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How Rooftop Gardening Strengthens Food Security and Urban Resilience in Post-Pandemic Dhaka

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ABSTRACT

Dense South Asian cities experienced severe food insecurity, income loss, and psychological strain during COVID-19, yet household-level evidence on rooftop gardening as crisis adaptation remains limited. This study investigates how the pandemic shaped rooftop gardening adoption and socio-economic resilience in Mohammadpur, Dhaka. A quantitative cross-sectional survey of 150 households compared 90 gardening adopters with 60 non-adopters, using descriptive statistics, t-tests, chi-square tests, and exploratory logistic regression. Findings show that 59.33% of households experienced pandemic-related income loss, while adopters reported higher peak stress than non-adopters but significantly lower current stress. Female respondents were 3.6 times more likely to adopt gardening, and households with full rooftop access were approximately 25 times more likely to garden than those without access. Food worry, gender, peak stress, and rooftop access emerged as key predictors, while 83.33% of respondents remained unaware of government or non-government urban agriculture initiatives. The findings demonstrate that rooftop gardening can reduce household food concerns, support mental wellbeing, strengthen women's food-related agency, and improve resource efficiency in dense neighbourhoods. By linking community microagriculture with urban economic resilience, the study offers practical guidance for inclusive planning, urban food governance, and sustainable urban management.

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Highlights:

- Stress doubled adoption, showing crisis shocks shaped home food practices.
- Full roof access raised adoption 25-fold, exposing spatial barriers clearly.
- Women were 3.6-times likelier adopters, raising household food agency locally.
- Gardening reduced stress, supporting recovery in dense homes after lockdowns.
- Gardens cut grocery costs, also boosting resilient urban household economies.

Contribution to the field statement:

This study advances urban resilience research by showing how pandemic stress transformed rooftop gardening from hobby into household survival strategy in Mohammadpur. Using evidence from 150 households, it reveals links with food security, lower stress, women's agency, and cost savings, offering guidance for inclusive urban agriculture policy and economic resilience.

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1. Introduction

The rapid global spread of COVID-19 between December 2019 and March 2020 disrupted 186 countries, profoundly affecting daily life and urban systems (Lal, 2020). Specifically, the infection was anticipated to spread rapidly in densely populated urban areas, prompting instructions for people to stay at home to avoid close contact and curb the airborne spread. Due to restrictions on urban mobility, the supply chains for daily needs were severely hampered. Urban food insecurity intensified as a primary impact and was catalysed by disruptions in the supply chain, restricted physical and economic access to nourishment, and a rise in food waste. Consequently, severe food insecurity among people in urban areas was projected to rise dramatically, potentially doubling from 135 million to 265 million by the end of 2020 (Lal, 2020). Simultaneously, the pandemic placed unprecedented pressure on sustainable fresh food systems, compounding existing challenges such as rapid urbanisation, population growth, climate change, and resource scarcity (Khan et al., 2020).

The rapid pace of global urbanisation has transformed cityscapes into dense hubs of activity, and as Bangladesh's capital, Dhaka, is among the world's most densely populated megacities, the conversion of green spaces into concrete infrastructure has reached critical levels. Dhaka has experienced a dramatic reduction in green spaces, with open areas decreasing from 44.8% to 24.1% over the past 30 years (Momtaz, 2020). Within this urban sprawl, Mohammadpur represents a microcosm of these challenges, characterised by high residential density and limited access to traditional agricultural land. The area is heavily dependent on the nearby Mohammadpur Town Hall, Kacha Bazar, Krishi Market, Kacha Bazar, Shia Masjid, Kacha Bazar, Rayer Bazar, Kacha Bazar, Geneva Camp, Bazar, Bosila, Kacha Bazar, etc. During the COVID-19 pandemic, most of the food supply cores were access-restricted to control the spread of infection, resulting in severe disruptions to the fresh food supply chain in the Mohammodpur area.

1.1. History of Rooftop Gardening

Dating back to the Neolithic Era (8000–4000 BC), early civilisations utilised soil and living grasses to insulate structures in harsh, extreme climates. They introduced a type of vernacular architecture, often called "sod-roofs," which was particularly common in the Arctic and in the semi-arid continental lands of Central Asia, where building materials were scarce (Bellini et al., 2024).

Gradually, over time, rooftop gardening took on monumental and aesthetic forms, with the Ziggurats of ancient Mesopotamia, built between 4000 and 600 BC, cited as an early example of roof gardens (Ghosh, 2021). The most famous historical example from this era is the Hanging Gardens of Babylon, one of the seven wonders of the world, which featured elaborate plantings on landscaped, elevated terraces (Ghosh, 2021).

The invention of reinforced concrete allowed engineers to design wide, flat roofs, creating new opportunities for elevated functional and ornamental gardens. In 1927, pioneering architect Le Corbusier famously included roof gardens among his "Five Points of Modern Architecture," citing their recreational value and their ability to protect concrete from temperature fluctuations (Bellini et al., 2024). The rapid urbanisation in developing countries has transformed rooftop gardens from an architectural luxury into an environmental imperative, helping counter the loss of natural green spaces and making urban agriculture vital for improving food security and combating ecological damage (Bellini et al., 2024). Modern urban rooftop gardens are widely viewed as an innovative strategy to combat the scarcity of urban agricultural land. Cultivating herbs and vegetables on roofs allows for sustainable local food production, reduces household waste, and mitigates the urban heat island effect (Gajbe, 2020). Furthermore, modern engineering advances, such as Rooftop Greenhouses (RTGs), integrate soil-less systems into buildings to improve water, energy, and carbon dioxide efficiency in high-density areas(Pons et al., 2015).

1.2. Rooftop Gardening as a Coping Mechanism During COVID-19:

Bangladesh is a largely agricultural society that has rapidly urbanised after its liberation in 1971. Dhaka became the capital and attracted people from surrounding areas seeking better civic amenities,

education, healthcare, administrative jobs, and employment in the garment sector, banking, and other lucrative industries. Thus, the city became a hotbed of opportunity. Surrounded by rivers that have shaped its history for over 400 years, the capital has become the central hub for many seeking to adapt to a modern lifestyle (Safayet et al., 2017). However, the DNA of farming remains deeply ingrained in the people. A cultural thread that connects them to an agro-based urban lifestyle. This practice is evident in urban government housing, where planned green spaces are often utilised for gardening and raising domestic animals.

This is not the case in the private housing sector, though. Due to high land prices, a sharp decline in urban green spaces, and extreme population density, ground-level gardens have become a luxury. This has led residents to opt for rooftop gardening to satisfy their agricultural inclinations (Safayet et al., 2017). A hot, humid climate, access to good soil and a wide variety of plant species have made rooftop gardening fairly easy to maintain and reasonably profitable. Studies have shown that these gardens provide tangible economic and nutritional advantages to households, allowing them to offset daily grocery costs and generate modest income (Tabassum & Rahman, 2022). Residents grow almost every possible vegetable and fruit on their roofs, with a long history of success. Ultimately, this has transformed urban rooftop gardening into a sustainable, community-engaged initiative in Dhaka.

The COVID-19 pandemic opened new opportunities to support rooftop gardening. What was once an informal practice, and sometimes merely a hobby, rapidly became an encouraged reality. During the lockdowns, rooftop farming acted as a critical safety net; Research reveals that a significant majority of rooftop gardeners in Dhaka relied directly on their harvests to maintain household food security and adapt to sudden supply chain disruptions (Bhuiyan & Ferdous, 2021). At the city level, mobility restrictions, social distancing measures, and the shutdown of restaurants and public canteens introduced by governments and local administrators have rapidly changed food consumption habits, food baskets, and diets (Pulighe & Lupia, 2020).

