

# Stakeholder Perception and Institutional Approach to Rooftop Gardening (RTG) of Urban Areas in Dhaka, Bangladesh

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## Abstract

Dhaka is one of the world's most populated cities and lacks the open fields and greeneries required for healthy living. Whereas urban sustainability depends on the greenness of the environment and the reduction of food dependency on the rural supply, currently, the city is failing to meet both requirements. The aim of this research is to understand why rooftop gardening (RTG) has failed to find its place in the policy agenda of Bangladesh, despite having support from citizens and experts. In answering this question, the authors have analysed the current state of rooftop gardening in Bangladesh with its major challenges and opportunities, explored the perception held by the city residents and agriculture professionals toward rooftop gardening, and discussed the existing institutional structure affecting the current rooftop gardening practices. The research presented in this paper argues that even though citizens have a positive attitude about rooftop gardening and experts consider it a viable opportunity, the existing policy process has hindered it from being a part of the policy agenda. Two online surveys were conducted on city residents and agriculture professionals from government and academic institutions. Interested participants from both categories participated in online interviews for in-depth discussions. In effect, the study shows that in the case of Dhaka city, the issue-framing is still at a very early stage. Though experts understand the value of RTG, they have not managed to raise enough awareness. From this perspective, experts have not played an adequate 'instrumental' role. As these two streams are quite weak, they are unlikely to join forces and intersect with the politics stream, where no attention to Rooftop gardening (RTG) can be observed at this point. Consequently, the researchers have not seen the RTG issue achieve enough policy momentum.

**Keywords:** rooftop gardening, urban greenness, urban food security, rooftop gardening policy, urban sustainability, public policy

## 1. Introduction

The urban population in the world is increasing. In 2018 global urban population was 55%, whereas, in 1950, it was 30%, and in 2050 the global urban population will be 68% (DESA, 2018). The population growth in urban areas of Bangladesh is 2.5 times higher than the rural areas; at present, the urban population is six times higher than what it was five decades ago, with an annual growth of 4 per cent (Dawla & Rahman, 2012). Dhaka city currently has 21 million inhabitants, where 23 thousand residents live per square kilometre, making Dhaka one of the world's most populated cities (Dhaka North City Corporation (DNCC) 2021). Dhaka city's Air Quality Index shows the worst unhealthy air quality in the world (WAQI, 2021). Furthermore, the city possesses only 5% green space in the older part and 12% in new areas, whereas, for healthy living, the recommended green space is 25% (Tuli & Islam, 2014). The reduction of natural spaces can create an urban heat island, where the urban atmospheric and surface temperature becomes warmer than its natural surroundings (Trotter et al., 2011).

To ensure sustainable development, building sustainable cities is crucial. As per Goal 11 of the UN Sustainable Development Goal (Agenda 2030), 'Sustainable cities and communities; urban food production and green space are considered the basis of urban sustainability. Sustainable cities require food crop production, waste recycling, reuse, and efficient energy use (Doughty & Hammond, 2004). Moreover, urban sustainability depends on the environment's greenness and on reducing food demand from the rural supply. The city suffers from food desert

and food miles; vegetables and fruits are being supplied from distant places at increasing transportation costs while reducing the quality of perishable vegetables. Proper utilization of a vast amount of cultivable space in the cities can produce a large amount of food and reduce the pressure on agricultural land. Plants' leaves and branches may reduce air pollution by deposition solid pollutants and absorbing gaseous pollutants through leaves stomata, assimilation and metabolism of gaseous pollutants (Mori et al. 2018). In the context of Dhaka city, rooftop gardening can be introduced as a viable policy approach that would address the abovementioned concerns and make the city sustainable. A sustainable urban food system and mitigating urban heat island effect strategy is necessary for building sustainable cities (Maye 2019). This policy area is where policymakers of Dhaka city have not focused yet.

In different parts of the world, urban residents practice urban agriculture on a small scale on rooftops, balconies and backyards, community gardens, allotment gardens, parks, commercial farms, nurseries, and greenhouses (Cretella & Buenger, 2016). Rooftop gardening is considered a sustainable approach to mitigating the environmental problem of the city (Younis et al., 2020). Growing population and decreasing environmental diversity in the urban regions require innovative technology favoring ecosystem services and ecological function. From this perspective, rooftop gardens in urban areas can be considered essential tools to improve the ecosystem (Carter & Fowler, 2008). Establishing green space on vacant rooftop surfaces can heal the environmental degradation in urban areas. (Carter & Keeler, 2008). Rooftop gardening can generate employment throughout the city, including private advisory services by skilled gardeners for garden management and marketing of rooftop gardening products; importantly, kitchen waste can produce organic fertilizer. Hence, waste collection cost reduction (Grewal & Grewal, 2012).

