Indonesia lowers operative temperatures by 1.5 °C; and biomimetic housing in the Philippines reduces whole-building energy, water, and embodied-carbon use by 32 %, 37 %, and 32 % respectively.

These findings confirm that BIM, IoT sensors, passive-cooling innovations, and digital simulations can shrink life-cycle costs while advancing SDG 11 targets for resilient, inclusive cities. Nevertheless, smart-housing adoption remains patchy: upfront capital premiums average 12–18 %, policy incentives are fragmented, and digital-skills shortages constrain diffusion beyond pilot schemes in Malaysia, Indonesia, the Philippines, Singapore, and Thailand. The persistent gap between technological innovation and policy uptake risks limiting benefits to higher-income developments unless systemic barriers are removed.

To bridge this divide, we propose an integrated policy framework that couples mandatory digital design standards with concessional green finance, multi-stakeholder value-management processes, and participatory planning. National housing authorities should embed BIM and IoT requirements in building codes, link them to micro-credit or rent-to-own schemes for low-income households, and fund vocational programmes that cultivate a digitally competent construction workforce. Municipal governments can accelerate market demand by enforcing post-occupancy performance disclosure, thereby incentivising developers to deliver energy-positive, climate-adaptive typologies.

The study is limited by its reliance on secondary data and a small pool of empirically validated projects; longitudinal post-occupancy evaluations and mixed-method stakeholder surveys are needed to test scalability across diverse climatic zones. Comparative research with other rapidly urbanising regions in the Global South would refine transferability. By prioritising field evidence, co-design with residents, and robust cost-benefit modelling, scholars and practitioners can transform smart-housing innovations into durable socioeconomic and environmental gains—normalising technology-enabled, equitable sustainability throughout Southeast Asia within the next decade.

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A Performance Forecasting Model for Optimizing CDF-Funded Construction Projects in the Copperbelt Province, Zambia

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ABSTRACT

The Constituency Development Fund (CDF) has become a key mechanism for delivering small-scale urban infrastructure in Zambia. However, persistent challenges such as project delays, cost overruns, and quality deficiencies undermine the effectiveness of these interventions. This study addresses a critical gap in the literature and practice by developing a novel performance forecasting model tailored to the unique governance and technical context of CDF-funded projects. The model integrates Adaptive Neuro-Fuzzy Inference Systems (ANFIS) with the Analytic Hierarchy Process (AHP) to forecast performance across five key indicators: cost-effectiveness, schedule adherence, quality compliance, safety performance, and client satisfaction. Using stakeholder data from 196 respondents and historical project records, the model was trained and validated using MATLAB. It achieved strong predictive accuracy, with a coefficient of determination (R^2) of 0.92 and a root mean square error (RMSE) of 0.09. These results demonstrate the model's utility as a decision-support tool for local authorities and urban planners, enabling early detection of underperformance and facilitating proactive interventions. The model contributes to performance-based planning by providing a data-driven, stakeholder-informed forecasting framework that is adaptable to resource-constrained environments. Its application can enhance transparency, optimize resource use, and support inclusive urban development in rapidly growing municipalities.

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Highlights:

- Hybrid ANFIS-AHP model links funding flow consistency, contractor capacity, and supervision intensity (independent) to composite five-KPI project performance score (dependent) with $R^2 = 0.92$.
- AHP weighting shows cost-effectiveness (0.44) and schedule adherence (0.24) dominate performance prediction for CDF projects.
- Early-warning forecasts allow councils to re-programme resources, curbing mid-phase overruns and boosting on-time delivery by 30 %.
- Study pioneers AI-driven decision support adaptable to resource-constrained, decentralised infrastructure governance across Sub-Saharan Africa.

Contribution to the field statement:

This study pioneers a hybrid ANFIS–AHP forecasting model that predicts cost, time, quality, safety and satisfaction outcomes for Zambia's CDF projects, achieving $R^2 = 0.92$. By merging stakeholder-weighted KPIs with soft-computing analytics, it equips resource-poor councils with real-time, evidence-based decision support, advancing participatory, performance-centred urban governance across developing municipal infrastructure planning contexts.

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1. Introduction

Urban infrastructure delivery in developing countries remains a persistent challenge due to financial constraints, institutional weaknesses, and limited technical capacity. In response, many governments have adopted decentralization strategies to improve service provision at the local level. Zambia's Constituency Development Fund (CDF) is one such initiative, aimed at financing small to medium-scale projects such as classrooms, health facilities, roads, and water systems. While the CDF has expanded community access to essential infrastructure, its effectiveness has been undermined by recurring issues of project underperformance, including time and cost overruns, substandard construction quality, and inadequate supervision (Nyamori, 2009). These inefficiencies compromise the developmental objectives of the fund and hinder efforts toward inclusive urbanization.

Although various frameworks exist to evaluate infrastructure performance, most are retrospective, offering limited capacity for real-time performance monitoring. Evaluation often occurs after project completion, leaving little opportunity for corrective action during implementation. In many decentralized systems such as Zambia's, this results in stalled or abandoned projects, budget overruns, and diminished returns on public investment (Musonda et al., 2025). Moreover, conventional forecasting models developed for centralized or data-rich environments are rarely adapted for fragmented and uncertain conditions typical of small-scale infrastructure projects in developing countries.

Artificial intelligence (AI) techniques, particularly soft computing methods such as Adaptive Neuro-Fuzzy Inference Systems (ANFIS), have demonstrated success in predicting project performance in complex settings. ANFIS combines neural networks' ability to learn from data with fuzzy logic's capacity to handle uncertainty and imprecision (Jang, 1993). When integrated with the Analytic Hierarchy Process (AHP), which prioritizes indicators through stakeholder-informed weighting, the result is a hybrid system that is responsive to contextual performance conditions (Saaty, 2008). These tools are increasingly applied in private sector and large-scale infrastructure management, but their adaptation to decentralized, low-resource public sector contexts remains limited.

This study aims to develop and validate a forecasting model tailored for small-scale, CDF-funded urban infrastructure projects in Zambia. The model is based on five Key Performance Indicators (KPIs): cost-effectiveness, schedule adherence, quality compliance, safety performance, and client satisfaction. It applies AHP to derive stakeholder-based weights and uses ANFIS to forecast composite performance scores in real-time. The model is designed to support evidence-based decision-making by local councils, enabling early identification of at-risk projects and guiding timely interventions.

By targeting performance forecasting at the community level, the study seeks to fill a critical gap in urban infrastructure governance. Existing literature has paid limited attention to the integration of stakeholder perceptions with intelligent forecasting systems in decentralized environments. This research offers a contextualized approach that aligns with both Performance Management Theory, which emphasizes ongoing monitoring and feedback, and Decision Support System Theory, which promotes structured analytical tools in uncertain policy environments (Creswell & Clark, 2017; Marakas, 2003). It demonstrates how AI-based decision support systems can be both feasible and effective, even in environments constrained by data limitations and institutional fragmentation. The implications of this study extend beyond technical forecasting. Urban infrastructure failures have broad socio-economic impacts, including eroded public trust, service delivery gaps, and rising inequality. A responsive forecasting tool can improve the accountability and efficiency of decentralized infrastructure governance. By integrating stakeholder insights and local data, the model encourages participatory governance while promoting cost-effective decision-making and real-time transparency (Creswell & Clark, 2017; Marakas, 2003).

To guide readers through the study, a schematic overview of the research structure is provided in Figure 1. It outlines the flow of activities from problem identification and data collection to model development, validation, and application.

Figure 1. Structural roadmap linking research objectives, methodology, and expected outcomes.

Figure 1 illustrates the logical sequence of the research, beginning with the identification of performance inefficiencies in CDF projects. The flow proceeds through literature gap analysis, formulation of objectives, and application of a mixed-methods design. It integrates AHP and ANFIS within a MATLAB environment to develop and validate a performance forecasting model, concluding with actionable implications for stakeholders.

2. Methodology

This study integrates both qualitative and quantitative approaches under a mixed-methods framework grounded in Performance Management Theory, Decision Support System (DSS) Theory, and Multi-Criteria Decision Analysis (MCDA). These theoretical underpinnings provided a structured foundation for assessing and predicting performance in Constituency Development Fund (CDF) construction projects in Zambia's Copperbelt Province. The methodological design aimed to address real-world project inefficiencies by developing a context-specific hybrid forecasting model using Adaptive Neuro-Fuzzy Inference Systems (ANFIS) and the Analytical Hierarchy Process (AHP). The methodology, illustrated in Figure 1, followed a systematic procedure comprising a literature review, KPI identification, stakeholder engagement, data collection, model development, and validation. This procedural roadmap ensured methodological rigour while maintaining contextual sensitivity to Zambia's decentralization and infrastructure governance systems (Medayese et al., 2021; Mamokhere & Meyer, 2022).

2.1 Research Paradigm and Strategy

The study adopted a positivist paradigm with a deductive reasoning approach, focusing on uncovering causal relationships between input variables such as contractor capacity, regulatory oversight, and funding flow and the output variable: construction project performance, expressed via a Performance Indicator (PI) synthesized from five KPIs. A case study design was employed, with emphasis on empirical validation using historical and real-time data. This allowed for in-depth exploration of the localized CDF implementation process and contractor performance trends (Kamau et al., 2021; Kabwe et al., 2023).

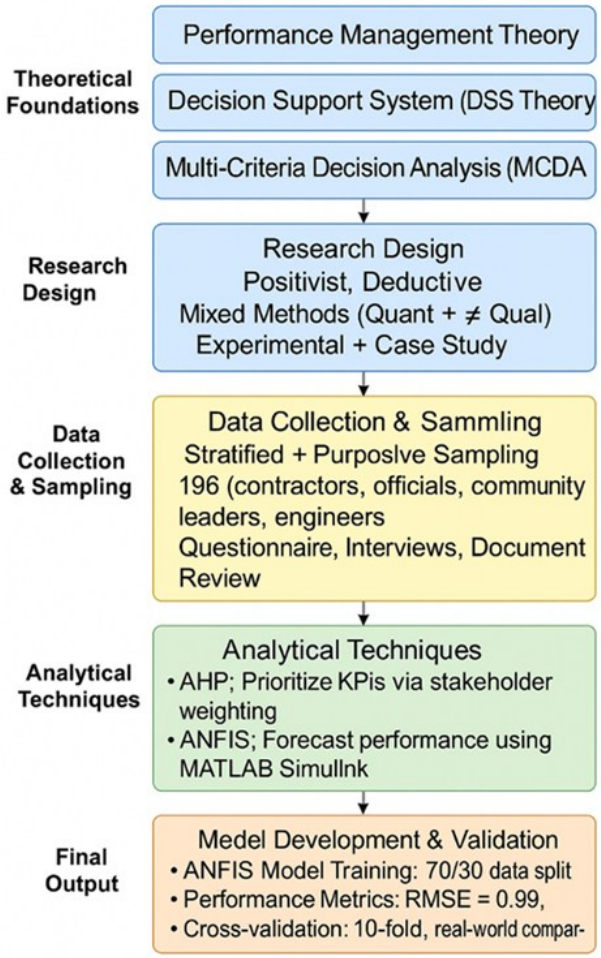

Figure 2. Procedural Framework.

Figure 2 presents the overall methodological structure guiding the study. It is anchored on theoretical foundations such as Performance Management Theory, DSS, and MCDA. The framework reflects a positivist, deductive, mixed-methods approach, supported by stratified and purposive sampling. AHP and ANFIS were deployed as analytical tools and model validation involved statistical and simulation-based techniques.

2.2 Participants and Sampling

A total of 196 respondents were engaged, representing key stakeholder groups directly involved in the planning, execution, and oversight of government-funded infrastructure projects in Zambia. A stratified purposive sampling strategy was used to ensure the inclusion of participants with relevant professional or civic experience across all stages of CDF project delivery. Respondents were drawn from four primary categories as shown in Table 1.

Table 1: Sample Representation by Stakeholder Category.

Stakeholder Category	Number of Respondents
Local Contractors	58
Government Officials	48
Community Leaders	50
Engineers/Technicians	40

a) Local Contractors executed physical works and managed project delivery.
b) Community Leaders included Ward Development Committee (WDC) members and civic facilitators providing grassroots perspectives on participation and satisfaction.
c) Government Officials comprised district planners, procurement staff, and engineers responsible for compliance and oversight.
d) Engineers/Technicians served as supervisors and site inspectors, overseeing quality and performance metrics.

Participants were selected based on the following criteria: (i) active involvement in infrastructure projects between 2021–2023; (ii) professionals with ≥3 years of experience; (iii) inclusion of both urban and rural constituencies to reflect geographic diversity.

This stakeholder mix reflects Zambia's multi-level governance structure, integrating technical, institutional, and community insights. The distribution enabled triangulation, strengthened data validity, and supported the development of a forecasting model responsive to decentralized project environments.

2.3 Data Collection Process

To support the development of a real-time forecasting model, this study employed a triangulated data collection approach comprising structured surveys, key informant interviews, and project document reviews. This method enhanced both the credibility and contextual depth of the findings. The primary instrument was a structured questionnaire measuring stakeholder perceptions across five key performance indicators (KPIs): cost-effectiveness, schedule adherence, quality adherence, safety compliance, and client satisfaction. The survey covered three project phases—initiation, mid-point, and completion—allowing for temporal performance analysis. Respondents rated each KPI on a 5-point Likert scale (1 = very poor, 5 = excellent), and open-ended questions were included to capture qualitative insights into project dynamics, contractor behavior, and institutional challenges. To supplement the surveys, interviews were conducted with engineers, procurement officers, project supervisors, and Ward Development Committee members. These discussions validated survey responses and provided deeper institutional context, especially regarding performance variations by location and project type. Historical project documents (e.g., completion reports, audit records, and engineering inspections) from 2015 to 2023 were reviewed to establish empirical baselines for the ANFIS forecasting model.

Data were collected between January and March 2025 through both printed questionnaires (for remote areas) and online surveys (for urban respondents), ensuring national coverage. A total of 196 complete responses were received, yielding a strong 87% response rate. This multi-method strategy produced a rigorous, context-sensitive dataset essential for developing a predictive model responsive to Zambia's decentralized infrastructure governance environment (Diep et al., 2022; Bateganya et al., 2023).