Rooftop gardening emerged as a significant coping mechanism during the COVID-19 pandemic, offering both mental health benefits and food security solutions. It also increased women's participation in household food-related decisions, as many families involved women in gardening, food management, and related domestic decision-making. Rooftop gardening has been identified as a therapeutic activity that can significantly reduce anxiety and stress levels. Studies have shown that engaging in gardening activities can lead to lower anxiety scores, particularly among individuals who have been gardening for extended periods (Gerdes et al., 2022).

The pandemic highlighted the importance of vertical urban spaces, such as rooftop gardens, as place-making elements that may serve as both private and semi-public spaces. It has been realised that these private and semi-public spaces can offer unique qualities in terms of location, accessibility, and experience and become valuable components of urban landscapes (Ehab & Heath, 2024).

Rooftop gardening contributes to economic savings and income generation by reducing the need for market-bought vegetables and enabling surplus sales. In India, for instance, the adoption of rooftop gardening increased from 6% to 30%, significantly improving household access to fresh vegetables and dietary diversity (Singh et al., 2025). In Bangladesh, women involved in home gardening reported a 40% increase in annual income compared to non-adopters, enhancing their decision-making power and societal status (Akter et al., 2020).

This Research examines, through the lens of Crisis-Induced Behavioural Adaptation, how this may influence a shift in human attitudes toward adopting specific activities, such as rooftop gardening, into their daily lives. Using the Theory of Planned Behaviour, this study examines the notion of self-sufficiency that led to action to adopt rooftop gardening. This Research compared adopters with non-adopters to determine how rooftop gardening emerged as an important coping strategy during the pandemic, how it contributed to reduced household grocery expenses, and how it was associated with improved psychological wellbeing, including lower stress levels and reduced food-related concerns. The practice also empowered women by increasing their role in household decision-making.

While rooftop gardening provided numerous benefits during the pandemic, it also faced challenges, including accessibility and the need for technical knowledge in urban horticulture. Additionally, the

benefits of gardening were not uniformly experienced across different demographics and regions, highlighting the need for inclusive policies to ensure equitable access to these benefits (Chen-Fa Wu et al., 2023). Furthermore, the therapeutic value of gardening, while significant, may not fully address the broader mental health challenges posed by the pandemic, necessitating a comprehensive approach to mental health care (Chen-Fa Wu et al., 2023).

2. Literature Review:

2.1. The Theory of Planned Behaviour (TPB):

The Theory of Planned Behaviour, developed by Icek Ajzen**,** is a psychological framework that explains how individuals' intentions to engage in specific behaviours. It postulates three conceptually independent determinants of intention: attitude, subjective norms, and perceived behavioural control (Ajzen, 2020). This theory extends the earlier Theory of Reasoned Action by incorporating perceived behavioural control to account for behaviours not entirely under volitional control (Conner, 2020). TPB has been widely applied across various domains, including consumer behaviour, professional development, and environmental actions, demonstrating its versatility and effectiveness in predicting behavioural intentions (Bosnjak et al., 2020; Yuriev et al., 2020).

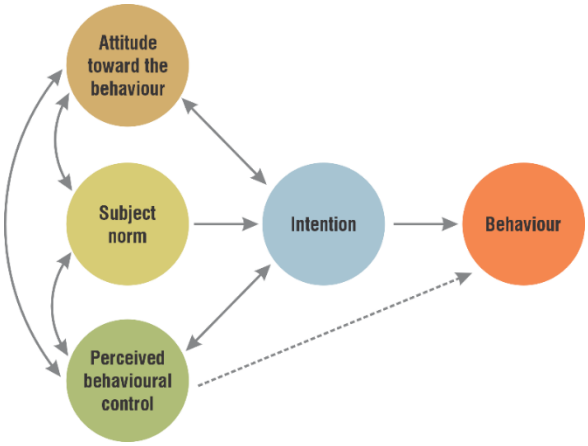

Figure 1. Theory of planned behavior. Source: (Conner, 2020).

2.1.1. Attitude:

Attitude refers to the individual's positive or negative evaluation of performing a behaviour. It is a significant predictor of intention (Carroll et al., 2025; Hamilton & Terblanche-Smit, 2018). For example, in the context of educational technology, teachers' positive attitudes towards using computers for lesson delivery were found to be a critical determinant of their intention to use such technology (Jung Lee et al., 2010).

2.1.2. Subjective Norms

Subjective norms involve perceived social pressures from significant others to perform or not perform a behaviour. This factor reflects the influence of societal expectations and the motivation to comply with these expectations (Kiriakidis, 2017). For example, when purchasing a modern green vehicle, societal norms have a moderate influence; however, other factors also affect consumer intention, highlighting the importance of perceived social support and encouragement (Hamilton & Terblanche-Smit, 2018).

2.1.3. Perceived Behavioural Control

Perceived behavioural control (PBC) refers to an individual's perception of their ability to perform the behaviour, taking into account both internal and external constraints and expectations (Kiriakidis, 2017). PBC has been shown to significantly influence intentions, as demonstrated in studies on professional development participation and consumer behaviour, where individuals with higher perceived control were more likely to intend to engage in the behaviour (Carroll et al., 2025; Hamilton

& Terblanche-Smit, 2018).
TPB has been applied across diverse fields, including environmental behaviour, health management, and marketing, highlighting its broad applicability. Despite its widespread use, TPB faces limitations, such as the need for precise definitions of target behaviours and the challenge of accounting for unexpected barriers that may prevent translating intention into action (Bosnjak et al., 2020; Yuriev et al., 2020). While TPB provides a robust framework for understanding behavioural intentions, it is essential to consider the dynamic interplay between individual beliefs and external influences.

2.2. Relevance to the Research:

This study employed the Theory of Planned Behaviour (TPB) to explain why some households within the randomly selected sample of 150 adopted rooftop gardening, while others did not, despite experiencing the same pandemic conditions. A structured questionnaire was developed based on the three core determinants of TPB to identify the most influential factors contributing to rooftop gardening adoption during the pandemic.
The TPB constructs were operationalised using context-specific survey items rather than a full, validated TPB scale. Therefore, TPB is used as an interpretive behavioural framework in this study, not as a latent-variable measurement model.

2.2.1. Attitude (Personal Beliefs):

This component examines whether respondents perceived rooftop gardening as a beneficial activity. In the survey, this was captured by asking adopters about their motivations, such as the belief that it could provide safe, organic food, reduce mental stress, or help save money.

2.2.2.Subjective Norms (Social Influence):

This dimension measures the influence of social and community factors. During lockdowns, for example, observing neighbours successfully growing vegetables may have encouraged others to adopt similar practices. The questionnaire addressed this by including questions about community interactions, such as seed sharing and neighbourly support.

2.2.3. Perceived Behavioural Control (Resources & Ability):

This factor is crucial in explaining why some households do not adopt rooftop gardening despite being in the same environment. A household may have a positive attitude towards gardening; however, if they lack sufficient control over necessary resources or conditions—such as access to a rooftop (e.g., being a tenant), the initial funds for materials, or adequate knowledge of cultivation—they are less likely to adopt the behaviour (Rahman et al., 2022).