Rooftop greenhouses can yield 10-50 Kg/m<sup>2</sup> of fresh fruit and vegetables per year, such as tomatoes, cucumbers, lettuce, and herbs (Cerón-Palma et al., 2012). During the lockdown period, due to COVID 19 pandemic, city dwellers in Dhaka, like other urban areas, faced food shortages, especially the shortage of fresh vegetables and fruits. People had to stay at home for several months. There was little scope for getting vegetables from the kitchen market for family consumption. To deal with this, the Food and Agriculture Organization of the United Nations (UN-FAO) provides directives to its member countries to distribute seeds for establishing home gardening to ensure food security for vulnerable people.

Globally, cities such as Toronto, London and New York have formulated comprehensive urban food policies and shared good practices through the Milan Urban Food Policy Pact (Kasper et al., 2017). In contrast, others have struggled with policy challenges due to not having a clear understanding of the urban food agenda (Moschitz, 2018). Examples of good practices that cities can use as a guide to adapt new policies and practices include the development and expansion of rooftop gardening in the city. Stakeholders, such as city residents, government and non-government organizations, research institutions, engineers, agriculturalists, and agriculture input suppliers can play a key role in the guidance and implementation of such practices (Labuschagne & Zulch, 2016). Urban planning should consider Building Integrated Agriculture (BIA), Zero-acreage Farming (Z Farming), Sky farming and vertical farming type urban agriculture for green urbanism to make the city sustainable for a clean environment and urban food self-sufficiency (Nadal et al., 2017). The absence of government support, such as incentives and increased price hikes for rooftop gardening materials, hinders the expansion of rooftop gardens in urban areas (Zhang et al., 2012). In this rapidly changing policy environment where there is a need for policy to promote rooftop gardening, this research attempts to understand Bangladesh's situation.

Rooftop gardening is gradually transitioning from a hobby to a necessity for residents in Dhaka city, Bangladesh. However, even though the residents have started practicing rooftop gardens to some extent, this has remained a primarily neglected policy area as the city has not yet utilized its massive potential for rooftop gardening. The number of building in urban areas is continuously increasing; there are approximately 400000 buildings in Dhaka city and an average of 1593 sq feet per household. All rooftop structures in Bangladesh are Reinforced Concrete Coarse (RCC) type and can bear heavy loads, favoring rooftop gardening in Bangladesh (Hossain et al., 2019; Pramanik, 2013). Thus, rooftop urban areas are becoming an opportunity to increase cultivable spaces in the country (Uddin et al. 2016).

Therefore, the government of Bangladesh could adopt necessary policy measures and introduce immediate initiatives to establish an institutional structure to facilitate the increase of green spaces in the city (Nayeem et al. 2008). Local government authorities have the potential to collaborate with key stakeholders related to urban development, environment, and food security department, and facilitate the collective action of city organizations to establish a sustainable food system for the city (White & Bunn, 2017).

This research paper explores where Bangladesh stands in terms of introducing a policy to facilitate the expansion

of rooftop gardening in urban areas, and whether adequate support for this policy exists within the present policy environment. The aim of this research is to understand why rooftop gardening has failed to find its place in the policy process of the country, despite having support from the citizens and experts. The authors analyzed the current state of rooftop gardening in Bangladesh with its significant challenges and opportunities, explored the perception held by the city residents and agriculture professionals toward rooftop gardening through surveys and interviews, and discussed the existing institutional structure affecting current rooftop gardening practices.

## 2. Materials and Methods

### 2.1 Materials: Study Site and Stakeholder Groups

The study took place in Dhaka city, the capital of Bangladesh. The city is situated in the middle of the country (23.8103° N, 90.4125° E), it has a tropical savanna climate, and monsoonal season with an average annual rainfall of 1854 mm. The reason for choosing this study site was the high urban growth, high population density, and large number of high-rise buildings.

Two stakeholder groups were considered for this study: Dhaka city residents, and agricultural professionals from the Department of Agricultural Extension and Bangladesh Agricultural Research Institute (BARI), and Sher-e-Bangla Agricultural University (SAU).