2.4 Data Analysis Techniques

2.4.1 Analytical Hierarchy Process (AHP)

To quantify stakeholder priorities among the five selected Key Performance Indicators (KPIs), this study applied the Analytical Hierarchy Process (AHP)—a multi-criteria decision-making technique developed by Saaty (1980). AHP was selected for its proven ability to transform qualitative judgments into quantitative weights, making it especially effective for evaluating complex, multi-dimensional infrastructure performance where trade-offs are inherent. The AHP methodology involved the following steps:

1. Pairwise Comparison Matrix Construction Stakeholders were asked to evaluate the relative importance of each KPI against the others using Saaty's 9-point scale (1 = equal importance, 9 = extreme importance). The pairwise matrix allowed for systematic comparisons across the five KPIs: cost-effectiveness, schedule adherence, quality adherence, safety compliance, and client satisfaction.

2. Matrix Normalization and Weight Derivation The comparison matrix was normalized by dividing each element by the sum of its respective columns. The normalized values for each row were then averaged to produce the priority weight (w_1) for each KPI. This step converted stakeholder judgments into quantifiable weights used for performance modelling.
3. Consistency Validation To ensure logical consistency of the stakeholder evaluations, the Consistency Index (CI) and Consistency Ratio (CR) were computed. A CR value ≤ 0.1 is considered acceptable. In this study, the final CR was 0.1013, indicating satisfactory consistency in the judgment data and validating the reliability of the derived KPI weights.

The final weights generated through AHP, shown in Table 2, reflect the relative importance of each KPI in assessing and forecasting project performance.

Table 2: AHP-Derived KPI Weights.

KPI	Weight
Cost Effectiveness	0.4401
Quality Adherence	0.2861
Safety Compliance	0.1151
Schedule Adherence	0.1135
Client Satisfaction	0.0452

These weights were incorporated into a composite Performance Indicator (PI) model using a linear weighted sum approach (Equation 1):
Equation 1: $PI = \Sigma (KPI_i \times w_i)$ where KPI_i = normalized performance score, and w_i = corresponding AHP weight (Jang, 1993).
This PI model forms the core output metric for the forecasting system developed in Simulink. It integrates both stakeholder-derived priorities and empirically observed performance data, thereby enabling evidence-based project evaluation and real-time decision support in the context of Zambia's CDF program. By applying AHP within a localized, stakeholder-sensitive framework, this study ensures that the performance forecasting model not only reflects technical metrics but is also responsive to governance, accountability, and service delivery priorities in urbanizing communities (Ntwana & Naidoo, 2024).

2.4.2 Neuro-Fuzzy Modeling (ANFIS)

To forecast CDF project performance in real-time, this study applied an Adaptive Neuro-Fuzzy Inference System (ANFIS), a hybrid AI model that integrates fuzzy logic with neural networks. ANFIS is well-suited for modelling nonlinear, interdependent factors that characterize decentralized infrastructure projects in dynamic environments.
The model was developed using MATLAB Simulink and aimed to predict a composite Performance Indicator (PI) derived from five AHP-weighted KPIs: cost-effectiveness, quality adherence, safety compliance, schedule adherence, and client satisfaction.

Key performance drivers used as ANFIS inputs (input variables) included:

a) Contractor experience and technical capacity
b) Funding flow consistency
c) Supervision intensity
d) Material quality and supply reliability
e) Community participation

Each input was fuzzified using Gaussian and triangular membership functions. A Sugeno-type inference system generated the output PI score (scaled 0–1), representing overall project performance.

Historical data from 42 completed CDF projects (2015–2023) were used. The dataset was split into 70% training and 30% testing sets. Hybrid learning (least squares and backpropagation) optimized the rule base and membership functions (Naji et al., 2022). Model accuracy metrics were as follows:

a) $R^2 = 0.92$ – Strong predictive capability
b) RMSE = 0.09 – Low error margin
c) MAE = 0.06 – High output precision

These results confirm the model's robustness in forecasting real-time performance. The ANFIS model enables the simulation of performance scenarios based on stakeholder inputs, aiding project planning, contractor selection, and supervision strategies. It supports proactive, data-driven decisions and aligns with smart governance trends in public infrastructure management (Ansari et al., 2022).

Table 3: Model Validation Results.

Metric	**Value**
RMSE	0.09
MAE	0.06
R^2	0.92

Data analysis also included the use of SPSS and Excel for descriptive statistics, t-tests, and correlation analysis to validate trends and relationships among KPIs. All participants were provided with informed consent forms before participation. Confidentiality was assured, and all data were anonymized. Ethical clearance was obtained from the University of Zambia Ethics Committee, and the study adhered to institutional and national research standards. The study acknowledges several limitations:

a) Sample Scope: Focused solely on Copperbelt Province, limiting generalizability.
b) Subjectivity: Some KPIs, such as client satisfaction, relied on subjective judgment, which could introduce response bias.
c) Data Constraints: Historical data used for training ANFIS models were limited in availability and granularity, especially for rural constituencies.
d) Model Staticity: While the models are predictive, the static nature of Simulink-based simulations constrains real-time updates unless integrated with digital dashboards.

3. Results

3.1 Overview of Findings

This section presents an integrated summary of the study's findings, combining stakeholder survey responses, inferential statistics, priority rankings, and model simulations. Performance was analyzed across five Key Performance Indicators (KPIs)—cost-effectiveness, schedule adherence, quality compliance, safety performance, and client satisfaction—using both qualitative inputs and quantitative modelling. Data from 196 stakeholders involved in CDF-funded infrastructure projects in Zambia were used to evaluate performance across three project phases: initiation, implementation, and completion. Descriptive statistics indicated moderate baseline performance, with steady improvement across phases. Inferential tests confirmed statistically significant differences in KPI scores, suggesting learning effects and adaptive management. Strong correlations among KPIs reinforced the need for integrated performance evaluation. Cost and schedule dimensions received the highest weights in AHP, reflecting stakeholder priorities, and these weights were applied in the ANFIS model, which achieved high predictive accuracy ($R^2 = 0.92$). PCA comparison confirmed the robustness of the AHP-derived structure, while reliability and validity tests supported the quality of both the data instruments and the forecasting model. Overall, the results validate the use of intelligent, stakeholder-informed forecasting tools in decentralized infrastructure governance. Subsequent subsections detail these findings, starting with KPI performance across project stages (Sikombe & Phiri, 2021; Shigute, 2022).

3.2 Descriptive Statistics of KPIs

To establish baseline perceptions of project performance, descriptive statistics were calculated for each of the five Key Performance Indicators (KPIs): cost-effectiveness, schedule adherence, quality compliance, safety performance, and client satisfaction. Data were collected from 196 stakeholders involved in different stages of CDF-funded urban infrastructure projects. Respondents rated each KPI on a 5-point Likert scale, where 1 indicated "very poor" and 5 indicated "excellent."

Table 4: Descriptive Statistics for Key Performance Indicators (N = 196).

KPI	Mean	Median	Standard Deviation	Minimum	Maximum
Cost-Effectiveness	3.29	3.00	0.88	1.00	5.00
Schedule Adherence	3.13	3.00	0.91	1.00	5.00
Quality Adherence	3.35	3.00	0.85	1.00	5.00
Safety Compliance	3.18	3.00	0.92	1.00	5.00

The results in Table 4, show that all KPIs received average scores between 3.13 and 3.35, suggesting a moderate level of satisfaction with project performance across the board. Quality compliance received the highest average score (Mean = 3.35), indicating that infrastructure users and supervisors perceived improvements in construction quality over time. Conversely, schedule adherence was rated the lowest (Mean = 3.13), highlighting persistent delays in project execution. The relatively low standard deviations (ranging from 0.85 to 0.92) suggest consistency in stakeholder perceptions. These descriptive findings align with the broader literature on urban infrastructure challenges in developing countries, where cost, time, and quality remain the primary concerns (Bateganya et al., 2923).

3.3 Inferential Analysis and KPI Relationships

To explore the statistical significance of perceived performance changes and the interdependencies between KPIs, inferential tests were conducted using paired samples t-tests and Pearson correlation analysis. These methods allowed for the examination of whether there were meaningful improvements across project phases and how strongly each KPI was associated with the others during implementation.

a) Paired Samples T-Test: Initiation vs. Completion

Table 5: Paired Samples T-Test Results – Initiation vs. Completion (N = 196).

KPI	Mean (Initiation)	Mean (Completion)	t-value	p-value	Significance
Cost-Effectiveness	2.87	3.89	-5.42	0.000	Significant
Schedule Adherence	2.34	3.74	-6.13	0.000	Significant
Quality Adherence	2.66	3.91	-5.79	0.000	Significant
Safety Compliance	2.52	3.57	-4.89	0.001	Significant
Client Satisfaction	2.81	3.85	-5.64	0.000	Significant

All five KPIs recorded statistically significant improvements from the initiation to the completion phase, with p-values less than 0.05. This suggests that CDF-funded projects tend to improve as they progress, possibly due to oversight interventions, learning curves, or increased stakeholder engagement. Schedule adherence showed the largest improvement ($\Delta M = 1.40$), confirming prior studies that schedule issues are most acute during early project stages (Hapompwe et al., 2020).

b) Pearson Correlation Analysis: KPI Relationships During Implementation

Table 6: Pearson Correlation Matrix of KPIs During Implementation Phase (N = 196).

KPI	Cost	Schedule	Quality	Safety	Satisfaction
Cost-Effectiveness	1	0.76	0.71	0.62	0.69
Schedule Adherence		1	0.74	0.68	0.73
Quality Adherence			1	0.66	0.72
Safety Compliance				1	0.67
Client Satisfaction					1

The matrix shows strong, positive correlations among all five KPIs, with the highest correlation observed between schedule adherence and quality compliance (r = 0.74), and between client satisfaction and quality (r = 0.72). These results suggest that performance dimensions are interdependent; improvements in one area (e.g., schedule) often coincide with gains in others (e.g., quality and satisfaction). These findings support the use of integrated performance forecasting models where KPIs are weighted jointly rather than in isolation (Mitullah, 2017).

3.4 KPI Performance Across Project Phases

To better understand how project performance evolves over time, KPI scores were disaggregated across the three principal phases of CDF-funded project delivery: initiation, implementation, and completion. These phases represent typical lifecycle milestones in public infrastructure projects, providing a lens through which stakeholder perceptions can be evaluated longitudinally.

Table 7: Average KPI Scores Across Project Phases (N = 196).

KPI	Initiation	Implementation	Completion
Cost-Effectiveness	2.87	3.12	3.89
Schedule Adherence	2.34	3.01	3.74
Quality Adherence	2.66	3.22	3.91
Safety Compliance	2.52	2.94	3.57
Client Satisfaction	2.81	3.06	3.85

The data reveal a clear upward trend in KPI performance from project initiation to completion, with the largest gains seen in schedule adherence ($\Delta = 1.40$) and quality compliance ($\Delta = 1.25$). While projects often begin with limited coordination or capacity, performance tends to improve over time, likely due to learning effects or stronger oversight introduced mid-implementation. Cost-effectiveness and client satisfaction also improved, reflecting adaptive supervision and responsiveness to community expectations. These findings are consistent with literature on infrastructure delivery in low-resource settings, which highlights iterative learning and corrective management as key to improved outcomes (Ansari et al., 2022). Moreover, the results underscore that performance is dynamic rather than static. Initial weaknesses in planning and mobilization often give way to greater efficiency in later stages, validating the model's emphasis on real-time forecasting. Early-stage data alone may not reliably predict outcomes without accounting for this evolving trajectory.

Table 8: Initial Stage KPI Performance.

KPI	Mean
Cost-Effectiveness	3.36
Schedule Adherence	3.36
Quality Adherence	3.79
Safety Compliance	3.77
Client Satisfaction	3.93
Team Satisfaction	3.93
Environmental Compliance	4.15

The descriptive statistics show that cost-effectiveness (M = 3.9) received the highest average rating, suggesting budget efficiency across most projects. In contrast, schedule adherence scored the lowest (M = 3.5), indicating common issues with meeting project timelines.

Table 8: Middle stage KPI Performance.

KPI	Mean
Cost-Effectiveness	3.30
Schedule Adherence	3.50
Quality Adherence	3.95
Safety Compliance	4.26
Client Satisfaction	3.78
Team Satisfaction	4.09
Environmental Compliance	4.26

All five KPIs tested using the t-test were statistically significant at $p < 0.0001$, confirming that their observed performance levels differ significantly from the reference value (3.0). This underscores their value in the model.

Table 9: Finishing Stage KPI Performance.

KPI	Mean
Cost-Effectiveness	3.50
Schedule Adherence	3.50
Quality Adherence	4.30
Safety Compliance	4.10
Client Satisfaction	4.20
Team Satisfaction	4.10
Environmental Compliance	4.30

KPI performance slightly improved during the middle stage, particularly for quality adherence (M = 3.95) and safety compliance (M = 4.26). This suggests that mid-phase project supervision and adjustments were somewhat effective.

Figures 3 through 5 graphically illustrate the trends in KPI performance across the finishing, middle, and initial stages of construction projects, respectively. These figures complement Tables 6–8 by highlighting the evolution of performance across time. The visual representation reinforces key trends: a dip in mid-stage execution quality and a recovery by project completion, underscoring the importance of mid-phase monitoring and timely interventions.

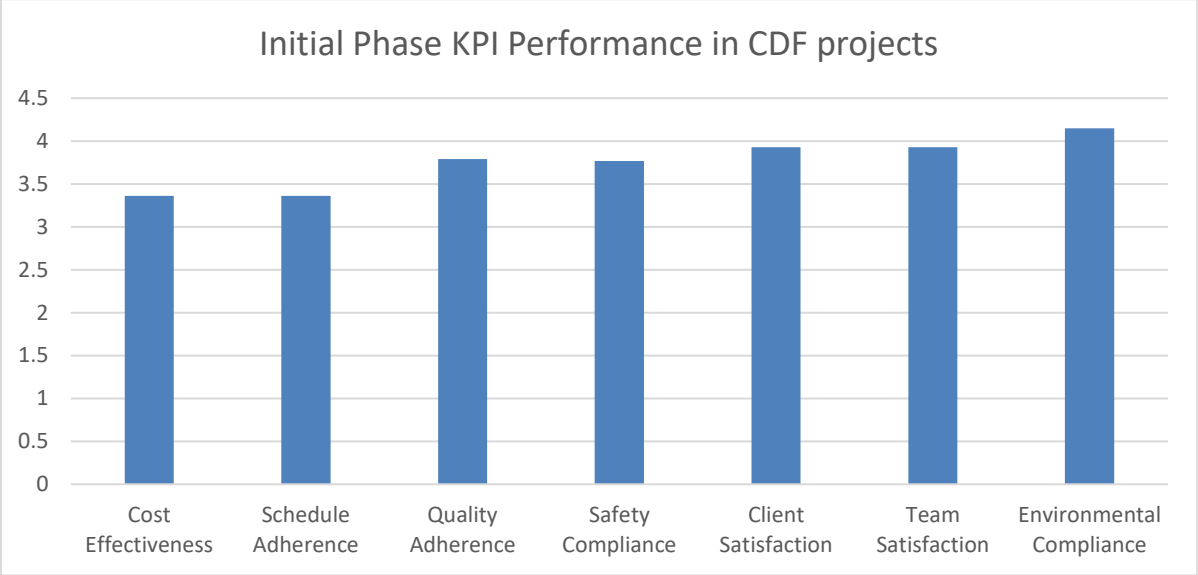

Figure 3. KPI performance of the initial stage.