2.3. Crisis-Induced Behavioural Adaptation

It refers to the rapid process through which individuals and groups modify their actions and routines in response to sudden, unpredictable external shocks (Zozmann et al., 2024). This framework explores how people transition from their "normal" status quo to new survival-oriented patterns when standard coping mechanisms fail.
The core mechanisms of the Crisis-Induced Behavioural Adaptation framework centre on the psychological and functional transition from stable routines to emergency-driven actions. When an external shock occurs, it triggers a state of psychological disequilibrium, in which existing cognitive models fail to address the new reality, forcing individuals to undergo a "re-optimisation" of their life choices to regain a sense of control (Efimova et al., 2015; St-Jean & Tremblay, 2023).
This process is governed by two primary pathways: autonomous adaptation**,** a self-directed shift driven by personal risk perception and survival instincts, and policy-induced adaptation**,** in which behaviour is modified in response to structural mandates or social pressure (Zozmann et al., 2024).

Ultimately, these mechanisms serve a dual purpose, ensuring physical survival through effective resource management and restoring psychological comfort by establishing new, predictable routines within a chaotic environment (Cameron & Schoenfeld, 2018).

2.4. Household Livelihood Resilience & Food Security Framework:

Resilience is defined as the "capacity of a system to absorb disturbance and still retain its basic function and structure" (Walker et al., 2002). It is often considered highly context-specific, which makes its implementation through policy mechanisms challenging (Cooper & Wheeler, 2015). Livelihood resilience is the multi-generational ability of communities to maintain and enhance their standard of living and wellbeing, even when confronted with environmental, economic, political, or social upheavals. This concept prioritises a human-centric approach, emphasising individuals' rights, self-determination, and their power to anticipate and withstand crises (Tanner et al., 2015). In contemporary psychological discourse, the definition of well-being has evolved to encompass multiple dimensions, including physical, socio-emotional, spiritual, cognitive, and behavioral aspects (Manita et al., 2019).

2.4.1. Food Security Framework - Four Pillars of Food Security:

Food security traditionally relies on four core dimensions: availability, access, utilisation, and stability. These pillars ensure that food is consistently available, physically and economically accessible, properly utilised, and stable over time (Clapp et al., 2022). During the pandemic, food stability and access were threatened by disrupted supply chains and income loss. Rooftop gardening directly addressed these challenges by increasing food availability by producing fresh vegetables at the household level. It also supported food access by reducing household food costs and limiting the need for market visits during periods of travel restrictions and social distancing. Urban gardens are underappreciated yet crucial spaces that not only support city food production and ecosystems, but also preserve and share generational knowledge on growing crops and managing the environment (Barthel et al., 2015).

2.5. Theoretical rationale:

Considering a given situation, why a specific household will actually start or be encouraged to get involved in gardening to achieve resilience depends on their personal views, neighbourhood peer influence, and access to a roof/resources (Theory of Planned Behaviour, TPB).

The COVID-19 pandemic hit Mohammadpur, creating a socio-economic and health crisis that impacted human behaviour (Crisis-Induced Behavioural Adaptation).

Families faced income losses and the fear of food shortages, prompting them to adopt alternative survival strategies (Household Livelihood Resilience & Food Security).

To clarify the connection between the theoretical frameworks and the empirical analysis, Table 1 presents the operational linkages among the key theoretical constructs, study variables, and statistical procedures used in this study.

Table 1: Operational linkage between theoretical framework, study variables, and analysis

Framework	Construct	Study variable/indicator	Analysis used
Theory of Planned Behaviour	Attitude	Perceived benefits of gardening, including food safety, savings, and stress relief	Descriptive analysis
Theory of Planned Behaviour	Subjective norms	Neighbour/community support and gardening-related interaction	Descriptive analysis
Theory of Planned Behaviour	Perceived behavioural control	Rooftop access, cost, knowledge, and landlord restrictions	Chi-square; logistic regression
Crisis-Induced Behavioural Adaptation	Pandemic pressure and behavioural shift	Peak stress, income loss, adoption during/after COVID-19	t-test; chi-square; logistic regression
Food Security/Livelihood Resilience	Food access and household coping	Food worry, grocery savings, household production	Descriptive analysis; chi-square; logistic regression

Figure 2. Food Security Framework - Four Pillars of Food Security (Adopted by the authors).

2.6. Case studies:

2.6.1. Cuba's urban gardening revolution:

Cuba's urban gardening revolution is a remarkable transformation that emerged in response to severe economic challenges following the collapse of the Soviet Union (French et al., 2010). This movement has been characterised by a shift from industrial monoculture to diversified agroecology, emphasising self-sufficiency and community involvement (Smith, 2014). Urban agriculture in Cuba has not only addressed food security but also fostered food sovereignty, enabling communities to take control of their food systems (Rodríguez & Esteban, 2021). The revolution is underpinned by principles of land redistribution, agricultural diversification, and agroecology, which have collectively contributed to a more resilient and sustainable agricultural model (Rodríguez & Esteban, 2021; Smith, 2014).

While Cuba's experience demonstrates how severe socio-economic crises act as powerful catalysts for

Figure 3. To combat imminent food shortages, Cuba's government urged Havana residents to cultivate vacant city lots. Communities united to clear tons of rubble, transforming these spaces into thriving organic farms. (Source- *FotoDocument – A Unique Not-for-Profit Arts Education Social Enterprise*, n.d.)

crisis-induced behavioural adaptation, Mohammadpur's case reveals similar economic necessities as primary drivers of rooftop gardening during the pandemic. This comparison validates the study's core theoretical argument: community-led microagriculture is a globally proven, resilient mechanism for restoring food security and self-sufficiency when traditional supply chains fall short or collapse (Dlamini & Dludlu, 2025).

2.6.2. Sri Lanka: The "Lockdown Boom"

Throughout the first wave of the pandemic, Sri Lanka experienced a "lockdown home gardening boom" (Perera et al., 2021). To help residents meet their daily food requirements, the government actively encouraged the public to cultivate unused spaces. A study of the Western Province found that households effectively utilised available space, including rooftops and small yards to grow fresh, nutritious vegetables, fruits, and medicinal plants. Beyond securing an immediate food source, residents reported that gardening, a form of physical activity, played a major role in reducing mental stress and the psychological burden of strict lockdown measures (Perera et al., 2021).

The case demonstrates how citizens effectively utilised rooftops and small yards during the first wave of the COVID-19 pandemic to cultivate fresh food and mitigate the severe mental stress caused by strict lockdowns.

2.6.3. Indonesia: Rooftop Resilience in Jakarta

In densely populated Jakarta, urban and rooftop farming proved highly effective coping mechanisms. During the height of the COVID-19 pandemic, researchers evaluated the impacts of these practices across the city and found that public perception of urban farming was overwhelmingly positive (Komalawati et al., 2022). For households facing economic anxiety and restricted movement, cultivating rooftop gardens provided much-needed stress relief. Furthermore, it empowered communities to supplement their incomes and boosted local diets, which residents believed helped strengthen their immune systems during the health crisis (Komalawati et al., 2022). Most women in the greater Jakarta area exhibit sustainable mental well-being, encompassing low stress and multidimensional factors such as resilience, optimism, and life satisfaction (Benanda Yasminingrat et al., 2023). The case illustrates how densely populated urban households, facing pandemic-induced restrictions on movement and economic anxiety, adopted rooftop farming to relieve stress, supplement their incomes, and boost nutrition. It also indicates women's empowerment as strategic managers of family nutrition, strengthening their say in domestic affairs.