### 2.2 Methods: Online Survey, Semi-Structured Interviews and Policy Analysis

Survey and interview questions were gathered from urban agriculture and urban planning literature from other countries. The purpose of these questions was to assess how existing urban gardening policies in other countries can provide guidance to stakeholders and enable them to formulate a rooftop gardening policy in Bangladesh. Two online surveys were design: a resident's survey in Bengali, and an agricultural professional survey in English. Both surveys included an invitation for a follow up interview for those participants willing to contribute to an in-depth discussion. Policy analysis on Institutional approach and recommendations is obtained from the literature.

#### 2.2.1 Online Survey

The survey questionnaire for Dhaka city residents consisted of 13 multiple choice questions. The questions include residents' status of growing fruits and vegetables, driving force, barriers, opportunities of growing crops in the context of environmental, economic, and social, technical issues (infrastructure and knowledge). The survey questionnaire for professionals consists of current Policy support for rooftop gardening (multiple choice answer) and proposed policy support to accelerate Rooftop Gardening (RTG) in the city (level of agreement or disagreement). Due to the emerging COVID-19 pandemic at the time of the study, both questionnaires included a question on whether respondents were like to grow their own food due to COVID-19 pandemic experience using the five-degree Likert scale. Participants that accepted the invitation for an in-depth discussion in the survey were contacted for a follow up interview.

#### 2.2.2 Semi-Structured Interviews

The semi-structured questionnaire included questions on rooftop gardening's driving force, barriers, and opportunities. Respondents also talked about proposed policy support to enhance rooftop gardening, the COVID 19 pandemic and the significance of growing own foods in the city. Interviews were scheduled as 45 minutes online meetings on Zoom. Sessions were available in Bengali and English, and they were audio-recorded for future reference. Audio recordings of the zoom meetings are stored in the Newcastle University research repository (<https://figshare.com/s/58da7d61bb5dc17ef220>).

#### 2.2.3 Analysis of Policy Influence from Other Countries

Literature review of urban gardening and city policy in other countries and comparison in the context of Dhaka city provides recommendations regarding urban gardening and city planning. These include Toronto Municipal Code, 2017; Toronto Green Roof bylaw, 2009; Neo Green Space Design, Guide to Rooftop and Wall Green Technology, Japan; Urban Agriculture Policy, Peru; and Leadership in Energy and Environmental Design (LEED).

## 3. Results and Discussion

The purpose of conducting surveys and individual interviews was to understand the current state, perceptions, existing institutional framework and limitations of rooftop gardening among city residents and agricultural professionals.

### 3.1 Stakeholder Perception of the Current State of Rooftop Gardening in Bangladesh

Survey participants' demographic information was collected, and they were requested to provide their email addresses if they wanted a final copy of the research project. A total of 365 out of 500 participants responded the

Dhaka city residents survey; with a 73% response rate. Among them, 61.71% were male, and 37.4% were female; most respondents were graduates (81.4%) and employed- 51.3%. The survey for agricultural professionals was responded by 58 out of 100 participants invited, with a 57% response rate. They were 65.4% government officials, and 32.7% university lecturers. A total of 9 survey participants were willingly to contribute to an in-depth discussion about rooftop gardening in Dhaka. Interview participants included 3 government organization members from the Department of Agricultural Extension (DAE), two academics from Sher-e-Bangla Agricultural University and four city residents. Interviewees discussed current rooftop gardening practices regarding motivation, obstacles, and the scope of rooftop gardening in the city. Interviewees also provided their opinion on current policy support for rooftop gardening and proposed policy support to accelerate rooftop gardening in the city.

### 3.1.1 Rooftop Gardening Crop Production

Almost all Dhaka city resident participants considered having plants in their living place beneficial (98.9%), and 90% of participants grew fruits and vegetables at a range of skills levels (see Figure 1). Participants preferred to grow on the rooftop (87.6%), and balconies (30.1%). Participants emphasized that they could get fresh and chemicals-free safe vegetables (92%) and fruits (78.7%). In addition, 58% of participants thought a rooftop garden could supplement nutritious food in a daily diet. Besides these, 62.9% of participants mentioned that rooftop gardening could reduce the building temperature. Rooftop gardening practices remain in supplementary stages (see Figure 2) with harvest annual yields per resident ranging from 2 to 44 Kg per year, as shown in Table 1.