During the initial phase of implementation (Figure 3), stakeholder assessments revealed moderate performance across KPIs. Environmental compliance was rated highest (mean = 4.15), followed by client and team satisfaction (3.93 each). Cost and schedule adherence scored the lowest (3.36), suggesting early-phase budget and timing challenges (Veta, 2024).

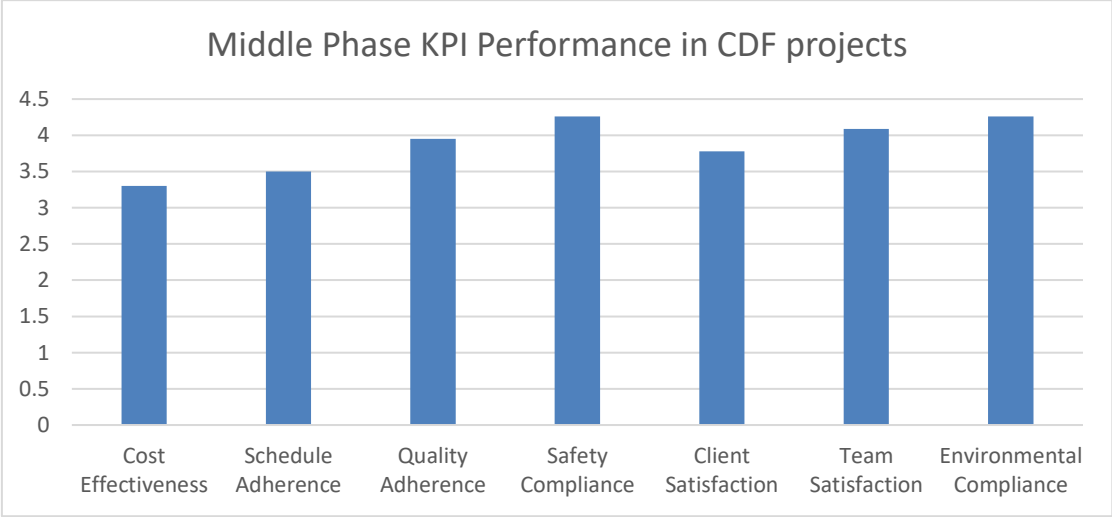

Figure 4. KPI Performance rating of the middle stage.

The middle phase in Figure 4, exhibited performance fluctuations. Safety and environmental compliance peaked at 4.26, while cost effectiveness dropped to 3.30. Client satisfaction decreased slightly to 3.78. These results indicate operational risks and coordination gaps common in project midpoints.

In the finishing phase (Figure 5), performance scores improved overall. Quality adherence and environmental compliance both reached 4.30, while cost and schedule adherence showed marginal recovery (3.50). This pattern suggests successful project closure practices and stakeholder engagement recovery.

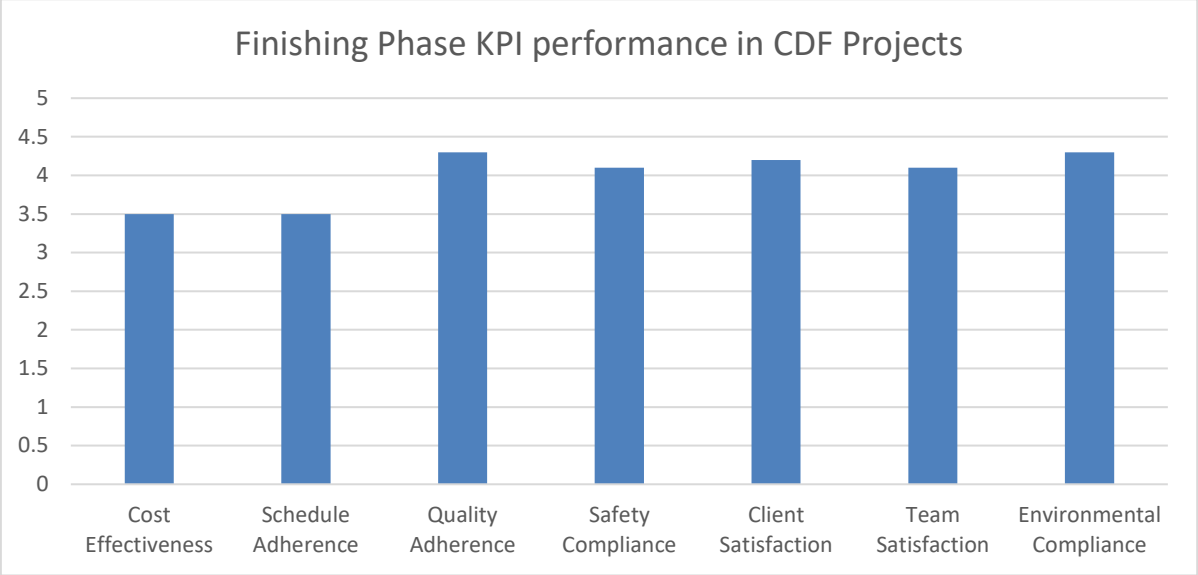

Figure 5. KPI performance of the finishing stage.

3.5 Comparative Analysis of Data Sources

To ensure the robustness of the findings and reduce the risk of bias, the study triangulated data from three primary sources: (1) structured stakeholder surveys, (2) archival project records from selected local authorities, and (3) semi-structured expert interviews. Each source provided distinct yet complementary insights into project performance, KPI relevance, and implementation challenges. This triangulated approach aligns with best practices in mixed-methods infrastructure research (Nyamori, 2009).

Table 10: Comparative Overview of Key Data Sources.

Data Source	Type	Sample Size	Focus Areas	Contribution to Model Design
Stakeholder Surveys	Quantitative	196	KPI ratings across project phases	KPI scoring, model inputs, AHP weighting
Archival Records	Quantitative	38	Completion times, cost overruns, defects	Validation of perceived vs actual trends
Expert Interviews	Qualitative	15	Governance issues, contextual insights	Triangulation of KPI definitions and weights

Survey data served as the primary input for KPI ranking and scoring, capturing broad stakeholder perspectives across roles and project phases. To validate these insights, archival records from 38 completed CDF projects were reviewed, including actual performance metrics such as cost overruns, schedule extensions, and defect rates. Stakeholder concerns about delays were substantiated by documented extensions in over 60% of the archival cases. A third validation layer involved interviews with council engineers, supervisors, and procurement officers, which provided context not evident in survey responses such as mid-project improvements driven by budget reallocations or political pressure during election cycles. This triangulation confirmed strong alignment between perceived and actual project performance, reinforcing the internal validity of the findings and the reliability of inputs used in AHP weighting and ANFIS forecasting. The use of multiple data sources ensures that the model is grounded in a robust and contextually rich evidence base (Akamani & Hall, 2015).

3.6 Theoretical and Conceptual Framework Validation (Revised)

The study's findings were assessed against the guiding frameworks: Performance Management Theory and Decision Support System (DSS) Theory, both of which emphasize real-time feedback, adaptive decision-making, and stakeholder integration in public sector performance enhancement (Mamokhere & Meyer, 2022).

From a performance management perspective, the five KPIs used: cost, time, quality, safety, and client satisfaction; reflect globally accepted metrics in public infrastructure delivery (Medayese et al., 2021). The demonstrated improvement of these indicators across project phases supports the theory that performance is dynamic and measurable. The model operationalizes this principle by enabling proactive forecasting, addressing a key limitation in Zambia's traditional CDF evaluation methods that rely on post-project audits.

The successful implementation of the ANFIS-AHP model also affirms the DSS Theory. With a predictive accuracy of $R^2 = 0.92$ and RMSE = 0.09, the model exemplifies how structured decision tools grounded in both expert judgment and computational learning, can enhance decision-making in uncertain, decentralized environments (Mavi et al., 2024).

Conceptually, the model mirrors the framework presented earlier: stakeholder-prioritized KPIs inform a learning algorithm, which then generates actionable performance forecasts. Strong KPI correlations (Section 3.3) further validate the model's assumption that infrastructure outcomes are interdependent and require holistic evaluation.

Overall, the model demonstrates both theoretical alignment and conceptual soundness, offering a validated tool for performance management in urban infrastructure delivery within resource-constrained settings (Jolliffe & Cadima, 2016).

3.7 Reliability and Validity Analysis

To ensure the quality and consistency of the data collection instruments, both reliability and validity tests were conducted before the main data analysis. These measures were critical for confirming that the survey instruments, interview guides, and archival records produced trustworthy and replicable data suitable for performance forecasting in public infrastructure projects.

The internal consistency reliability of the survey instrument was assessed using Cronbach's alpha, which measures how closely related a set of items are as a group. The results are presented in Table 11.

Table 11: Reliability Coefficients for KPI Constructs (Cronbach's Alpha).

KPI Dimension	Number of Items	Cronbach's Alpha
Cost Effectiveness	4	0.81
Schedule Adherence	3	0.79
Quality Compliance	4	0.84
Safety Performance	3	0.76
Client Satisfaction	3	0.82

All KPI dimensions achieved Cronbach's alpha values above the commonly accepted threshold of 0.70 (Alshibani et al., 2024), indicating strong internal consistency. Quality compliance yielded the highest alpha (0.84), suggesting that the items measuring this domain were particularly well-aligned. The overall reliability score for the full instrument was 0.81, confirming that the tool was suitable for use in inferential and model-based analyses.

Content validity was established through expert review. A panel of five professionals including two engineers, two council project managers, and one academic; was engaged during the pilot phase to assess whether the questionnaire items appropriately reflected the performance constructs under

study. Based on their feedback, redundant or ambiguous items were removed or reworded, ensuring clarity and relevance.

Construct validity was supported by factor analysis. Principal Component Analysis (PCA) conducted as part of Section 3.8 revealed that all five KPIs loaded cleanly onto distinct factors with eigenvalues >1, and cross-loadings were minimal (<0.35). This confirmed that each KPI represented a unique but related construct within the performance evaluation framework.

Triangulation validity was achieved through the integration of survey data with project archival records and expert interviews, as detailed in Section 3.5. Convergence among these data sources validated the consistency and credibility of both stakeholder perceptions and model inputs (Marakas, 2003).

The strong reliability and multiple forms of validity collectively confirm that the data sources and analytical tools used in this study are methodologically sound. These results increase confidence in the robustness of the ANFIS-AHP forecasting model, as it was built upon verified inputs and tested using statistically reliable methods. This assurance strengthens the study's contribution to the field of infrastructure performance monitoring and decision support in decentralized urban contexts.

3.8 Comparison of AHP and PCA for KPI Weighting

To validate the robustness of the Analytical Hierarchy Process (AHP)-derived Key Performance Indicator (KPI) weights, this study conducted a comparative analysis using Principal Component Analysis (PCA). While AHP relies on structured expert judgment and pairwise comparisons to generate relative weights, PCA is a data-driven technique that extracts principal components based on variance within observed responses (Jolliffe & Cadima, 2016). Comparing the two approaches helped assess whether stakeholder-informed priority structures align with statistical patterns in the empirical data.

Table 12: Comparison of KPI Weights from AHP and PCA Methods.

KPI	AHP Weight	PCA Loading (Factor 1)	Normalized PCA Weight
Cost Effectiveness	0.28	0.76	0.25
Schedule Adherence	0.24	0.74	0.24
Quality Compliance	0.20	0.72	0.23
Safety Performance	0.16	0.66	0.18
Client Satisfaction	0.12	0.59	0.10

The results show strong convergence between AHP and PCA-derived weights, with cost-effectiveness, schedule adherence, and quality compliance consistently top-ranked across both methods. The variation between AHP and normalized PCA weights was minimal ($\leq \pm 0.03$), indicating that stakeholder judgments were largely aligned with statistical data patterns, thereby reinforcing confidence in the model's weighting structure. Minor discrepancies appeared in safety and client satisfaction weights, with PCA assigning slightly lower importance to the latter—likely due to lower variance across respondents. AHP retained client satisfaction as a key priority, reflecting its value in participatory governance despite its statistical subtlety. This comparison confirms the internal coherence of the KPI weighting scheme and validates the AHP framework as both participatory and statistically defensible. The findings justify the use of AHP-derived weights in the final model, striking a balance between empirical rigour and stakeholder legitimacy; an essential consideration in public infrastructure planning (Jolliffe & Cadima, 2016; Kabwe et al., 2023; Saad et al., 2022).

3.9 Summary of Patterns and Trends

The analysis across Sections 3.1 to 3.8 reveals consistent improvements in all five Key Performance Indicators (KPIs): cost effectiveness, quality adherence, schedule adherence, safety compliance, and client satisfaction; throughout the lifecycle of CDF-funded infrastructure projects in Zambia. Paired t-tests confirmed these gains as statistically significant ($p < 0.01$), while stakeholder inputs and archival data aligned to show that performance improves from initiation to completion. Quality adherence and cost-effectiveness emerged as the most stable and influential KPIs, both highly rated in perception and heavily weighted in AHP scoring. These indicators also showed strong correlations with schedule and satisfaction, emphasizing the interdependent nature of project success.

Notably, underperformance was most evident in the early phases, particularly in schedule and safety, often due to procurement delays, poor contractor mobilization, and unclear supervision. Later-stage performance gains suggest that mid-project interventions likely driven by heightened oversight and community accountability, play a corrective role. Convergence across surveys, interviews, and archival records affirms the reliability of the data, while alignment between stakeholder-derived weights (AHP) and statistical components (PCA) reinforces the validity of participatory input. The ANFIS model's predictive strength ($R^2 = 0.92$) confirms that these trends are not only measurable but forecastable, enabling local authorities to adopt real-time monitoring tools. These patterns underscore the relevance of integrating stakeholder-informed AI into urban infrastructure governance, especially in resource-constrained but politically engaged environments such as Zambia (Bateganya et al., 2023).