3. Research Problem Statement

The COVID-19 pandemic unleashed unparalleled health and socio-economic disruptions, with the most severe impacts concentrated within the crowded urban centers of developing nations. Mohammadpur is situated in a moderately developed part of Dhaka, where density and urban cohesion with connected neighbourhoods are unique urban features. However, this urban fabric proved highly challenging in safeguarding the dense population from a deadly epidemic like COVID-19. It exacerbated food insecurity and income loss, prompting urban residents to adopt rooftop gardening as a means of self-sufficiency and resilience. This adaptation was particularly crucial in areas such as Mohammadpur, where high population density heightened the risk of disease spread and socio-economic disruption (Alam, 2021). This small-scale but precise study aims to understand how crisis-driven adaptation translates into sustainable urban agricultural practices and their broader socio-economic impacts at the household level. Allocating land for home gardens has emerged as a potential unified solution to two major pandemic-related challenges: limited access to urban green spaces and the growing mental health struggles among the working population (Lazuardi et al., 2022).

3.1. Research Rationale for Small-Scale Design

Following Cochran's (1977) formula for a Census, the 2022 population of 527,789 for Mohammodpur Thana, a sample size of 150 was calculated using a 95% confidence level and an 8% margin of error.

The 8% threshold was deliberately adopted in place of the conventional 5% to account for Mohammadpur's socio-spatial constraints. The area's dense settlements and conservative demographic introduce significant gatekeeping and privacy hurdles regarding private rooftop access.
The small scale has an in-depth approach for several strategic reasons:

- Precision over breadth: Focus on detailed, high-quality data from each household
- Feasibility: Manageable within limited time and resources
- Intensive quality control: The Researcher can personally oversee all data collection
- Pilot potential: Can serve as a pilot for larger future studies
- Community-focused: Deep engagement with a specific community segment
- Rapid turnaround: Quick insights for immediate policy relevance

3.2. Research Gap

Certain research gaps and available literature demonstrate the potential of this Research, and major findings show that there is limited micro-level empirical evidence on:

- Specific behavioural mechanisms driving pandemic-induced adoption of rooftop gardening in densely populated South Asian urban contexts
- Household-level impacts on food security, income, and wellbeing
- Women's empowerment through urban agriculture in urban areas

Literature reviews reveal that rooftop gardens facilitate both personal interest and communal involvement in urban contexts. This study contributes to the existing Research on rooftop gardening by examining post-pandemic behavioural adaptation in a dense, informal South Asian urban setting.

3.3. Research Objectives

This study primarily aims to investigate how the COVID-19 pandemic triggered behavioral shifts toward rooftop gardening in a small neighbourhood at Mohammadpur, and to evaluate the practice's socio-economic impacts on household resilience and well-being through a small-scale, in-depth survey.
To achieve this, the core objective has been broken down into the following specific sub-objectives:

3.3.1. Behavioural Analysis:

To identify key behavioural changes and motivations that led households to adopt rooftop gardening during the pandemic.

3.3.2. Driver Identification:

To examine primary drivers (economic, food security, psychological) influencing adoption

3.3.3. Impact Assessment:

To evaluate socio-economic impacts on:

- Household food security and cost savings
- Income generation
- Mental health and wellbeing
- Social cohesion

3.3.4. Social cohesion

- Gender Analysis: To assess women's participation and household-level agency in rooftop gardening and food-related decision-making.
- Barrier Identification: To identify constraints limiting adoption and sustainability
- Policy Insights: To develop evidence-based recommendations

4. Research Methodology:

4.1. Research Paradigm and Design:

This study adopts a pragmatic positivist approach, emphasising objective measurement, statistical analysis, and practical insights over mere data volume. The Research employs a small-scale, quantitative cross-sectional survey design. This framework enables intensive, focused, and high-quality researcher-supervised data collection, facilitating a clear comparative analysis of households that adopted rooftop gardening and those that did not.

4.2. Study Area and Observational Context:

The Research is conducted in Mohammadpur, Dhaka. To ensure random sampling is feasible, a specific geographical boundary (e.g., a designated block, street, or housing ward) serves as the primary sampling frame. During the field survey, the researcher will also conduct supplementary contextual observations, noting local livelihood patterns, neighbourhood dynamics, and street conditions to understand the study environment better.

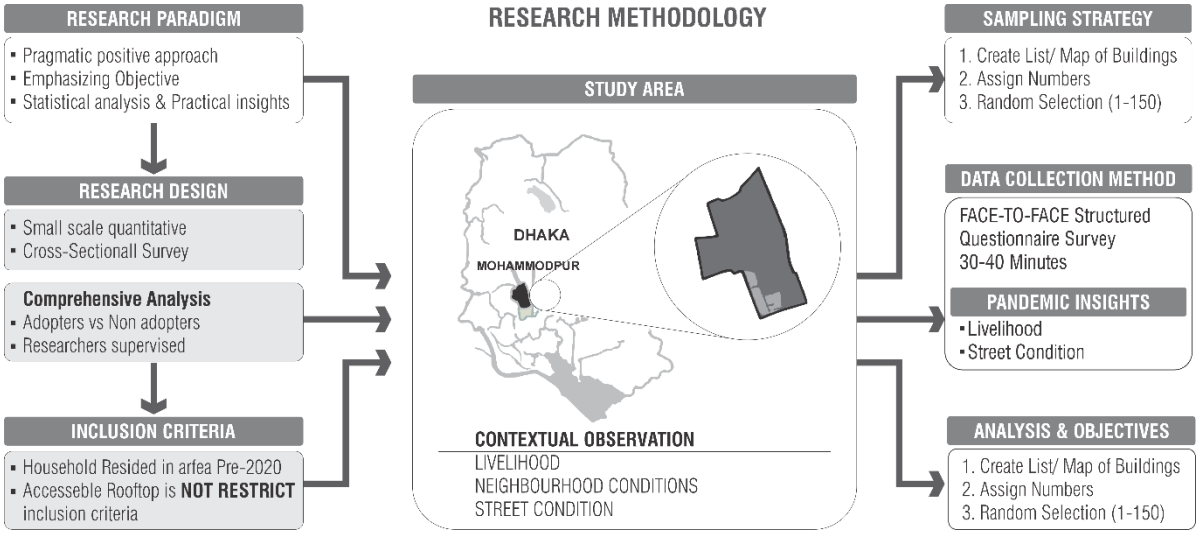

Figure 4. Research Methodology Frame Work (adopted buy authors).

4.3. Sampling Strategy

To ensure representative participant selection across diverse neighborhoods within the survey coverage area, the study employs a Proportionate Stratified Random Sampling approach to select 150 households. The execution of this strategy involves the following steps:

- **Stratification:** Dividing the study area into primary neighborhood zones based on spatial distribution (e.g., Shekhertek, Mohammadia Housing, Tajmahal Road). As illustrated in Figure 5, which details the road networks and connected alleys of the study areas, Mohammadpur is an older neighborhood characterised by complex household ownership structures and small plot sizes.
- **Creating the Sampling Frame:** Obtaining or creating a comprehensive list and map of all residential buildings along the defined survey coverage routes within these specific strata.
- **Assigning Identifiers:** Assigning a unique identifier (number) to each eligible building or household within the sampling frame.
- **Random Selection:** Using a random number generator to draw the final sample of 150 households (numbered 1–150) proportionally across the strata. This ensures all eligible residents have an equal probability of inclusion and minimises spatial selection bias.

4.4. Data Collection Method

Primary data were collected through face-to-face structured questionnaire surveys, with each session lasting approximately 30–40 minutes. Alongside the structured questionnaire, a brief semi-structured interview was conducted to capture contextual insights regarding the pandemic experience. The semi-

structured interviews were used only for contextual triangulation to support the interpretation of the survey findings, not as a separate qualitative analytical strand. Key probing areas included:

- What aspects of the pandemic affected them the most?
- The extent of stress caused by physical restrictions and lockdowns.
- Changes in time-use patterns, including how free time was spent and whether new hobbies were developed.
- For rooftop gardening adopters**:** How the practice engaged them, impacted their daily routines, and influenced their overall well-being during the pandemic.