Generating income through gardening is little; with very few residents consider rooftop gardening a commercial activity. From rooftop harvest, one hundred twenty-three participants earn money. Thirty-three participants made money from 2 USD to 1200 USD per year from rooftop gardening. Nine participants distributed extra produce among neighbors and relatives as a gift. The rest did not think about earning money.

### 3.1.2 Social Aspects of Rooftop Gardening

Survey participants responded that Dhaka city lacked open green spaces and parks and that motivated them to do gardening on the rooftop mainly to get mental freshness (92.8%) and escape a sedentary lifestyle (81.9%). Among the participants, 53.3% considered practical gardening education for children in plant science, and 43.6% of participants believed rooftop gardening promotes social interaction and a sense of community.

City residents later interviewed said that retired people and homemakers can engage in productive work and exercise through gardening. However, interviewees also pointed out some challenges regarding rooftop gardening. For instance, they identified multiple ownership of building in the city as the bone of contention in sharing rooftops for gardening. Rented flat house owners do not have access to the rooftop for gardening; as a result, tens of thousands of rooftops remain empty without gardening.

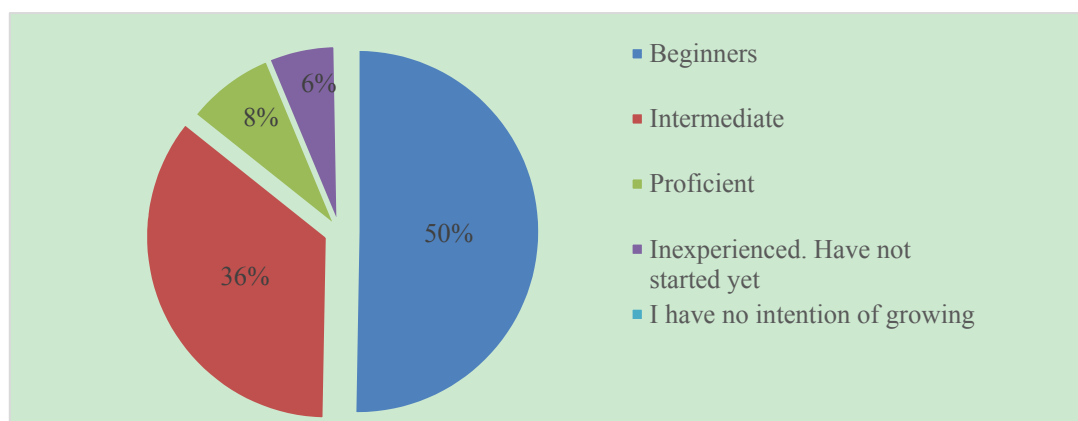


Figure 1. Level of growing fruits and vegetables of Dhaka city residents

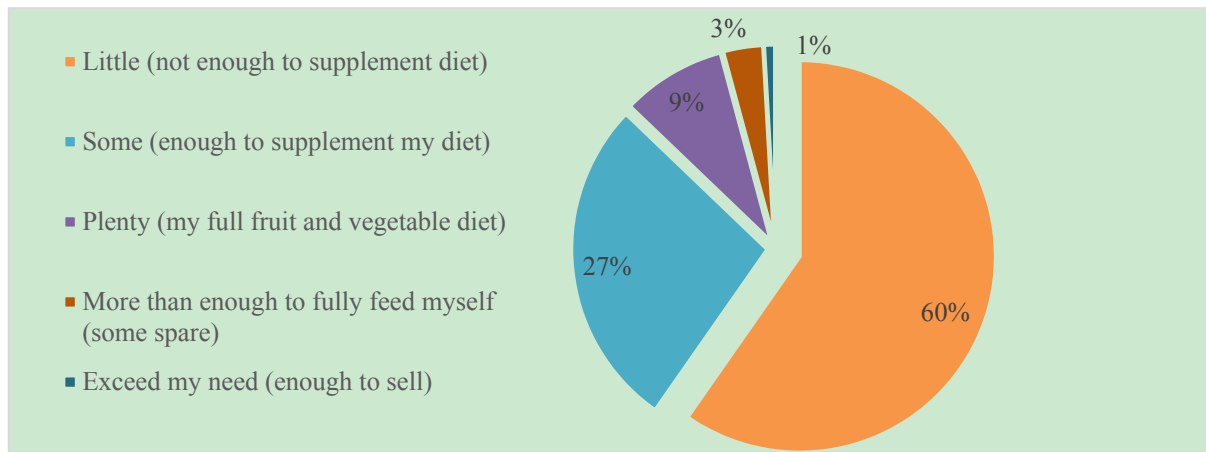


Figure 2. Amount of produces harvested by rooftop gardeners

### 3.1.3 Economic Aspects of Rooftop Gardening

Although the current number of city residents producing enough food to sell was low (1%), residents considered harvesting from rooftop gardening as an income-generating tool. Most survey participants thought that RTG could supplement the daily need for fruits and vegetables, allowing the residents to save money instead of buying from markets. Supplementation in diet and generating revenues from rooftop gardening motivated 81.8% and 48.2% residents to garden, respectively. Experiencing a food price hike drove one-fourth of respondents to garden on the roofs. However, commercial rooftop garden production was limited to 