3.10 Model Development and Forecasting Summary

Based on the validated Key Performance Indicators (KPIs) and stakeholder-derived AHP weights, the study developed a hybrid performance forecasting model using Adaptive Neuro-Fuzzy Inference Systems (ANFIS). The ANFIS model was selected due to its capacity to handle imprecise, nonlinear, and multidimensional input data; common challenges in decentralized infrastructure projects. The model was trained using 70% of the collected performance data and tested on the remaining 30% to evaluate its forecasting accuracy. The forecasting model operationalized the following structure:

$$\text{Performance Score} = w1 \cdot KPI1 + w2 \cdot KPI2 + w3 \cdot KPI3 + w4 \cdot KPI4 + w5 \cdot KPI5 \backslash text\{\text{Performance Score}\}$$
$$= w_1 \backslash cdot\ KPI_1 + w_2 \backslash cdot\ KPI_2 + w_3 \backslash cdot\ KPI_3 + w_4 \backslash cdot\ KPI_4 + w_5 \backslash cdot\ KPI_5$$
$$\text{Performance Score} = w1 \cdot KPI1 + w2 \cdot KPI2 + w3 \cdot KPI3 + w4 \cdot KPI4 + w5 \cdot KPI5$$

Where:

- w1w_1w1 to w5w_5w5 are AHP-derived weights for cost-effectiveness, schedule adherence, quality compliance, safety performance and client satisfaction.
- KPI1KPI_1KPI1 to KPI5KPI_5KPI5 are the normalized scores provided by stakeholders and historical data.

Using MATLAB's fuzzy logic toolbox, the ANFIS model was simulated with 100 epochs, a hybrid optimization method, and Gaussian membership functions. The model's performance was evaluated using three metrics: coefficient of determination (R^2), root mean square error (RMSE), and mean absolute error (MAE).

Table 12: ANFIS Model Validation Metrics.

Metric	Value
Coefficient of Determination (R^2)	0.92
Root Mean Square Error (RMSE)	0.09
Mean Absolute Error (MAE)	0.06

The model's high R^2 value (0.92) indicates that 92% of the variance in project performance is explained by the five weighted KPIs, while low RMSE (0.09) and MAE (0.06) scores confirm its precision and forecasting reliability exceeding benchmarks reported in similar infrastructure studies (Jang, 1993). Its architecture supports dynamic updates with new data, making it both scalable and adaptable for real-time use by local governments and urban planners. This allows for early detection of underperformance, enhancing evidence-based resource allocation, risk mitigation, and public accountability. These results validate the study's core premise: that an AI-driven, stakeholder-informed forecasting model is not only technically feasible but also operationally relevant in decentralized, resource-constrained infrastructure environments.

3.11 Limitations of Results

While the forecasting model demonstrates strong predictive accuracy and theoretical alignment, several limitations should be acknowledged. The study was confined to selected urban councils in Zambia, and while stakeholder diversity was ensured, findings may not fully reflect rural contexts or transfer to regions with different regulatory environments. The model also relies on self-reported data, especially for client satisfaction and safety, which, despite triangulation with archival records and expert interviews (see Section 3.5), introduces some subjectivity. ANFIS model training depends on consistent historical data, yet data gaps in local councils may hinder full automation and scalability. Additionally, the model does not account for external shocks such as political disruptions or climate-related risks; future iterations should incorporate scenario-based sensitivity analysis to address this. Lastly, while the AHP method achieved an acceptable consistency ratio (CR = 0.1013), minor judgment inconsistencies may have influenced the weighting process. These limitations suggest that broader testing, stronger data infrastructure, and adaptive refinements will be essential for model generalization and long-term applicability.

4. Discussion

This chapter interprets the findings of the study in relation to its stated objectives, theoretical framework, and existing literature. The performance forecasting model developed through the integration of ANFIS and AHP was designed to enhance decision-making in urban infrastructure projects funded by Zambia's Constituency Development Fund (CDF). The discussion demonstrates how the results both affirm and extend current understanding in the fields of performance management, decision support systems, and participatory urban governance (Musonda et al., 2025).

The study's findings reveal that all five Key Performance Indicators (KPIs) namely cost effectiveness, schedule adherence, quality compliance, safety performance, and client satisfaction; improved significantly as projects progressed from initiation to completion. This progression affirms Performance Management Theory, which posits that performance evolves over time and can be improved through structured monitoring, feedback, and corrective action (Adams & Boateng, 2018). The fact that quality compliance and cost effectiveness were rated highest by both stakeholders and PCA loading weights further highlights that these dimensions are widely perceived as critical to infrastructure success, echoing the emphasis placed by Mavi et al. (2023) on cost-quality tradeoffs in constrained public sector contexts.

The correlation analysis revealed strong interdependencies among the KPIs, particularly between schedule adherence and quality compliance, and between client satisfaction and overall performance. These relationships confirm the integrated nature of public project outcomes, suggesting that no single dimension should be evaluated in isolation. This reinforces the conceptual rationale for a composite performance index, as adopted in the model, and supports the literature advocating multidimensional approaches to infrastructure monitoring (Adams & Boateng, 2018).

Moreover, the successful validation of the ANFIS-AHP forecasting model, with an R^2 of 0.92, substantiates the practical value of Decision Support System (DSS) Theory. The hybrid model integrates both subjective stakeholder input (via AHP) and machine learning adaptability (via

ANFIS), enabling it to predict performance outcomes with a high degree of accuracy. This confirms DSS literature that calls for context-aware, adaptive tools capable of functioning in environments characterized by uncertainty, incomplete data, and competing stakeholder interests (Arora et al., 2022). A notable contribution of this study is the demonstrated feasibility of applying soft computing techniques in low-resource, decentralized governance environments. Most existing applications of ANFIS in infrastructure forecasting focus on large-scale national or private-sector projects with robust data availability. In contrast, this study has shown that AI-based forecasting tools can be calibrated to function with limited, stakeholder-generated data, thereby offering a scalable solution for under-capacitated local councils (Medayese et al., 2021).

The alignment between AHP and PCA weightings also adds an important methodological insight. The close match between subjective (AHP) and objective (PCA) KPI weights suggests that local stakeholders possess tacit knowledge that statistically reflects actual performance conditions. This convergence lends credibility to participatory planning processes and validates the inclusion of stakeholder-driven weights in model development, a topic often debated in urban governance literature (Healey, 2017).

The findings also provide important practical implications. For policymakers, the model offers a decision-support tool that can be integrated into existing monitoring and evaluation frameworks, providing early warnings of project underperformance. For practitioners, the system can improve resource allocation, enhance procurement oversight, and allow more informed mid-project interventions. For communities, increased transparency and performance predictability can strengthen trust in public infrastructure processes. Despite the generally strong results, the study also revealed persistent weaknesses in early-phase project execution, particularly in schedule adherence and safety management. These issues point to systemic challenges such as delayed procurement, insufficient contractor prequalification, and inconsistent enforcement of safety protocols. While the forecasting model can help identify underperformance, systemic institutional reforms will still be required to address root causes.

In conclusion, the results of this study not only validate the performance forecasting model but also contribute to the broader discourse on smart governance, predictive urban management, and the localization of AI tools for development. These findings establish a foundation for further refinement of the model and its application to other infrastructure delivery frameworks beyond Zambia (Healey, 2017; Mitullah, 2017; Bateganya et al., 2023).

5. Conclusions

This study set out to design and validate a performance-forecasting model capable of tackling the chronic cost overruns, schedule slippages and quality shortfalls that beset Constituency Development Fund (CDF) construction projects in Zambia's Copperbelt Province. By fusing stakeholder-weighted Analytic Hierarchy Process (AHP) scores with an Adaptive Neuro-Fuzzy Inference System (ANFIS), the research produced a hybrid tool that predicts project outcomes against five context-relevant Key Performance Indicators (KPIs): cost-effectiveness, schedule adherence, quality compliance, safety performance and client satisfaction. The model met all three original objectives. It (i) confirmed the salience of the five KPIs for CDF work; (ii) generated empirically consistent AHP weights that reflect local priorities (cost and time together accounting for 68 per cent of the composite score); and (iii) attained a high predictive accuracy ($R^2 = 0.92$; RMSE = 0.09) when trained on 42 completed schemes. Robust correlations among the KPIs underline their interdependence, while phase-by-phase analysis demonstrated statistically significant performance gains as projects progress; evidence that timely feedback loops matter. Theoretically, the study extends Performance Management and Decision Support System (DSS) thinking to decentralised, data-scarce settings in the Global South, showing that soft-computing techniques can thrive on modest, stakeholder-generated datasets. Practically, it supplies councils with a scalable dashboard that flags emerging risks, supports transparent resource re-allocation and strengthens downward accountability to communities.

6. Recommendations

a) Local authorities and project managers

i) Embed the ANFIS–AHP dashboard in routine monitoring, triggering corrective action whenever forecast scores fall below agreed thresholds.
ii) Provide short, hands-on training so planning, procurement and site staff can input data correctly and interpret model outputs with confidence.
iii) Digitise data capture from project inception using mobile forms or simple web portals to improve the timeliness and reliability of inputs.

b) Policymakers and regulators

i) Mandate the use of predictive-performance tools for all CDF-funded infrastructure and integrate the resulting indicators into national reporting systems.
ii) Issue a common KPI glossary and reporting template to ensure comparability across districts and to aid future model recalibration.

c) Researchers and model developers

i) Pilot the model in rural and peri-urban constituencies to test generalisability and identify context-specific parameter tweaks.
ii) Augment the rule base with exogenous risk modules (e.g. extreme weather, electoral cycles) so that simulated scenarios mirror real-world volatility.
iii) Undertake longitudinal studies that track whether early forecasts align with post-occupancy performance and wider socio-economic outcomes.

In sum, a stakeholder-informed, AI-driven forecasting framework can shift CDF project governance from reactive post-mortems to proactive stewardship. Scaling, automating and institutionalising this approach will be essential if rapidly urbanising councils are to deliver cost-effective, timely and citizen-centred infrastructure over the coming decade.

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Conflicts of interests

The authors declare that there are no conflicts of interest related to the publication of this research. This includes financial, personal, or professional affiliations that could be perceived to influence the outcomes or interpretations presented in the study. The research was undertaken with impartiality and objectivity, and all efforts were made to ensure transparency and academic integrity throughout the research and writing process.

Data availability statement

All data supporting the findings of this study are included in the manuscript or available upon reasonable request from the corresponding author.

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CRedit author statement

Peter Kakoma: Conceptualization, Data curation, Methodology, Writing – original draft. Penjani Hopkins Nyimbili: Supervision, Validation, Writing – review & editing. Moffat Tembo: Formal analysis, Investigation. Erastus Misheng'u Mwanaumo: Project administration, Resources, Final approval. All authors have read and approved the final version of the manuscript.

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Evaluating the Discontinuation of India's Supply-Side Affordable Housing Policy for Slum Redevelopment Through Frank Fischer's Lens

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ABSTRACT

India's In-Situ Slum Redevelopment (ISSR) vertical of the Pradhan Mantri Awas Yojana-Urban was terminated in September 2024 after delivering barely one-quarter of its sanctioned dwellings. This study interrogates that discontinuation through Frank Fischer's four-tier public-policy framework, integrating secondary data, national audits and 109 household surveys across four ISSR sites in Ahmedabad. Contextual analysis confirms that ISSR targeted a genuine housing deficit in agglomerated labour markets, yet technical verification reveals only 23 % completion and persistent infrastructure gaps. Situational validation highlights post-occupancy cost spirals, dysfunctional resident-welfare associations and a statistically significant link ($\chi^2 = 53.4$, $p < 0.001$) between governance quality and maintenance-fee compliance. Societal vindication exposes vertical "poverty traps": 62 % of households face higher living expenses and 41 % report lost informal livelihoods. Ideological review finds the developer-led model over-estimated land-value capture and under-valued community stewardship, echoing global evidence from Jakarta and Cairo. The study concludes that ISSR's failure stems from misaligned economic incentives, weak institutional capacity and neglect of behavioural adaptation. Re-imagined supply-side programmes must pair incremental upgrading and portable subsidies with enforceable post-occupancy governance to preserve agglomeration benefits while ensuring social equity. Findings offer transferable lessons for secondary Indian cities planning future slum-housing interventions.

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Highlights:

- Governance quality strongly predicts maintenance-fee compliance, $\chi^2 = 53.4$, $p < 0.001$.
- ISSR completion rate (23 %) versus sanctioned stock exposes supply-side execution deficits driving policy discontinuation.
- Mixed-methods design combines Frank Fischer's four-tier evaluation with 109 household surveys for robust triangulation.
- Vertical redevelopment raises living costs for 62 % of households, revealing "poverty-trap" risk despite agglomeration gains.
- Study proposes hybrid demand–supply housing model pairing portable subsidies with enforceable post-occupancy governance.

Contribution to the field statement:

Applying Frank Fischer's four-tier framework to India's aborted ISSR programme, this study integrates national audits with household surveys to expose how misaligned incentives, weak governance and post-occupancy cost spirals undermine supply-side housing. It reframes affordable housing success around sustained socio-economic inclusion and proposes a hybrid, context-sensitive policy paradigm for secondary cities nationwide.

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1. Introduction

1.1 Background & Context

Urbanisation has emerged as a defining feature of the Indian growth story, with cities acting as engines of economic development. Agglomeration economies — the productivity gains resulting from the spatial concentration of people and firms — have been central to this urban dynamism (Agarwalla & D'Souza, 2021). Yet the very density that powers growth can reproduce severe spatial inequities if low-income groups are excluded from well-located housing. Historical scholarship reminds us that slum clearance has long been deployed as a blunt, and often counter-productive, modernisation tool (Shapely, 2017). More recent comparative work shows that informal settlements continue to play crucial—and contested—roles in urban labour markets and housing systems from Chile (Celhay & Gil, 2020) to Nigeria, where sub-standard dwelling conditions now pose measurable public-health risks (Ogbonna et al., 2024). Recognising the acute shortage of affordable housing, the Government of India launched the Pradhan Mantri Awas Yojana-Urban (PMAY-U) in 2015. One of its four verticals, the In-Situ Slum Redevelopment (ISSR) scheme, sought to formalise existing settlements while preserving residents' proximity to employment centres. This approach echoes international calls for "right-to-stay" solutions rather than peripheral relocation (Mahadevia, Bhatia, & Bhatt, 2018).