4.5. Inclusion Criteria

To ensure the collected data is highly relevant to the pandemic's impact, the following parameters are applied to the sampling frame:

- **Continuous Residency:** The household must have resided in the study area since before the onset of the COVID-19 pandemic (pre-2020).
- **Capable Respondent:** The survey must be answered by an adult resident capable of accurately reporting the household's overall pandemic experience.
- **Note on Rooftop Access:** An accessible rooftop is not an explicit inclusion requirement. Including households without roof access is intentional; it serves as a necessary control to explain baseline spatial constraints and to capture the context for why certain randomly selected participants are non-adopters.

Figure 5. Mohammadpur- Survey Area.

5. Data Analysis

5.1. Descriptive Analysis: Household Characteristics and Pandemic Context

This study begins by understanding the background of the respondents. Field observations indicate that most households have 4–5 members, and a large proportion of respondents are in the 18–34-year

age group. The gender distribution shows that both male and female respondents were represented, though males were slightly more numerous. The majority of households have at least a Bachelor's degree. Housing types are fairly balanced between owned and rented homes.

Regarding rooftop access, most respondents had access, but a considerable number had either restricted or no access. It shows that rooftop availability is not only a physical issue but also connected to permission and control over shared spaces. Table-01 also shows that more than half of the respondents experienced job loss, business closure, or a major reduction in income during the COVID-19 pandemic. It indicates that the pandemic created economic pressure for many households in the study area. Of the 150 respondents, 90 households reported currently practising gardening, while 60 households reported not doing so.

Table 2: Household Profile and Pandemic Context of Respondents.

Variable	Category	Frequency (n)	Percentage (%)
Household Size	2–3	41	27.33%
	4–5	87	58.00%
	5+	22	14.67%
Age Group	18–24	45	30.00%
	25–34	39	26.00%
	35–44	21	14.00%
	45–54	16	10.67%
	55–64	13	8.67%
	65+	16	10.67%
Gender	Male	84	56.00%
	Female	66	44.00%
Education	Bachelor's/Honours	96	64.00%
	Master's or above	54	36.00%
Housing Type	Owned	75	50.00%
	Rented	75	50.00%
Rooftop Access	Yes, we have access	95	63.33%
	Restricted access	33	22.00%
	No access	22	14.67%
Income Loss (Pandemic)	Yes	89	59.33%
	No	61	40.67%
Gardening Status	Yes	90	60
	No	60	40

5.2. Descriptive Statistics of Scale-Based Variables

Table 2 presents the descriptive statistics for the scale-based variables used in the study. The peak stress level during the pandemic had a mean score of 6.34 on a 10-point scale, which indicates that respondents generally experienced moderate to high stress related to food and income during the lockdown period. The mean current stress level was lower, at 3.71. It suggests that respondents' stress levels have decreased compared to the peak of the pandemic. However, the variation in current stress scores shows that some households may still be experiencing stress even after the immediate crisis period. The perceived mental health benefit of green spaces or gardening had a high mean score of 4.55 on a 5-point scale. It indicates that respondents generally agreed that access to green spaces or gardening positively affects daily mood and mental health.

Table 3: Descriptive Statistics of Scale-Based Variables

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Peak stress level during the pandemic	150	6.34	2.16	1	10
Current stress level	150	3.71	1.78	1	9
Perceived mental health benefit	150	4.55	0.7	3	5

5.3. Food Worry, Decision-Making, Awareness, and Support Context

Table 4 presents the analysis of the outcome of perception-based variables. These variables represent respondents' recent food-related concerns, household decision-making dynamics, and awareness of formal urban agriculture initiatives.

Regarding food worry over the previous four weeks, the majority of respondents reported either never (40%) or rarely (24%) worrying about having enough food. However, a significant portion remains vulnerable: 30.67% report "sometimes" worrying, and 5.33% report "often" worrying. It indicates that while absolute food insecurity is not the norm, underlying food-related anxiety persists for more than a third of the households, demonstrating that concerns have not completely disappeared.

The decision-making pattern reveals that household choices, particularly those related to food sourcing and community activities, are not monopolised by a single group, but rather distributed relatively evenly. Wives of the family were the most common primary decision-makers at 30%, followed by husbands of the family (26%), joint decision-making (24%), and other family members (senior male/female) (20%). The slight prominence of wives in this role is highly relevant to this study, as rooftop gardening is deeply connected to household food management, daily domestic care, and family-level nutrition strategies.

Finally, awareness of urban agriculture initiatives was found to be critically low among respondents. An overwhelming 83.33% of households reported being unaware of any government or NGO initiatives promoting urban agriculture in Mohammadpur, compared to just 16.67% who were aware. This stark contrast highlights a significant gap between potential community interest in gardening and actual institutional outreach, suggesting a lack of formal support or communication reaching the grassroots level.

Table 4: Food Worry, Household Decision-Making, Awareness, and Support Context.

Variable	**Category**	**Frequency (n)**	**Percentage (%)**
Food Worry	Never	60	40
	Rarely	36	24
	Sometimes	46	30.67
	Often	8	5.33
Decision Maker	Wife/ Female member	45	30
	Husband/ Male member	39	26
	Joint decision	36	24
	Other family members	30	20
Awareness of Urban Agriculture Initiatives	Yes	25	16.67
	No	125	83.33

5.4. Patterns of Gardening Adoption and Barriers to Non-Adoption

Figure 6 summarises key patterns among households that practice gardening. Most adopters started gardening during the pandemic. Food supply and mental health were the main motivations, while leafy and fruiting vegetables were the most common crops grown. Most households reported small monthly savings from gardening, suggesting that it provides modest but meaningful household benefits.

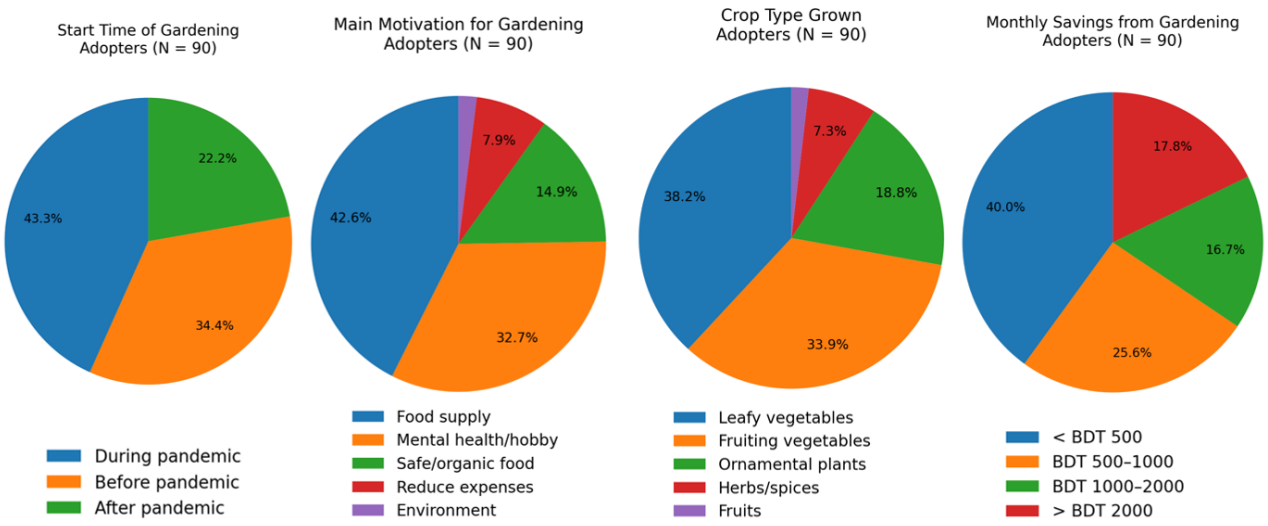

Figure 6. Gardening Characteristics among Adopter Households.