12.5% of survey participants. Most participants considered the high initial garden set-up cost (69.2%), and the lack of extra money to invest in gardening materials (43.8%) a significant barrier. Most participants were in favor of funding opportunities for the gardening community and small enterprises (60.1%), incentives in holding tax and water bills-(60.1%), and subsidies for initial garden set-up (58.2%).

Table 1. Dhaka city residents' harvest from the rooftop (Kg per year)

No. of participants	Fruits / Vegetables type	Kilo gram/ year/ Participant	Total (Kg)
96	Fruit and vegetable not specified	44.6	4282
33	Tomato	19.69	650
10	Leafy vegetables	7.7	77
4	Brinjal/ Eggplants	8	32
4	Green chilli	2.5	10
3	Indian spinach	9	27
2	Bitter gourd	10	20
2	Okra	10	20
1	Long yard bean	2	2
1	Ridge gourd	3	3
1	Bottle gourd leaves	20	20
1	Snake gourd	20	20
1	Bean	20	20
1	Sponge gourd	8	8
1	Sajina	1	1
1	Mint	30	30
1	Lemon	2	2
1	Fruits not specified	80	80
4	Mango	10	40
3	Guava	9	27
2	Dragon fruit	2	4
1	Papaya	30	30
1	Wax apple	20	20
1	Hog plum	3	3
2	Jujube/Bar	3	6
1	Pomegranate	3	3
1	Orange	5	5
1	Sugarcane	5	5
1	Pineapple	2	2
Total number of participants -180		30.27	5449

*Note:* For the Participants that said pieces instead of Kilogram, the values were converted to Kg by approximation (e.g., 10 Pieces of orange =1 kg orange, two pineapples = 1kg pineapple, ten pomegranate=1kg pomegranates, five sugarcane =1kg)

Surveyed and interviewed Dhaka city residents and professionals considered the COVID 19 pandemic as an opportunity that has encouraged the city residents to grow vegetables to meet their consumption needs during the lockdown period (see Figure 3). Participants thought that urban agriculture could play a crucial role in food security and self-sufficiency in the post-COVID-19 era. During the interview discussion, a city resident said:

*During the lockdown, they faced little difficulties as they cultivated vegetables on the rooftop; they planted Indian spinach and red amaranth in all containers along with other plants. They did this to get some vegetables to meet daily minimum requirements. The rooftop garden gave them relief and kept stress-free providing necessary vegetables, and they had worked together in the garden'(Interviewee 1: city resident participant).*