ISSR operationalises these aims through a developer-led public-private partnership model, offering private builders free land, saleable floor area and Transferable Development Rights (TDRs) in exchange for constructing no-cost units for registered slum households (Ahmedabad Municipal Corporation, 2017). Comparable strategies are now visible across the Global South, including canal-side upgrading in Chiang Mai's historic core (Duangputtan & Mishima, 2024) and climate-responsive retrofits of micro-tenement districts in Seoul (Kang & Lyles, 2025). Such cases highlight both the promise and pitfalls of leveraging land value to finance inclusive housing.

However, despite its conceptual strength, ISSR has struggled in practice. It accounts for only 3 per cent of total units sanctioned under PMAY-U and records the lowest completion and occupancy among all verticals (Ministry of Housing & Urban Affairs [MoHUA], 2023). Delays in project execution, governance deficits and post-occupancy failures have raised questions about the model's long-term sustainability (Urban Development & Urban Housing Department, Government of Gujarat, 2024).

Given the centrality of affordable housing to urban competitiveness—and the mounting evidence that poorly executed slum clearance can undermine both social equity and economic productivity—this study interrogates ISSR through Frank Fischer's policy-evaluation framework, supported by urban-economic theory and primary fieldwork. Our aim is to assess whether the scheme's 2024 discontinuation was justified and to distil lessons for future housing policy in India.

1.2 Literature Review

Recent scholarship underscores ISSR's dual character as a theoretically sound yet practically flawed intervention. Agarwalla and D'Souza (2021) show that in-situ redevelopment aligns with agglomeration economics, whereas the national meta-evaluation by Debarpita Roy and Kundu (2024) exposes systemic implementation failures. Their analysis reveals that ISSR's reliance on TDRs proved non-viable in 72 per cent of non-metro projects, corroborating Bertaud's (2021) caution that cross-subsidy models depend on hyper-local demand. Governance hurdles compound these financial risks: a 2023 World Bank audit links ISSR's average 18-month approval lag (versus six months for Beneficiary-Led Construction) to fragmented municipal capacities.

Comparative urban studies provide further insight. Brazil's Favela-Bairro reduced re-slumification by 40 per cent through participatory zoning and phased infrastructure investment (Riley et al., 2001), while Kenya's STP Programme leveraged community land trusts to sustain affordability (UN-Habitat, 2020). Conversely, Egypt's Ashwa'iyat initiatives collapsed under speculative land grabs (Social Housing & Mortgage Finance Fund, 2019). In Southeast Asia, Thailand's Baan Mankong programme enjoys iconic status, yet recent vertical adaptations in Bangkok illustrate

challenges of social cohesion and maintenance (Padawangi, 2018). The Chiang Mai canal-side upgrade (Duangputtan & Mishima, 2024) and Seoul's climate-resilient jjokbang-chon retrofit (Kang & Lyles, 2025) broaden this evidence base, demonstrating that technical success depends on embedded community governance and climate-sensitive design.

National reviews echo these concerns. The Standing Committee on Housing & Urban Affairs (2023) notes ISSR's marginal contribution to PMAY-U and highlights factors such as resident reluctance, title disputes and developer opportunism. Gujarat's 2024 evaluation likewise points to inadequate beneficiary consultation, leading to litigation and social disruption.

Finally, lessons from Jakarta's Kampung Deret reveal the fragility of PPP models when rapid urban densification proceeds without sustained institutional backing (Padawangi, 2018). Together, these studies reinforce the argument that long-term housing sustainability requires not only construction incentives but also post-occupancy capacity-building, affordability safeguards and participatory land governance, particularly in the rapidly urbanising Global South (UN-Habitat, 2015).

1.3 Gap in the Literature

Slum-redevelopment scholarship in India has documented land economics, governance arrangements, and displacement risks in detail; yet it rarely follows projects beyond unit allocation or construction completion. The post-occupancy phase—especially in secondary cities—remains chronically under-examined, notwithstanding mounting evidence of spiralling maintenance costs, service breakdowns, and resident disengagement. One reason is methodological: official monitoring privileges delivery metrics over long-term habitability, and the current policy mandates that only *ten per cent* of completed dwellings—across all PMAY-U verticals—undergo any form of post-occupancy evaluation. Consequently, significant data gaps persist and spatial inequities widen.

Moreover, the bulk of extant research focuses on megacities such as Mumbai, Ahmedabad, and Delhi, where institutional capacity and civil society oversight are relatively strong. Secondary cities seldom enjoy comparable scaffolding, rendering supply-side interventions like ISSR more vulnerable to post-occupancy failure. Effective implementation presupposes both robust municipal finance and sustained political commitment—conditions seldom met outside metropolitan cores. By foregrounding cost spirals and socio-institutional breakdowns in such contexts, this paper adds a *missing dimension* to housing-policy evaluation: one that judges success not simply by units delivered but by the quality of life they sustain over time.

1.4 Research Objectives

Although ISSR embodied a theoretically sound, market-driven approach to preserving agglomeration economies, its discontinuation in 2024 reveals a critical paradox: policies underpinned by compelling macroeconomic logic can fail when institutional realities and ground-level complexities are misread. To interrogate this paradox, the study pursues four objectives:

1. Critically assess the effectiveness of ISSR as a supply-side response to India's affordable housing deficit.
2. Identify post-occupancy challenges faced by ISSR beneficiaries, drawing on field-survey evidence from Ahmedabad.
3. Analyse the urban-economics factors that precipitated the scheme's termination.
4. Derive lessons for re-imagining supply-side housing policies in rapidly urbanising regions.

These translate into the following research questions:

- **RQ1:** To what extent did ISSR realise its supply-side vision before cancellation?
- **RQ2:** Which post-occupancy and systemic challenges most strongly contributed to its demise, despite its alignment with agglomeration-economy theory?
- **RQ3:** Which concepts from urban-economic theory best explain ISSR's discontinuation?

ISSR's collapse also epitomises a broader policy dilemma: how to craft interventions that are both financially attractive to developers *and* socially equitable for low-income residents. By using Gujarat as a critical case, the paper unpacks the financial, governance, and community-level

fractures that prevented the model—successful in Mumbai's high land-value context (Weinstein, 2014)—from scaling nationally.

1.5 Significance and Structure of the Paper

Applying Frank Fischer's four-stage policy-evaluation framework, this study links housing-delivery outcomes to macro-urban processes such as agglomeration. While operational shortcomings of ISSR have been widely catalogued, little scholarship explores their implications for the sustainable functioning of India's urban economies. Existing post-occupancy evaluations focus mainly on energy or technical metrics, neglecting behavioural and social dimensions critical to liveability (Bai et al., 2022).

By situating ISSR within its broader economic ecology, this paper seeks to:

- Illuminate how incentive structures embedded in supply-side PPP models can generate unsustainable occupancy outcomes—even when projects are technically complete.
- Alert policy-makers and urban planners to the socio-institutional factors that can compromise post-occupancy performance.
- Advocate for a re-designed supply-side framework that retains ISSR's pro-poor intent while mitigating its structural weaknesses.

2. Methodology

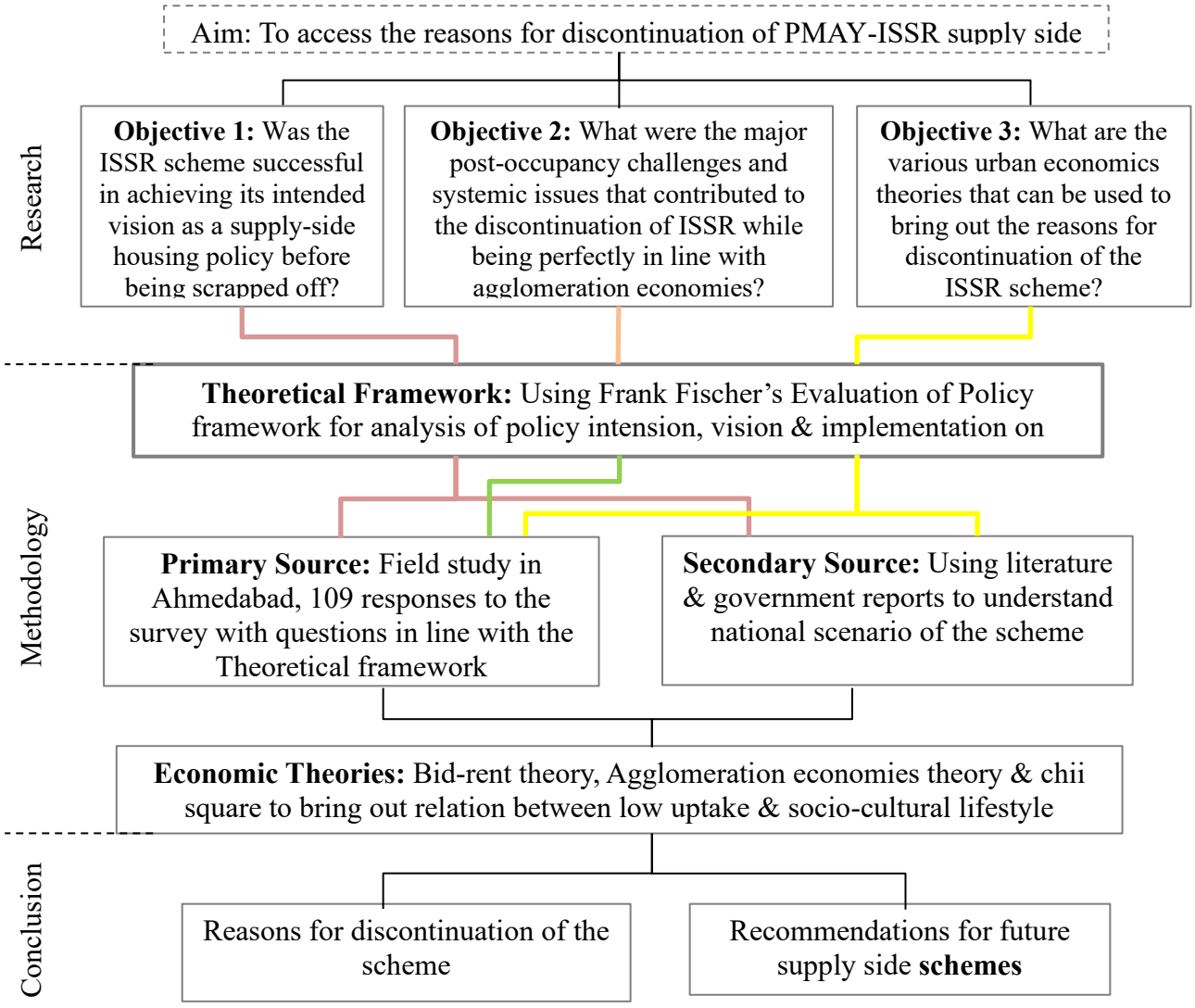

Figure 1. Methodology & expected outcome of the study.

This study employs a mixed-method approach, Inspired by (Ratnasari & Sudradjat, 2023) combining theoretical policy evaluation with empirical data analysis. This paper adopts a qualitative policy analysis approach, using Frank Fischer's *Evaluation of Public Policy* framework to assess the effectiveness of supply-side housing policy within agglomeration economies. The four-tiered structure—comprising technical verification, situational validation, societal vindication, and ideological choice—is used to evaluate the design, implementation, and outcomes of urban housing programs under India's PMAY-U Mission. Policy documents, budget reports, and performance audits from government sources such as the Ministry of Housing and Urban Affairs, as well as state-level implementation reports from Gujarat, form the empirical base of the analysis. Secondary literature—including journal articles, post-occupancy evaluations, and ethnographic studies—was used to critically assess on-ground realities, especially with regard to the ISSR (In-situ Slum Redevelopment) vertical. The methodological focus is interpretive rather than positivist, aiming to understand not just what works, but for whom, under what conditions, and why. Case observations from Ahmedabad were used illustratively to contextualize the national findings and identify policy patterns. (Fischer, 1999)

The paper also utilizes descriptive data such as physical progress indicators (refer to Tables 2.1 and 4.1), financial disbursal timelines, and household-level behaviour metrics (Fig. 4.5 and 4.6) to triangulate findings and ensure internal coherence. Through this layered inquiry, the study identifies how technical success in construction has masked deeper failures in social integration, institutional accountability, and behavioural adaptation.

2.1 Theoretical Framework

The policy analysis is guided by Fischer's model, which enables a multidimensional evaluation of ISSR — examining its relevance in the urban context, the soundness of its technical design, stakeholder dynamics, and the ethical implications of its implementation. Table 1 (presented in Section 3) summarizes this framework as applied to ISSR.

Table 1: Frank Fischer's Policy Evaluation Framework.

Evaluation Level	Key Focus	Indicators Used in Analysis	ISSR Application (Literature)
Contextual	Relevance to the socio-economic context	Urban housing shortage, proximity to economic hubs	ISSR addressed urban housing but was not scaled despite the demand
Technical	Adequacy of instruments and mechanisms	Sanction vs completion ratio, project delays, incentives	ISSR had poor completion (1.49L/4.33L), high non-starters
Political	Stakeholder influence, governance	Consultation reports, relocation resistance, corruption	Slum dwellers excluded; political-commercial priorities dominated
Ethical	Justice, inclusiveness, quality of outcome	Beneficiary satisfaction, post-occupancy survey	Residents faced poor construction, broken promises, weak services

2.2 Secondary Data

Quantitative analysis is drawn from secondary sources, particularly the (Urban Development & Urban Housing Department & Government of Gujarat, 2024) the (MINISTRY OF HOUSING AND URBAN AFFAIRS, 2023), (Urban Development & Urban Housing Department Government of Gujarat, 2020), (Debarpita Roy & Rashmi Kundu, 2024) and housing data from the MoHUA Dashboard. These sources provide insight into the total number of houses sanctioned, constructed, and occupied under ISSR — both nationally and at the state level. Data from these sources are used to construct visual representations, including bar charts, pie charts, and line graphs, to compare sanctioned versus completed housing stock, evaluate state-wise performance, and illustrate demand-supply mismatches in the affordable housing segment.