Figure 7 shows that most non-adopters were still interested or possibly interested in starting gardening. The main barriers were a lack of rooftop access, a lack of knowledge, landlord restrictions, and a lack of time. Only a small portion reported no interest, suggesting that non-adoption is mostly caused by practical and structural barriers rather than unwillingness.

5.5. Pie charts of the Household Profile

Figure 8 compares adopter and non-adopter households based on gender and rooftop access. The gender distribution shows that adopters had a higher share of female respondents, while non-adopters

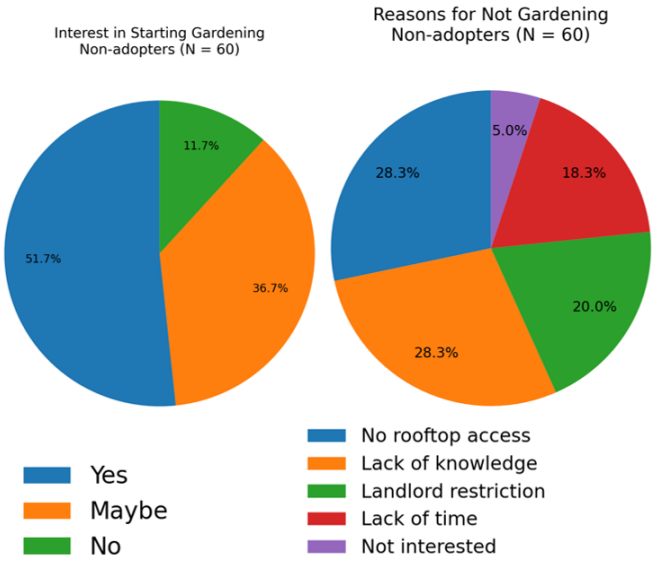

Figure 7. Non-adoption reasons and future interest among non-adopters.

were mostly male. It suggests that women may have played a more significant role in household gardening. The rooftop access comparison shows a clear difference between the two groups. Most adopter households had full rooftop access, whereas non-adopters had a higher proportion of restricted or no rooftop access. It indicates that rooftop access is an important practical condition for adopting gardening.

6. Comparative Analysis

6.1. Comparison of Stress and Mental Health Perception between Adopters and Non-Adopters

Independent samples t-tests were conducted to compare adopter and non-adopter households across selected scale-based variables: peak stress during the pandemic, current stress, and perceived mental

health benefit of gardening, which were measured as numeric scale variables.

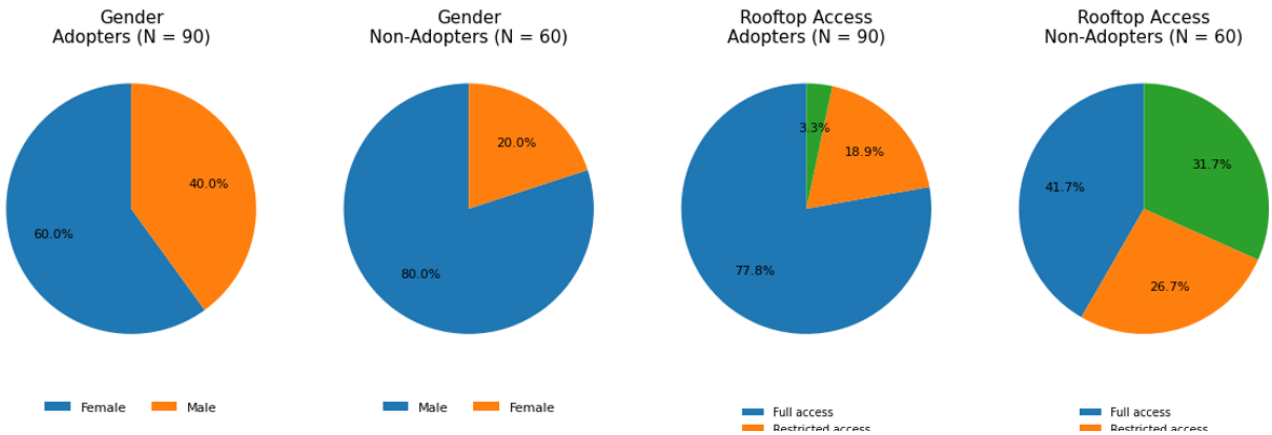

Figure 8. Gender and rooftop access distribution among adopter and non-adopter households.

Since the adopter and non-adopter groups differed in size, Levene's Test for Equality of Variances was conducted before interpreting the t-test results. For the peak stress, Levene's test was not significant, so the equal-variance assumption was used. For current stress and perceived mental health benefit, Levene's test was significant, so unequal-variance results were used.

As shown in Table 5, all three variables showed statistically significant differences between adopters and non-adopters. Adopter households reported a significantly higher peak stress level during the pandemic than non-adopters. It suggests that households experiencing stronger food- and income-related stress during the lockdown period may have been more likely to adopt rooftop gardening as a coping strategy.

In contrast, current stress was significantly lower among adopters than non-adopters. It suggests that gardening households may currently experience greater stress relief and psychological well-being. Adopters also reported significantly stronger agreement that gardening or access to green spaces improves daily mood and mental health. Overall, Table 5 indicates that gardening adoption is meaningfully associated with pandemic stress, current stress, and positive mental health perception.

Table 5: Comparison of Stress and Mental Health Perception between Adopters and Non-Adopters.

Variable	Adopters Mean	Adopters SD	Non-adopters Mean	Non-adopters SD	Levene's p-value	Equal Variance Assumed	t-value	t-test p-value	Mann-Whitney p-value
Peak stress	7.18	2.07	5.08	1.62	0.0622	Yes	6.593	< 0.001	< 0.001
Current stress	3.42	1.94	4.15	1.44	0.0383	No	-2.639	0.0092	0.0013
Mental health benefit	4.66	0.64	4.4	0.76	0.0281	No	2.141	0.0345	0.0229

6.2. Stress Change from Pandemic Period to Current Period

Table 5 presents a stress-related comparison between the pandemic and the current period. The paired t-test results show that stress decreased significantly among all respondents. When examined separately, both adopters and non-adopters showed significant reductions in stress, but the decline was stronger among adopters.

The independent t-test further shows that adopters currently report significantly lower stress than non-adopters. It suggests that although stress generally decreased after the pandemic, households that gardened experienced a greater reduction and currently show better stress-related well-being. Therefore, the findings support the idea that rooftop gardening may be associated with psychological recovery and stress relief after the pandemic. Occupants with home gardens exhibited significantly

lower stress levels than those without, thereby indirectly promoting better psychological health (Lazuardi et al., 2022).

Table 6: Stress Analysis Using Paired and Independent t-tests.

Analysis Type	Group Compared	t-value	p-value	Significance	What it Means
Paired t-test	Peak Stress vs Current Stress (All respondents)	11.38	< 0.001	Significant	Overall stress decreased over time
Paired t-test	Peak Stress vs Current Stress (Adopters only)	13.22	< 0.001	Significant	Adopters experienced a strong reduction in stress
Paired t-test	Peak Stress vs Current Stress (Non-adopters only)	3.46	0.001	Significant	Non-adopters also experienced stress reduction, but less strongly.
Independent t-test	Current Stress (Adopters vs Non-adopters)	-2.64	0.009	Significant	Adopters currently report lower stress than non-adopters

6.3. Chi-square Analysis of Categorical Factors Associated with Gardening Adoption

Chi-square tests were conducted to identify which categorical variables were significantly associated with rooftop gardening adoption. The analysis focused on demographic factors, household conditions, pandemic-related pressure, food worry, and awareness of urban agriculture initiatives.