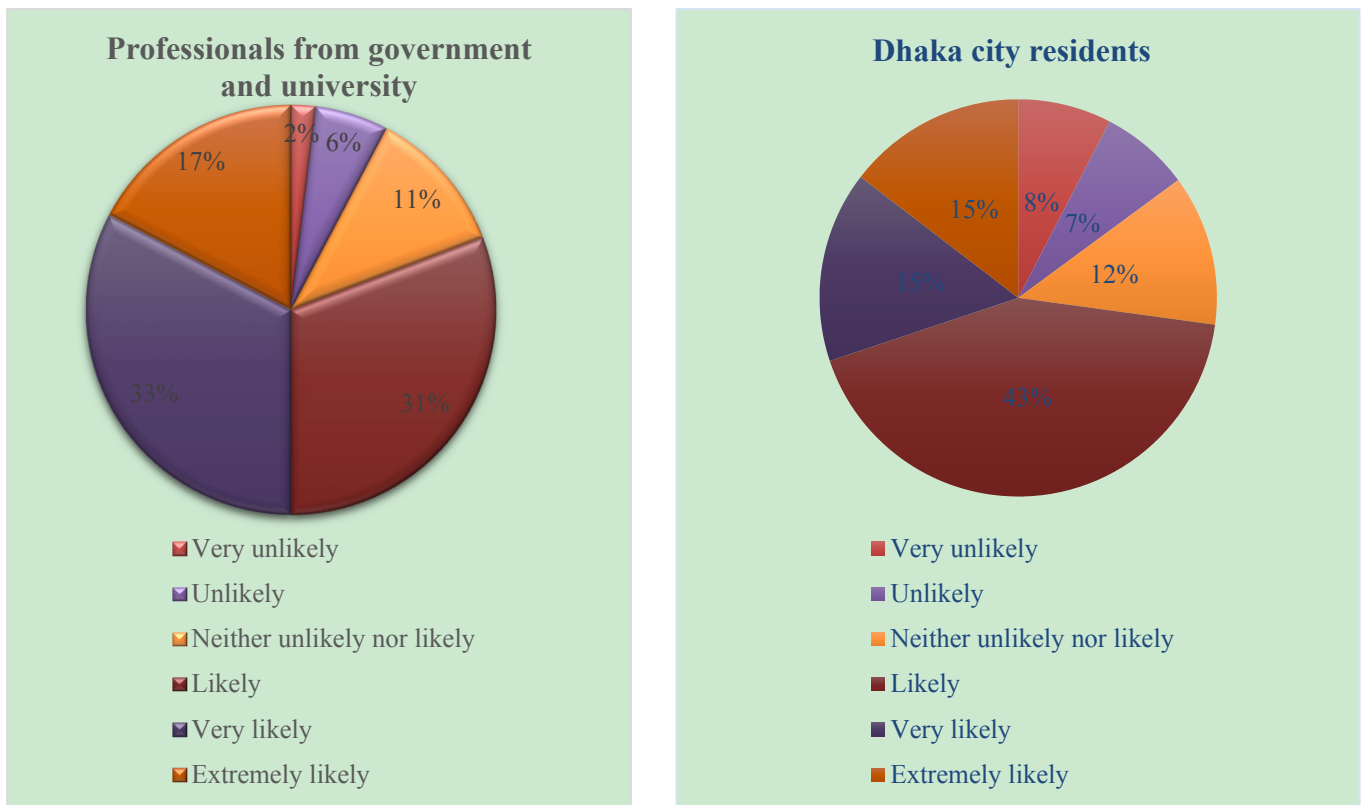


Figure 3. COVID 19 pandemic and the likelihood of growing vegetables and fruits by professionals and city residents

### 3.1.4 Environmental Aspects of Rooftop Gardening (RTG)

Most survey participants consider rooftop gardening to achieve environmental sustainability in the city. Among them, 86.5% thought rooftop gardening practices increase urban green spaces, and two-thirds of respondents believe rooftop gardening reduces CO<sub>2</sub> through carbon sequestration, air pollution, and building temperature.

### 3.1.5 Technological Aspects of Rooftop Gardening

Dhaka city residents interviewed identified obstacles such as, unavailability of seeds, planting materials, soil, rooftop garden materials, booklets, lack of training, and technical information and advice as the main drawbacks of rooftop gardening. Expert opinion on current policy support in urban agriculture in government projects and agriculture offices in the city favors rooftop gardening 67.3% and 65.3%, respectively. On the other hand, in the interview, professionals identified insufficient workforce and logistic support as a significant constraint to providing advisory services to the city residents. City residents (75.7%) seek advisory assistance from government agriculture extension officers; they also consider network formation among rooftop gardeners as a support group to help each other, and hands-on training on horticultural crop production is 69.8% and 68.6%, respectively.