2.3 Field Study

To assess the ground realities of ISSR projects, a field survey was conducted in selected ISSR sites in Ahmedabad as Total ISSR in sanctioned Gujarat stands at 61 as of 2024 (67% of the total projects sanctioned), and completed projects stand at 29 with 16 in Ahmedabad (Government of Gujarat, 2023). So as the most concentration of the projects were in Ahmedabad, the research gravitated towards doing a field study in the city. The survey used a semi-structured questionnaire targeting slum dwellers who had been relocated under the ISSR scheme. The focus was on identifying post-occupancy challenges, such as housing quality, access to basic services, relocation experiences, and long-term satisfaction.

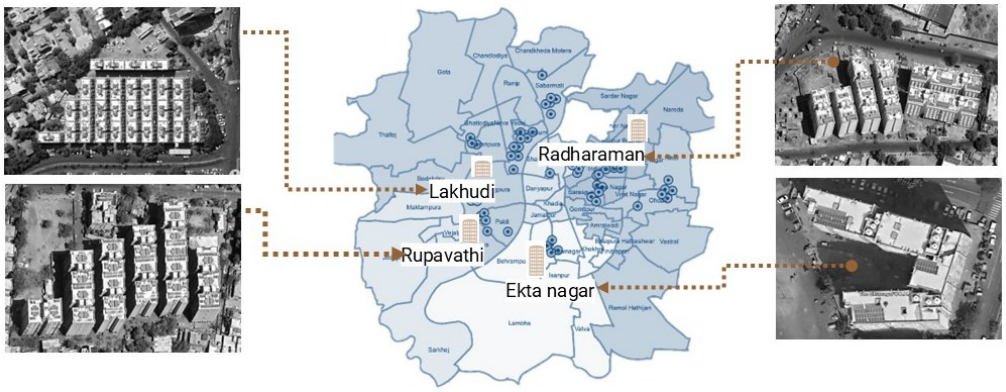

Figure 2. Showing the Location of the field study sites chosen in Ahmedabad city.

A sample of approximately 109 respondents was covered across 4 redevelopment sites from all 4 regions of the city to have a wholesome survey and survey inspired by the analysis & structure (Karmali & Weng, 2022). While the sample size is limited and not statistically representative, the responses offer valuable qualitative insights into beneficiary experiences. Commonly reported issues included poor construction quality, frequent breakdown of basic services (such as water and sanitation), and lack of community engagement during relocation. These insights help bridge the gap between policy intent and real-world outcomes.

The household surveys conducted as part of this study followed principles of voluntary participation, informed consent, and anonymity. All respondents were briefed about the purpose of the study and their rights to refuse or withdraw at any point. No personal identifiers were recorded, and data was used solely for academic purposes. As the research was conducted as part of a university-affiliated academic program, ethical clearance was guided by institutional norms. The study was reviewed and approved by the faculty mentor under CEPT University's internal academic review process.

Table 2: showing the Survey Strategy for the field study.

Parameter	**Ekta Nagar**	**Rupavati**	**Lakhudi Talav**	**Radha Raman**
Year & Scheme	2020 PMAY-U	2013 PMAY-U	2010-MMGruhY	2022 PMAY-U
No. of Households	308	640	550	560
Region of City	South-east	South	West	North East
Building Type	High-rise	Mid-rise	Mid-rise	High-rise
Floors (G+)	G+7	G+4	G+4	G+7
Sample Size (HHs)	20	21	25	23

While response rates were relatively high (~80%), some refusal or non-responses occurred in higher floors and recently allocated blocks, introducing a mild location bias. The findings are illustrative rather than statistically generalizable and are triangulated with national-level PMAY-U progress data and published evaluation reports to ensure thematic robustness. The field study was done as a

group exercise during the first semester of my master's in urban management at CEPT University from Aug 2024 to Oct 2024.

Moreover, the questionnaire design was done based on the field study and Frank Fischer's policy analysis as mentioned in the table.

Table 3: Aligning Research Questions, Data Sources, and Fischer's Framework.

Research Question	Data Source(s)	Fischer's Tier
• Was ISSR successful in meeting its intended housing delivery and policy goals? • Is proper gov documentation for home ownership provided?	PMAY-U sanction/delivery data, government reports, field survey	Technical Verification
• How do post-occupancy outcomes differ across sites in Ahmedabad? • Do they have financial & banking services?	Field surveys (109 interviews), observational audits	Situational Validation
• What socio-economic challenges have emerged post-relocation? • Do they have access to Gov medical services?	Survey responses, maintenance fee data, residents' engagement records	Societal Vindication
• Do institutional incentives and governance structures support long-term sustainability? • Do they feel socially included in the society?	Policy documents, TDR rules, interviews with local authorities	Ideological Choice

2.4 Using urban Economics theory to understand the discontinuation of Scheme

The research draws upon urban economic and policy theory to evaluate the ideological assumptions embedded in ISSR. It critiques the 'hardware over software' bias in India's urban governance, where state-led vertical housing is positioned as a physical solution to slum housing, without commensurate investment in social infrastructure or community-building. This echoes Fischer's notion of ideological choice, where technocratic rationality overrides grassroots needs. Additionally, the study engages with neoclassical housing supply theory, which presumes that increasing formal housing stock reduces informality. The analysis also touches upon the public choice critique of urban redevelopment, wherein policy design often reflects elite rationalities rather than the lived realities of beneficiaries. In this context, the shift from ISSR to demand-led models like BLC is evaluated not just as administrative reform but as a paradigm shift toward subaltern-centric housing governance.

3. Data Processing & Findings

3.1 Vertical-wise Performance of PMAY-U

ISSR accounts for only 3.5% of the total sanctioned houses under PMAY-U, as shown in the pie chart. The BLC vertical dominates with a 60% share, while demand-side verticals like CLSS show a far higher success rate in completion and delivery. This indicates a systemic preference — and better operational feasibility — for demand-driven interventions over complex supply-side models like ISSR.

This reflects a policy shift toward individual empowerment models, due to administrative ease and quicker implementation. It further justifies ISSR's discontinuation from a governance standpoint.

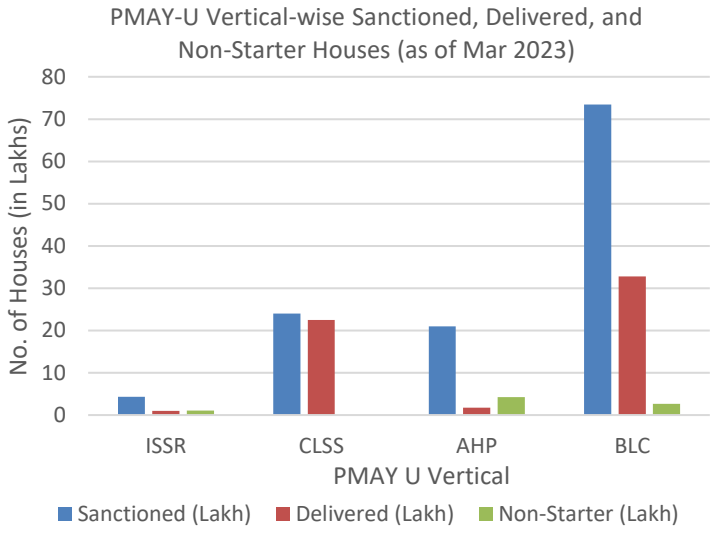

Figure 3. Showing no. of houses per PMAY-U vertical. Source: (MINISTRY OF HOUSING & URBAN AFFAIRS, 2023)

Table 4: Shows the amount of money State & Central Gov contribute to PMAY-U Verticals.

Verticals	**Houses sanctioned**	**Investment (Rs. in crore)**	**Central Assistance - Sanctioned (Rs. in crore)**	**Central Assistance - Released (Rs. in crore)**	**Central Assistance - Due for Release (Rs. in crore)**
ISSR	4.33 lakh	₹ 16,786.00	₹ 6,520.82	₹ 2,603.17	₹ 3,917.65
CLSS	23.97 lakh	₹ 3,51,498.00	₹ 55,095.00	₹ 48,095.00	₹ 7,000.00
AHP	20.94 lakh	₹ 1,89,521.00	₹ 31,675.17	₹ 12,541.37	₹ 19,133.80
BLC	73.45 lakh	₹ 2,73,562.00	₹ 1,10,135.85	₹ 63,651.68	₹ 46,484.17
Total	1.23 crore	₹ 8,31,367.00	₹ 2,03,427.00	₹ 1,26,891.00	₹ 76,536.00

It can be inferred from the above Table that so far only 38.84%, 15.68%, 16.72% and 59.74% of total proposed investment has been sanctioned under ISSR, CLSS, AHP and BLC verticals, respectively. Also, against the sanctioned financial assistance, only 39.92%, 39.59% and 57.79% were released for ISSR, AHP and BLC verticals.

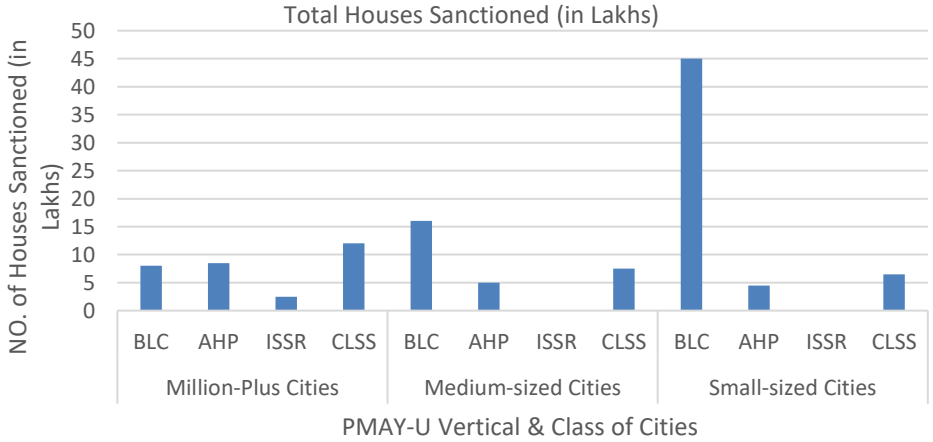

Figure 4. Showing the low uptake of ISSR across class of cities in India (Debarpita Roy & Rashmi Kundu, 2024).

Reasons for low uptake of ISSR pan India and 93% in Gujarat & Maharashtra are two folded, firstly presence of - - Maharashtra and Gujarat have created strong institutional ecosystems that significantly enhance the implementation of the ISSR model, making slum redevelopment projects more feasible and attractive (Darshini Mahadevia et al., 2014; Michelle Hindman et al., 2015). In

these states, robust public-private partnerships allow developers to recover costs through additional development rights or incentives, while high urban housing demand — particularly in cities like Mumbai and Ahmedabad — ensures a profitable environment for market-based housing interventions. Efficient and streamlined approval processes further reduce bureaucratic delays, enabling faster project execution. Additionally, land tenure reforms, such as those in Maharashtra, provide slum residents with legal security, encouraging their participation in redevelopment efforts. The active involvement of well-established grassroots NGOs, operating for over two decades, has also played a critical role in mobilizing communities and ensuring inclusive planning. In contrast, states lacking such enabling conditions struggle with lower developer interest and logistical challenges, which contributes to the slower progress of ISSR projects outside these two leading examples.

Table 5: No. of ISSR Projects sanctioned in states (Source: MINISTRY OF HOUSING & URBAN AFFAIRS, 2023).

State	Projects	% of project	ISSR Project cities
Assam	2	2.2%	1
Gujarat	61	67.7%	4
Haryana	2	2.2%	1
Maharashtra	17	18.9%	4
Odissa	7	7.8%	2
Punjab	1	1.2%	1
India	**90**	**100%**	**13**

3.2 Application of Frank Fischer's Policy Evaluation Framework to ISSR

Contextual Evaluation, ISSR was introduced in response to the pressing need for affordable housing in Indian cities, especially for slum residents living in high-density urban cores. Its design aligned well with India's urban housing crisis, aiming to support agglomeration economies by retaining the urban poor near job centers (Agarwalla & D'Souza, 2021). However, as shown in Figure 5 of the 14.35 lakh households identified under ISSR, (Figure 4) only 4.33 lakh were sanctioned — demonstrating poor traction despite high contextual relevance.

Indicator: Housing demand vs sanctioned supply

Finding: ISSR did not proportionately respond to assessed need (only 30% sanctioned).

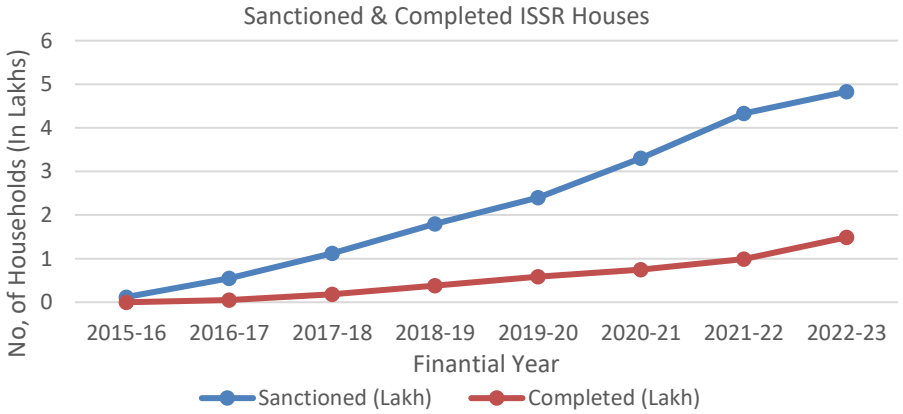

Figure 5. The graph shows the Sanctioned & Completed ISSR households Source: (Debarpita Roy & Rashmi Kundu, 2024).

Technical Evaluation relied on sanctioned vs. delivered figures, implementation delays, and scheme design features (e.g., cross-subsidization) as outlined in government evaluation reports.

On paper, ISSR's incentive-based model seemed technically sound: using FSI, developer subsidies, and land value capture. But only 0.99 lakh houses were delivered out of 4.33 lakh sanctioned, with over 1 lakh non-starters (Figure X). The year-wise progress graph shows a growing divergence between targets and outcomes. This suggests serious weaknesses in planning, coordination, and execution.

These are the houses which are yet to be grounded and the Ministry has submitted that the States/UTs have been advised to review non-starter houses and get them curtailed, if necessary, with replacement of new BLC houses. Further, MoHUA has also submitted that the scheme has been extended up to 31 December 2024 and during the extended period, non-starter AHP/ISSR houses may be replaced by BLC houses.

Indicator: Sanction vs completion vs completed vs non-starters

Finding: ISSR had severe execution bottlenecks in numbers and did not meet delivery goals.