As shown in Table 6, several variables were significantly associated with gardening adoption. Gender was significant, indicating that gardening participation differed between male and female respondents. It suggests that gender roles or household participation patterns may influence who engages in rooftop gardening.

6.3.1. Housing type and rooftop access:

Significant, showing that structural conditions played an important role in adoption. Households living in owned residences and households with full rooftop access were more likely to practice gardening, while restricted or unavailable rooftop access acted as a barrier. It is one of the most important findings because rooftop gardening depends directly on access to usable space.

6.3.2. Income loss during the pandemic:

It was significantly associated with gardening adoption, suggesting that households affected by job loss, business closure, or income reduction may have been more likely to turn to gardening as a coping strategy. Similarly, food worry was significant, indicating that food-related concern was connected with gardening behaviour.

6.3.3. Awareness of urban agriculture initiatives:

Significantly, this suggests that households aware of government or NGO initiatives were more likely to engage in gardening practices. It highlights the importance of information, outreach, and institutional support in encouraging urban agriculture.

In contrast, household size, age group, education, and household decision-making pattern were not statistically significant. It suggests that gardening adoption was less influenced by broad demographic background and more strongly shaped by gender, rooftop access, housing condition, pandemic-related economic pressure, food worry, and awareness.

Table 7: Chi-square test of association between categorical variables and gardening adoption.

Variable	Chi-square value	p-value	Significance
Household size	0.464	0.7928	Not significant
Age group	4.504	0.4793	Not significant
Gender	21.781	< 0.001	**Significant**
Education	2.027	0.1546	Not significant
Housing type	14.694	0.0001	**Significant**
Rooftop access	28.107	< 0.001	**Significant**
Income loss	7.553	0.006	**Significant**
Food worry	23.093	< 0.001	**Significant**
Decision maker	7.559	0.0561	Not significant
Awareness	4.05	0.0442	**Significant**

6.4. Exploratory Logistic Regression Predicting Gardening Adoption

A logistic regression was conducted to identify which factors predicted the likelihood of adopting rooftop, balcony, or indoor gardening. The model included variables that were theoretically relevant and/or significant in the earlier comparative analyses, including gender, housing type, income loss, peak stress, current stress, rooftop access, food worry, and awareness of urban agriculture initiatives.

As shown in Table 7, gender, peak stress, rooftop access, and food worry remained significant predictors of gardening adoption. Female respondents had higher odds of being adopters than male respondents, suggesting that women may have played a stronger role in household gardening practices. Peak stress during the pandemic was also significant, indicating that households with higher food- and income-related stress during the lockdown period were more likely to adopt gardening. It supports the interpretation of gardening as a crisis-related coping or adaptation strategy.

Rooftop access was one of the strongest predictors in the model. Compared with households without rooftop access, households with restricted or full access had significantly higher odds of practising gardening. Full rooftop access showed the largest effect, confirming that usable rooftop space is a major structural condition for adoption.

Food worry showed a significant negative association with gardening adoption. Since food worry was measured for the recent period, this suggests that adopter households may currently experience lower food-related concern, possibly because gardening contributes to household food support. However, this should be interpreted as an association rather than direct causation.

Housing type, income loss, current stress, and awareness were not statistically significant after controlling for the other variables. It means that although some of these variables were significant in earlier chi-square tests, their independent effects became weaker in the regression model. Overall, Table 7 suggests that rooftop gardening adoption was mainly predicted by gender, pandemic peak stress, rooftop access, and current food-worry condition.

Table 8: Logistic regression predicting rooftop gardening adoption.

Predictor	Coefficient	Odds Ratio	p-value	Significance	Interpretation
Gender	1.292	3.639	0.0198	**Significant**	Female respondents are about 3.6 times more likely to adopt gardening than males.
Owned house	0.527	1.694	0.3807	Not significant	Households owned by the wealthy have higher odds, but these differences are not statistically significant after controlling for other factors.
Income loss	0.636	1.889	0.2795	Not significant	Households with income loss appear more likely to adopt, but the effect is not significant in the full model.
Peak stress	0.697	2.008	< 0.001	**Significant**	Each unit increase in peak stress doubles the odds of adopting gardening, supporting a crisis-response behaviour.
Current stress	-0.234	0.791	0.1009	Not significant	Higher current stress is associated with lower adoption, but the effect is not statistically significant.
Restricted rooftop access	2.238	9.375	0.0272	**Significant**	Households with restricted access are about 9 times more likely to adopt than those with no access.
Full rooftop access	3.212	24.839	0.0015	**Significant**	Households with full access are about 25 times more likely to adopt, showing access is a key enabling factor.
Food worry score	-1.012	0.364	0.0016	**Significant**	Higher food worry is associated with lower odds of adoption, suggesting adopters may currently experience less food concern.
Awareness of initiatives	1.501	4.484	0.0515	Not significant	Awareness increases the odds of adoption, but the effect is only marginal and not statistically significant.

7. Qualitative Analysis of Household Dimensions and Behavioural Adaptation

7.1. Household Structures, Gender Roles, and Empowerment

- The field observation shows that nuclear families dominate the selected area and is empirically anchored in the quantitative dataset, which shows that 58% of the survey families consist of 4-5 family members. During the field survey, male members were readily available to participate in the interview, highlighting the socio-cultural factors that impact women's availability. However, the underlying household dynamics showed a balanced distribution of domestic power.
- Among 30% of surveys, family structure indicated that wives function as the primary decision-makers for food sourcing and household care. This qualitative narrative of female agency is supported by the paper's predictive modeling, which shows that female respondents were approximately 3.6 times more likely to adopt rooftop gardening than male respondents.
- Ultimately, the qualitative insights and quantitative metrics converge to show that rooftop gardening actively strengthens women's domestic decision-making power and elevates their status as key strategic actors.

7.2. Crisis Experiences and Psychological Resilience

- The qualitative survey details a widespread surge in mental stress, isolation-induced anxiety, and financial panic among residents during the height of the lockdowns. This phenomenon is supported by quantitative analysis, which shows a high mean peak stress level of 6.34 out of 10 during the pandemic period.
- A certain crisis drove the behavioral shift toward rooftop gardening; households experiencing the most severe qualitative anxieties and income shocks were the ones that actively modified their routines.

- In the post-pandemic landscape, qualitative data indicate that gardening has become a lasting therapeutic tool, offering relaxation and mental satisfaction. This psychological recovery is mathematically proven by the study's independent t-tests, which show that current stress scores are significantly lower among adopters than non-adopters

7.3. Food Security Dynamics and Intentional Cultivation

- Field interviews indicate that rooftop gardening shifted rapidly from an informal pre-pandemic hobby into a practical necessity to secure safe, chemical-free food amid mobility restrictions. This narrative directly aligns with the study's application of the Four Pillars of Food Security, demonstrating that the practice strengthened household-level food availability and access.
- Qualitatively, respondents highlighted that the mental satisfaction and nutritional security derived from cultivating plants far outweighed direct monetary benefits. It matches the quantitative observation: though individual monthly financial savings remain modest, the behavioral drive to continue rooftop gardening remains exceptionally high due to concerns about safe food supplies.