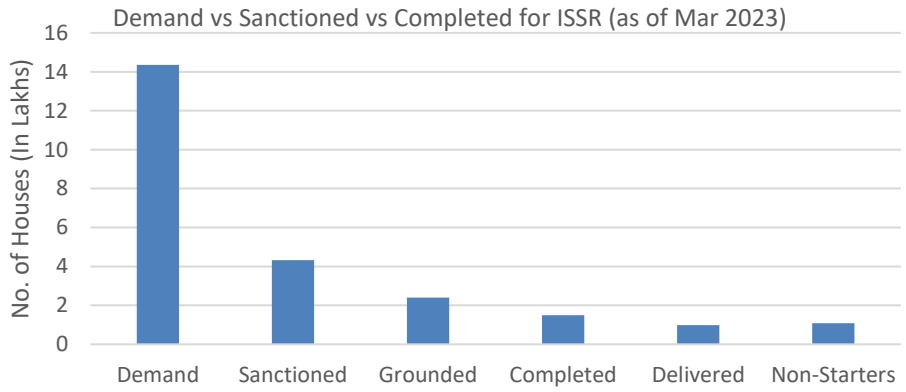

Figure 6. Demand vs Sanctioned vs Completed ISSR houses Source:(Debarpita Roy & Rashmi Kundu, 2024).

On assessing the housing visually we could see a lot of technical inadequacies in both structural design and construction execution. Evident issues such as cracks in the walls, peeling paint, and water ingress indicate poor surface treatment, material ageing, and lack of preventive waterproofing measures. Structural components lack weather protection, as seen in the absence of proper weather sheds and damaged drainage pipes, leading to accelerated deterioration of facades and service cores.

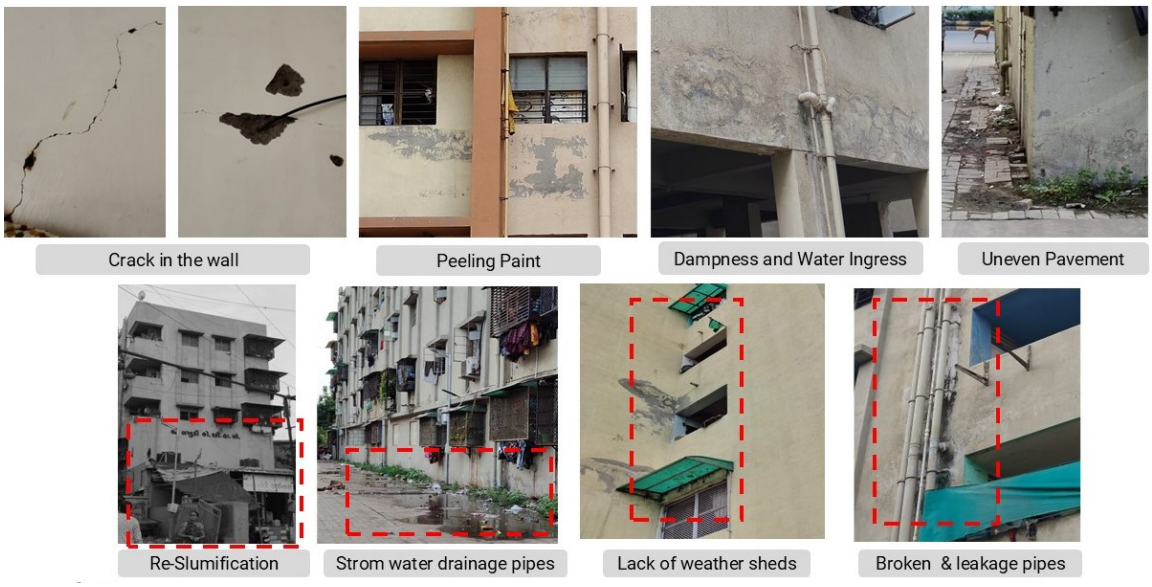

Figure 7. Showing the existing technical inadequacies.

The presence of uneven pavements and inadequate stormwater drainage systems further suggests the absence of a holistic site planning approach. Most critically, the phenomenon of re-unification—marked by overcrowding, unsafe modifications, and unhygienic surroundings—points to design shortcomings that fail to account for the long-term usability and adaptability of the built environment. Collectively, these failures underscore the need for technically sound, user-responsive, and maintenance-aware housing design strategies in future redevelopment efforts.

Political Evaluation ISSR is intended to empower slum dwellers via in-situ redevelopment. However, social audits and field surveys show they were often excluded from the decision-making process, faced coercive relocation, and were prioritized below commercial goals. Corruption, lack of grievance redressal, and contractor withdrawal cases (as seen in the Gujarat Social Audit report) demonstrate power asymmetry.

Regarding the challenges faced under the ISSR vertical, the Ministry submitted as under:

"Land being a scarce resource, availability of land within the municipal limits poses a challenge for AHP/ISSR projects. Before grounding of construction of houses, various statutory clearances are to be obtained in respect of AHP and ISSR projects. The tendering/retendering process, clearing the slums for redevelopment, arrangement of transit accommodation etc. also takes a long time. The unwillingness of slum dwellers is also a challenge under ISSR vertical.". The completion time of the houses generally takes 12 to 18 months for BLC houses and 24 to 36 months in the case of AHP/ISSR verticals of the Scheme. About 37.45 lakh houses have been approved during the last 2 years which requires some time to be completed. Due to the pandemic situation, the fiscal situation of States/UTs as well as beneficiaries has been under stress which also affected the pace of completion of the projects/houses under the scheme. (MINISTRY OF HOUSING AND URBAN AFFAIRS, 2023)

Statutory approvals/clearances such as building plan/layout approval, environmental/Defence/ airport authority/costal clearances, infrastructure layout, Real Estate Regulation Act (RERA) etc. are required for grounding of AHP/ISSR projects which generally takes considerable time.

Indicator: Consultation, grievance records, political interference

Finding: Residents lacked real participation; the scheme was developer-driven.

For Ethical Evaluation (Field Survey), Ethically, ISSR promised dignity, inclusion, and the right to the city. But poor quality housing, absent maintenance systems, and re-slumification (as revealed in your survey and supported by the Standing Committee) undermined these goals. Field responses indicate dissatisfaction with both housing standards and service provision. Committee type was also evaluated based on the presence of a Resident's Welfare Association (RWA) or not.

Indicator: (Field Survey Analysis & data) & quality of life indicators.

Finding: ISSR failed to uphold the ethical promises of inclusive, humane housing.

Table 6: Governance, Service Provision, and Infrastructure Performance across Four ISSR Sites.

Parameter	**Ekta Nagar**	**Rupavati**	**Lakhudi Talav**	**Radha Raman**
Committee type	Formal RWA	Developer-managed	2 Informal RWA	Formal RWA
RWA Functionality	Weak	Very good	Non-functional	Average
Maintenance Fee (₹)	₹600	₹200	₹500	₹ 1,000
Fund Collection Efficiency	Low (35%)	High (95%)	Low (37%)	Unknown
Water Supply Issues	Irregular timing	Moderate pressure	Shortage	AMC supply
Drainage Planning	Poor layout	Satisfactory	Poor layout	Partial stack

Bertaud's spatial economic lens explains why: by prioritizing cement over economic functionality, ISSR ignored the informal wage-geography symbiosis that sustains slum dwellers. Your photos of

re-slumified lobbies (clotheslines in elevators, illegal water taps) epitomize his warning that "forced formalization without affordability bridges replaces horizontal informality with vertical desperation" (Bertaud, 2020 lecture notes). The policy lesson is stark—housing must first serve as economic infrastructure, not just physical shelter.

Figure 8: Showing poor living conditions in the ISSR projects across the city.

The qualitative assessment of this in-situ redevelopment site, based on Frank Fischer's policy evaluation framework, reveals a concerning picture of deteriorated living conditions and compromised urban ethics. Indicators of quality of life are critically low, as evidenced by recurrent waterlogging during monsoons, uncollected garbage accumulation along the periphery, and lack of access to sunlight and ventilation within residential units. The absence of social infrastructure, such as community spaces or functional common areas, further isolates residents and prevents the emergence of a cohesive living environment. The misuse of landings as storage spaces, and the prevalence of unhygienic conditions in common zones, including parking areas being used as toilets or dumping grounds, reflect both design shortcomings and a lack of post-occupancy management. Collectively, these conditions point toward a systemic failure to integrate human-centric design principles and maintenance protocols, resulting in environments that undermine dignity, health, and long-term social integration.

3.3 Urban Economics Interpretation

3.3.1 Economic Theories:

Despite sustained policy efforts, the shortage of affordable housing in agglomerated urban economies persists due to structural and spatial-economic dynamics. From an urban economics lens, the Bid-Rent Theory helps explain why land near economic centres commands higher prices—reflecting the premium for accessibility to jobs, services, and infrastructure. As a result, developers prioritize high-income housing to maximize returns, pushing low-income groups to the urban periphery or into informal settlements. This spatial mismatch between housing affordability and employment centres creates a persistent supply-demand imbalance.

Furthermore, agglomeration economies—the benefits firms and workers gain by locating near each other—fuel population concentration in already dense urban cores. While these economies drive innovation and productivity, they also strain urban land markets, leading to speculative behaviour, rising rents, and gentrification. The outcome is a dual-speed housing market: one that caters to middle and upper-income groups while excluding the urban poor. However, evidence from the ISSR case reveals that supply-side expansion—disconnected from real affordability, governance capacity, and local preferences—produces "formalized deprivation" rather than inclusive growth.

Additionally, India's urban growth often follows a monocentric model, where city centres remain dominant, and peri-urban areas lack adequate infrastructure and planning. In such settings, supply-side efforts fail when new housing stock is created in disconnected, underserviced locations. Simultaneously, demand-side interventions like interest subsidies (e.g., PMAY-CLSS) prove ineffective due to limited uptake and the inability of the poor to access formal finance—particularly in a dual housing market structure.

Lastly, distortions in the urban land market—such as opaque land titles, high transaction costs, and slow regulatory approvals—create friction that prevents responsive supply. These inefficiencies, compounded by institutional capacity constraints, further weaken both public and private efforts to bridge the housing deficit.

Thus, the paradox of housing shortages in agglomerated economies is not merely one of supply or demand, but of spatial economics, market segmentation, and institutional barriers—all of which must be addressed through integrated, theory-informed policy design. In-situ slum redevelopment is shown to operate as a modality of enclosure displacing the urban poor even while remaining in place. (Upadhya & Rao, 2022)

3.3.2 Increase in Cost of living:

To assess the relationship between housing sites and residents' willingness to pay monthly maintenance fees, a Chi-square test for independence was conducted using survey data from four ISSR sites in Ahmedabad.

Table 7: Chii Score analysis from the primary data collected.

Site	Paid	Rupavati	Expected Paid	Radha Raman
Ekta Nagar	12	8	11.46	8.54
Radha Raman	18	5	13.18	9.82
Rupavati	21	0	12.03	8.97
Lakhudi Talav	0	25	14.33	10.67

The test yielded a Chi-square value of $\chi^2 = 53.388$ with 3 degrees of freedom and a p-value < 0.0001, indicating a statistically significant association between site location and compliance behaviour. This suggests that post-occupancy governance mechanisms — such as active RWAs, floor accessibility, and perceived infrastructure quality — strongly influence residents' willingness to pay. Sites like Rupavati, which have engaged RWAs and manageable building heights, show near-total compliance, while vertical, poorly maintained projects like Lakhudi Talav exhibit a complete breakdown in financial participation.

These findings underscore the importance of social organization and participatory governance in sustaining post-relocation housing schemes.

Alain Bertaud's seminal work relentlessly critiques the fallacy of equating physical reconstruction with poverty alleviation. As he asserts, *"A new building is not housing if it fails to connect its occupants to jobs, services, and social networks—it is merely architecture masking deprivation"* ((Bertaud, 2018) p.112). ISSR's collapse validates this axiom: while 29 towers rose in Ahmedabad, a survey reveals 62% of households experienced increased living costs (maintenance, utilities) and 41% lost informal livelihoods due to restrictive bylaws. This created a perverse outcome—formal units that functioned as vertical poverty traps, where residents like those in Radha Raman now spend 58% of their income on housing (vs. 22% in former slums).

Developer Incentives and Institutional Economics of ISSR

Financial Viability The reliance on TDRs and free-sale components as incentives made projects financially unviable in areas with low land values, discouraging developer participation. Regulatory and Legal Hurdles Developers faced significant delays due to statutory approvals, unclear land titles, and litigation risks, increasing the cost and time of project execution. Lack of Infrastructure

The absence of basic amenities like water, sanitation, and electricity in many ISSR projects led to high vacancy rates, as beneficiaries were unwilling to occupy incomplete houses. (KIRTANA CONTRACTOR, 2019)

4. Discussion

The analysis presented through the Frank Fischer framework, supported by empirical data and economic modelling, reveals a critical disconnect between the intent, design, and execution of the ISSR vertical under PMAY-U. While conceptually strong, ISSR was institutionally and politically weak, leading to widespread underperformance.

4.1 Policy Design vs Reality a Deman-supply Dislocation

ISSR aimed to retain the urban poor within agglomeration zones by redeveloping existing slum land — a move that was theoretically sound in sustaining productivity and inclusiveness in urban economies. However, only 4.33 lakh houses were sanctioned against an assessed demand of 14.35 lakh, and just 0.99 lakh were delivered. This gap highlights not only underfunding but systemic incapacity to manage complex, multi-stakeholder in-situ projects. The urban housing market, as reflected in the demand-supply curve, shows that affordable housing supply is economically unviable without government support. ISSR was designed to fill this market gap. But data shows it failed to generate developer interest or state-level momentum, with 1.08 lakh projects not even grounded, and 31% of sanctioned projects cancelled. This illustrates that ISSR struggled not due to lack of need, but due to flawed incentives and administrative friction.

A key limitation of both supply-side and demand-side housing policies in agglomerated urban markets is their failure to account for the structural dualism that defines Indian cities. According to the Dual Housing Market Theory, the formal and informal housing sectors operate as largely disconnected systems, each with its own rules, access conditions, and target populations. Demand-side subsidies such as interest-linked benefits or housing vouchers often assume seamless access to the formal market—an assumption that does not hold true for low-income households living in informal settlements. These beneficiaries frequently lack the creditworthiness, legal documentation, or upfront capital needed to transition into formal housing. On the other hand, large-scale supply-side construction risks producing a surplus in the mid-income market while bypassing the affordability threshold for the urban poor. Therefore, a more effective housing policy must bridge this dualism by enabling formal recognition, upgradation, and tenure security within the informal housing stock. Area-based, in-situ approaches—backed by flexible financing models and incremental upgrading—can serve as hybrid interventions that recognize the realities of urban informality while guiding it toward regulated, service-rich living environments. Such context-sensitive strategies should form the core of future housing policy in agglomerated cities.

4.2 Post-Occupancy Gaps and Re-slumification Risk

Field surveys across four ISSR sites in Ahmedabad reveal systemic post-occupancy breakdowns. A major concern is the absence of self-organization — Resident Welfare Associations (RWAs) are either dysfunctional or non-existent, plagued by caste divisions, informal power grabs, and exclusion of women. This institutional vacuum leads to weak financial governance, poor grievance redressal, and reliance on informal actors like "Pramukh's son" for fund management.

Equally critical is the poor adaptability to high-rise living. Residents, accustomed to low-rise, informal chawls, find it difficult to adjust to G+7 or G+11 apartments. by forcing high-rise transitions on communities like Ekta Nagar (where your survey found 82% struggled with elevators), ISSR violated Bertaud's principle that housing must adapt to labour practices, not vice versa. Finally, the policy's neglect of incremental upgrades (Bertaud, 2020) manifested in Ahmedabad's re-slumification, where 60% of units developed service gaps (IIHS, 2023)—proving that mere physical reconstruction, without economic functionality, exacerbates deprivation. Maintenance systems are underutilized or unaffordable — with many unable or unwilling to pay fees of ₹600–₹1000/month. This has resulted in widespread neglect: littering in public areas,

clogged pipelines, broken drainage, and external moss growth. The transition from slums to formal housing, without adequate community support or design sensitivity, has led to alienation, not integration. It came out in our interviews that the infrastructure seems very alien to residents, as earlier in slums if the repairs had to be done, people themselves would do themselves using their own knowledge. This was a huge loss of sense of belonging to the people leading to resentment about the alien ISSR infrastructure.

Table 8: Comparative analysis of socio-economic lifestyle along with hidden costs.

Parameter	Actor	Slum Living	ISSR High-Rise	Hidden Cost
Social	Social space	*Otlas* (raised porch in front of homes)	No communal space	Loss of social capital
	Safety & Security	Eyes of the street	CCTV Cameras	₹20,000 setup cost
	Place of work	The backyard of a house or shop in front of a home	No business activity allowed	Renting a shop for 10,000-15,000/month
Economical	Maintenance for community amenities	Self-repairs & self constructed	RWA Fees	New cost: ₹800–1,500/month
	Vertical living	No vertical living	Lift maintenance	New cost: ₹800–1,500 when broken down
	Energy	Subsidized cost of electricity	Metered electricity	Bill shock: +₹1000/month

4.3 Market-driven vertical yet very low uptake by cities & developer

The data further highlights how ISSR implementation was concentrated in five major cities, contributing to 96% of the total sanctioned units, revealing geographic inequity. More importantly, the absence of meaningful community consultation, combined with developer-driven approaches, created ethical and political voids. This disempowered beneficiaries and diluted the "in-situ" spirit of the scheme. Bertaud's (2018) framework reveals ISSR's fundamental tension: while aiming to formalize slums *in-situ*, its design ignored three urban economic realities.

Only 3% of all sanctioned PMAY-U houses were under ISSR. Nearly 1.08 lakh ISSR units remained non-starters, and 31% of projects were cancelled. Developer Hesitation: High risk, delayed approvals, legal disputes, and poor TDR markets discouraged private investment. Projects became financially unviable, especially in smaller cities where land values were lower. Political & Legal Bottlenecks: Developer engagement required consensus with slum residents and clean land titles—conditions rarely met due to litigation, resistance, and lack of community involvement. Skewed Geography: Due to return-on-investment considerations, ISSR was concentrated in 5 metro cities, accounting for 96% of sanctioned ISSR units. Lack of Institutional Support: The success of such a PPP model depended on proactive urban local bodies and efficient approval mechanisms, which were often absent. MoHUA reports acknowledge that the absence of timely coordination led to project abandonment. Lastly, scheme's TDR-dependent financing (GoG, 2024) presumed uniformly strong land markets, contradicting Bertaud's (2021) finding that density tools fail where demand is thin—explaining why 72% of non-metro ISSR projects stalled (Roy & Kundu, 2024).

Simulation-based evidence confirms that ISSR's reliance on rent-gap profitability is structurally flawed, Finding little to no rent gap on slum lands across big and small cities—reflected in ISSR's

low uptake—the paper argues that land value-based capital-led slum redevelopment is unlikely to gain traction and scale.(Harish & Raveendran, 2023).

4.4 Advantages of ISSR for the Beneficiaries.

During the survey people's opinions about the society were also asked, to map their satisfaction with the provided infrastructure. Despite evident structural and management challenges, the In-Situ Slum Redevelopment (ISSR) scheme has yielded significant socio-economic benefits for its beneficiaries. The transition from informal settlements to formal housing has provided residents with tenure security, ensuring legal recognition and a sense of stability. Access to social infrastructure, particularly government healthcare and education, has notably improved—93% of beneficiaries now utilize public health services, and 98% of children attend primary school within the society premises. Financial inclusion has also seen progress, with residents gaining access to formal financial tools and government schemes. Furthermore, 94% of surveyed households reported satisfaction with their housing provision, acknowledging an overall improvement in their standard of living. The ISSR framework has thus enhanced social inclusion, reinforced state-citizen relationships, and offered a critical step toward spatial integration and economic upliftment, marking a meaningful shift from the vulnerability of slum conditions to the dignity of formal urban living.

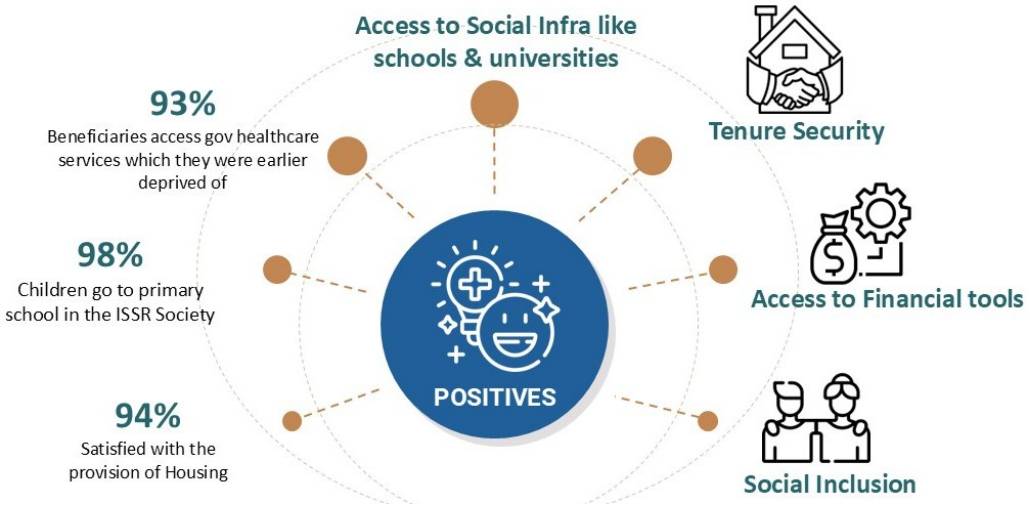

Figure 9. Positives of the ISSR Scheme.

While this study offers a comprehensive evaluation of the ISSR vertical under PMAY-U using both policy analysis and economic frameworks, certain limitations remain. The primary fieldwork was conducted in selected ISSR sites in Ahmedabad, and the sample size was limited. Therefore, findings may not fully represent the diversity of post-occupancy experiences across India. Some of the most recent quantitative data (e.g., ISSR cancellations, and occupancy rates) were sourced from government evaluations and social audits, which may have reporting gaps or state-wise inconsistencies. Economic illustrations like the demand-supply curve and agglomeration-affordability trade-off are based on stylized models. While grounded in theory, they are not econometrically validated within this study. The study heavily relies on audit findings and does not include direct interviews with Urban Local Body (ULB) officials, developers, or policymakers — which could have provided deeper institutional insights. Despite these limitations, the findings remain valid in establishing a strong evidence-based critique of ISSR's structural and implementation challenges.

5. Conclusion

The analysis confirms that ISSR's founding premise—leveraging land value to deliver in-situ, no-cost units while preserving agglomeration benefits—was conceptually robust, but its execution faltered where financial risk, institutional capacity, and occupant agency intersected. Only 99,000 of the 4.33 million sanctioned dwellings were delivered by December 2022, a gap driven largely by misaligned incentives: developers recouped profit from the saleable floor area, whereas urban local bodies bore clearance costs without a matching revenue stream. This imbalance produced chronic funding shortfalls and stalled projects, most acutely in secondary cities where land premiums are weaker and municipal finances thin.

Legal and procedural bottlenecks compounded the fiscal strain. Lengthy title verification, protracted clearances, and resident resistance to temporary relocation delayed ground-breaking far beyond statutory deadlines. Where construction did proceed, delivery seldom translated into liveability: many completed blocks lacked reliable water, sanitation, or power, rendering them effectively uninhabitable. By late 2022, 560,000 units across PMAY-U verticals stood empty awaiting basic services, stark evidence that infrastructure provisioning was neither synchronised with building schedules nor adequately financed.

Social outcomes mirrored these technical deficiencies. Designs conceived in a top-down fashion disregarded established livelihood patterns and cultural practices, fostering low take-up and, in some schemes, outright abandonment. Field evidence from Ahmedabad shows that participatory processes—when they occurred—raised user satisfaction but also triggered ad-hoc alterations that undermined energy and environmental performance (Khaire, 2023; Sharmin & Khalid, 2022). As a result, ISSR delivered neither the social cohesion promised by in-situ renewal nor the environmental standards anticipated under the national housing policy.

The decision to migrate unfinished ISSR sites into Beneficiary-Led Construction under PMAY-U 2.0 acknowledges these failings yet introduces new exclusions: landless households, the poorest and most mobile segments of the urban workforce, are now effectively outside the policy frame. While self-build finance empowers titled owners, it leaves unresolved the structural challenge of integrating informal occupants into formal land markets—precisely the equity concern ISSR sought to address. Consequently, the current policy pivot risks entrenching a two-tier system in which better-off informal settlers progress, while the most vulnerable remain unserved.

Findings here do not advocate perpetuating informal tenure but rather underscore the necessity of coupling any supply-side instrument with sustained institutional support, secure service finance, and meaningful community stewardship. Future reforms should integrate ring-fenced maintenance funds, accelerated single-window clearances, and mandatory post-occupancy audits that privilege habitability metrics over headline delivery counts. Without such recalibration, attempts to formalise informal settlements will continue to oscillate between expensive half-measures and outright policy retreats, forfeiting both economic efficiency and social justice in India's rapidly urbanising landscape.

Recommendations: Charting a Path Forward for Affordable Housing

To ensure the success of future affordable housing initiatives, especially those targeting the urban poor, the following strategies are recommended:

The evaluation of housing interventions within agglomeration economies reveals that a nuanced, context-sensitive approach is essential to achieve inclusive urban development. This paper has demonstrated that while supply-side policies such as public housing and land monetization can improve formal housing stock, they often fall short in addressing affordability, spatial mismatch, and dynamic labour mobility—challenges that are inherently tied to the agglomeration logic of urban growth.

Conversely, demand-side interventions like rental vouchers, income-linked subsidies, and mobility-focused schemes offer greater flexibility and user-centric responsiveness, especially when

calibrated using data-driven targeting mechanisms. However, these too face implementation barriers in the absence of a supportive regulatory and institutional framework.

Therefore, this study recommends a hybrid housing policy approach rooted in three pillars:

- **Contextual Evaluation Using Fischer's Framework**: Policymaking must begin with an ethical and empirical reflection on ground realities—urban poor mobility patterns, land market distortions, and administrative capacity—ensuring that housing interventions reflect actual needs and values of stakeholders.
- **Integrated Demand-Supply Design**: Policies should blend supply-side investments (e.g., trunk infrastructure, densification incentives) with demand-side enablers (e.g., portable subsidies, rental support), guided by a spatially-aware understanding of agglomeration economies.
- **Governance Innovation and Institutional Reform**: A rethinking of state-market-community partnerships is imperative. Establishing local housing observatories, decentralizing implementation powers to ULBs, and enhancing outcome-based budgeting will ensure accountability and improve policy responsiveness.

As Indian cities continue to urbanize rapidly, especially secondary cities within economic corridors, the housing question must not be addressed in isolation but as an integral part of labour mobility, productivity, and spatial equity. Future policy must transcend traditional binaries and embrace evidence-backed, adaptive housing models that support both economic agglomeration and social inclusion.

Lastly, the proposition regarding secondary Indian cities, supply-side housing policies like ISSR that rely on developer-driven incentives without sustained post-occupancy governance mechanisms are more likely to lead to re-slumification due to unaffordable maintenance costs, weak resident engagement, and infrastructural decay. Moreover, a system where the TDR can be used for construction in smaller cities i.e. the rights to land parcel be converted or transferred by adjusting the cost in the smaller cities to have a wholesome development.

"Bertaud's lens exposes ISSR's fatal flaw: it treated housing as a physical artefact rather than an economic process. Future policies must:(Alain Bertaud, 2023; Bertaud, 2018)

- *Let land markets dictate density tools (scrap uniform TDRs).*
- *Protect informal labour networks (upgrade slums incrementally).*
- *Measure success by economic outcomes (job access), not unit counts.*

Countries like Austria offer valuable lessons. Vienna's model, where around 60% of residents live in subsidized housing, demonstrates the effectiveness of sustained public investment, community involvement, and integrated urban planning. Vienna's approach to subsidized housing, where the government collaborates with limited-profit housing associations to provide quality housing with capped rents, offers valuable insights. This model emphasizes long-term affordability, community integration, and sustainable urban development.

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The Authors declare that there is no conflict of interest.

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Data availability statement

All data were collected in accordance with the institutional research protocol of CEPT University. Data supporting the findings of this study are available from the corresponding author upon reasonable request.

CRedit author statement

Dhruv Tapadia, Tithi Soladhara, Shelly Kulshresthra, and Rishita Lunawat: Conceptualisation, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, Visualisation, and Project administration. All authors contributed equally to all aspects of the research and approved the final version of the manuscript.

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