7.4. Structural Barriers, Knowledge Gaps, and Institutional Failures

- For non-adopters of rooftop gardening, qualitative accounts identify severe spatial limitations, restrictive landlords, and a lack of technical knowledge as the primary barriers preventing participation.
- These practical constraints correspond directly to the Perceived Behavioural Control dimension of the Theory of Planned Behaviour (TPB).
- The significant impact of spatial accessibility is quantitatively verified by the logistic regression model, which shows that residents with full rooftop access have approximately 25 times the odds of practicing rooftop gardening compared to those without rooftop access.
- Qualitative analysis also identified a lack of awareness campaigns, which aligns with the quantitative findings and indicates a substantial gap in governmental and NGO-led urban agriculture initiatives in the Mohammadpur area. This is further supported by the survey results, which show that 83.33% of respondents were unaware of rooftop gardening, highlighting a significant gap in efforts to promote it within the community.

Figure 9: Word Cloud -Field Interview.

Table 9: Explanation of the Word Cloud.

Key Academic Term	Relevance to the field: Interview
Crisis-Induced Adaptation	The theoretical framework explains how severe external shocks forced households to change daily routines and adopt survival strategies.
Peak Stress	A statistically significant variable, adopters experienced higher pandemic stress, which drove their behavioral shift toward gardening.
Income Loss	A major catalyst for food insecurity, affecting 59.33% of respondents and prompting a need for self-sufficiency.
Women's Empowerment	A critical socio-economic outcome, demonstrated by women acting as primary decision-makers in 30% of households.

Figure 10: Word Could- Field Interview

Table 10: Explanation of the Word Cloud-Figure 10.

Key Academic Term	Relevance to the field: Interview
Perceived Behavioural Control	A TPB component explaining why non-adopters fail to garden; it emphasises resources, knowledge, and spatial constraints.
Food Security Pillars	Gardening successfully addressed the "availability" and "access" pillars by providing household-level fresh produce during lockdowns.
Rooftop Access	The most significant structural predictor of adoption is full access, which makes a household roughly 25 times more likely to garden.
Institutional Gap	The lack of formal support is evidenced by 83.33% of the community being unaware of any NGO or government agricultural initiatives.

8. Conclusion

This study investigated how the COVID-19 pandemic catalysed a behavioural shift toward rooftop gardening among households in Mohammadpur, Dhaka, examined through the lens of Crisis-Induced Behavioural Adaptation and guided by the Theory of Planned Behaviour. Situated within a broader international context of comparable crisis-driven urban agricultural responses documented in Cuba, Sri Lanka, and Jakarta, the Mohammadpur experience suggests that community-led microagriculture can represent a globally recurring pattern of urban resilience under conditions of acute socio-economic stress. Using a quantitative cross-sectional design with 150 surveyed households, the findings reveal that rooftop gardening emerged as an important coping strategy during the pandemic, appearing to directly address two of the Four Pillars of Food Security, availability and access, by enabling fresh

vegetable production at the household level and potentially reducing dependence on severely disrupted market supply chains during periods of lockdown and restricted movement.

The comparative analysis further reveals that adopter households reported significantly higher peak stress levels during the lockdown period, driven by income loss and food insecurity, yet currently report lower stress levels than non-adopters, suggesting that gardening is associated with improved psychological wellbeing and stress relief. Chi-square analysis identified gender, housing type, rooftop access, income loss, food worry, and awareness of urban agriculture initiatives as significantly associated with gardening adoption — indicating that adoption was likely shaped less by broad demographic characteristics and more strongly by structural conditions, pandemic-related economic pressure, and access to information. A significant gender dimension was also identified: female respondents were approximately 3.6 times more likely to adopt gardening than male respondents, and wives were the most common primary decision-makers in food sourcing and household activities, accounting for 30% of decision-makers overall. It indicates that rooftop gardening not only engaged women in productive household activities but also strengthened their participation and household-level agency in domestic food-related decision-making. Rather than claiming broad empowerment, this study interprets the gender-related findings as evidence of increased women's participation and household-level agency in food production and decision-making. Rooftop access was identified as the strongest structural predictor of adoption in the logistic regression model. At the same time, 83.33% of respondents remained unaware of any government or NGO urban agriculture initiative, highlighting a significant gap between community-level interest and formal institutional support.

This study has a few limitations related to its cross-sectional design and focus on a single neighbourhood, which restricts causal inference and limits broader generalisability. The relatively small sample of 150 households constrains deeper sub-group analysis, and the retrospective self-reporting of pandemic stress levels introduces the possibility of recall bias. Since the interview responses were not subjected to formal thematic coding, they are treated as contextual evidence rather than independent qualitative findings. The logistic regression model included several predictors, given the sample size of 150 households. Therefore, the model should be interpreted as exploratory, and future studies with larger samples are needed to validate the predictor structure. Furthermore, the lack of systematic economic quantification means that the full monetary benefits of rooftop gardening at the household level remain unmeasured.

Future Research should prioritise longitudinal studies to determine whether pandemic-induced adoption has translated into a sustained urban agricultural practice, and whether the Four Pillars of Food Security continue to be meaningfully addressed beyond the immediate crisis period. Comparative studies across multiple neighbourhoods or South Asian cities would help contextualise these findings more broadly. Given the critically low institutional awareness recorded in this study, evaluating the effectiveness of targeted government and NGO outreach programmes represents a particularly important avenue for future investigation. A deeper qualitative inquiry into how rooftop gardening reshapes intra-household gender dynamics and strengthens women's community influence would also meaningfully extend this work. Ultimately, integrating these insights through transdisciplinary collaboration between architects, urban planners, and policymakers could provide the evidence base needed to embed community-led microagriculture into formal urban policy, potentially helping build permanently resilient, sustainable, and gender-inclusive cities.

Figure 11: Unplanned rooftop gardening practices in Mohammadpur area, showing the use of diverse makeshift containers such as plastic and earthen pots, half-cut plastic drums, GI sheet containers, plastic buckets, concrete beds, and trays. Many of these.

Figure 12: Rooftop goat rearing practices in Mohammadpur area, where several households keep goats on rooftops. Goat manure is collected and processed into organic fertilizer, which is subsequently used to support rooftop gardening activities.

Figure 13: Organic fertiliser production on rooftops in Mohammadpur, where dry leaves are burned in a temporary brick-enclosed structure to produce ash. The resulting ash is collected and used as a soil amendment in rooftop gardening practices.

Figure 14: Adaptation of urban gardening in Mohammadpur among households lacking rooftop access, where plants are cultivated in verandas, staircases, and semi-indoor spaces with partial sunlight, demonstrating flexible spatial use for domestic gardening.

Figure 15: Survey respondent Professor Dr. Mosharraf Hossain (80), a retired radiologist. Many senior Mohammadpur residents share his deep emotional attachment to leisure gardening.

Figure 16: Small-scale rooftop poultry farming practices in Mohammadpur, where chicken waste is processed into organic fertiliser and reused in rooftop gardening practices, demonstrating a localised organic nutrient recycling system.

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Conflicts of Interest
The Authors declare that there is no conflict of interest.

Data Availability Statement
Data is available upon request due to privacy/ethical restrictions. Raw data were produced at [North South University]. Processed data can be obtained from the corresponding Author, [Shahriar Iqbal Raj], upon request.

Institutional Review Board Statement
This study was conducted in accordance with ethical research principles, ensuring voluntary participation, informed consent, anonymity, and confidentiality of all participants. Ethical guidance was followed in accordance with the policies and procedures of the North South University Institutional Review Board/Ethics Review Committee (IRB/ERC) (North South University, n.d.). North South University. (n.d.). *Institutional Review Board/Ethics Review Committee (IRB/ERC)*. https://www.northsouth.edu/research-office/research-committee

CRediT Author Statement

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