## 3.2 Institutional Framework for Rooftop gardening in Bangladesh

### 3.2.1 Existing Institutional Framework for Rooftop gardening in Bangladesh

The National Agriculture Policy (NAP), 2018 of Bangladesh proposes that 'Urban agriculture has to be brought into mainstream agriculture, and that commercial production in rooftops will be facilitated'. This policy mentioned that both government and non-government sectors would be engaged in rooftop garden research and extension activities (National Agriculture Policy, 2018). Technical support for urban agriculture development and extension will be provided (Ministry of Agriculture (MoA) 2020). However, implementing this general statement is no specific to provision and strategy. The existing initiative on rooftop gardening in Bangladesh is not enough to harvest the full potential for agricultural production in urban areas. Rooftop gardening and urban agriculture should be incorporated into urban planning (Islam et al., 2019a)

### 3.2.2 Limitations of Existing Institutional Framework and Policies toward Rooftop Gardening in Bangladesh

Dhaka city's urban development strategy and planning do not consider urban agriculture. National agriculture policies do not specify the extension of urban agriculture. They do not mention specific measures that would encourage the responsible government agency to expand RTG into Dhaka and other urban areas. Government policies do not mention the role of city organizations such as the City Development Authority, City Corporations and government agencies such as the Department of Agricultural Extension, Arboriculture of Roads and Highway Department in urban agriculture. Legal instruments such as Bangladesh National Building Code (BNBC) do not specify rooftop gardening provisions in the building specification; which can legally bind the developers to set up rooftop gardens in newly constructed buildings (Safayet et al. 2017a).

Due to the lack of appropriate policy support, Dhaka city's rooftop gardening does not get production momentum. Consequently, half of the participants (50%) remain at the beginners' level in rooftop gardening in Dhaka and one-third of the respondents stay at the intermediate level (Figure 1). The absence of proper policy and guidelines leads more than half of the participants (60%) to harvest little amount from their RTG that cannot supplement their diet. Among the participants, only nine per cent can harvest plenty of fruits and vegetables from the rooftop garden that can meet their daily needs (Figure 2). The huge gap between poor and plenty of harvest from RTG indicates massive opportunities to enhance RTG production through appropriate policy support.

Different studies have also pointed out these limitations and argued that harvesting the massive potential of greening and food crop production through rooftop agriculture should be incorporated into urban agriculture (Islam et al., 2019b; Safayet et al., 2017b). According to these authors, the government should initiate training and awareness-building programs for rooftop farming on a large scale in Dhaka city and the urban areas across the country; the government's largest extension service provider agency Department of Agricultural Extension, should work more to spread rooftop gardening and related technology through the support from NGO's, community organizations and development partners (Chowdhury et al., 2020)

### 3.2.3 Institutional Framework toward Rooftop Gardening in Different Countries

The adoption of urban food strategies among cities in developed countries' is increasing rapidly. In these countries, the key policy instruments for urban food production are named as plan, strategy or charter (Alemu & Grebitus, 2020; Sonnino, 2016). Countries such as Canada, Germany, Japan, Hongkong, and Singapore, consider green roofs as environmental healing of negative impact of building in urban areas. These countries have the mechanism for expansion of the green building and motivate the building owners by giving incentives and easing regulations (Ismail et al., 2012). The 2001 Tokyo plan directed any new building size 1000m<sup>2</sup> and a more must-have minimum of 20% of green roof. Chicago city of USA and Hamburg, Germany, practice legal bindings and motivation with incentives for urban gardening (Massonneau 2012). In Latin America, urban agriculture is one of the crucial sources of safe and nutritious food for urban residents; stakeholders involved in urban management claimed government intervention nationally and regionally to introduce demanding urban housing policies and incentives (Nadal et al., 2018). Nowadays, the municipalities in various countries, especially in Europe and North America, officially recognize the importance of urban agriculture in their urban planning and food policy documents to ensure sustainable development and better city life with a quality environment (Cretella and Buenger 2016). UN-FAO launched the City Region Food Systems (CFRS) Programme intending to boost rural-urban interactions to enhance the regional agro-food system, and Milan Food Policy Pact makes a forum of 240 cities around the world to share urban food policies and strengthen the local food system (Samoggia et al., 2021). Table 2 illustrates international examples of policy and good practice against current ones in Bangladesh

## 3.3 Stakeholder Attitudes towards Future Policy Interventions

### 3.3.1 Urban Agriculture and Urban Planning

In the survey, 84.6% of agriculture professionals prefer incorporating rooftop gardening in urban planning, and 84.0% of residents favor introducing a city-specific rooftop gardening model for sustainable expansion of rooftop gardening. During the interview discussion, a professional participant said:

*“Construction of rainwater harvest in all public and private buildings should be mandatory. Compost chamber, polytunnel, storeroom and other permanent structures needed for rooftop gardening should develop during the building construction phase. Water reuse and use of greywater can do sustainable urban gardening; otherwise, the city may face water crises during the dry season”.* (Interviewee 2: Professional participant)



Table 2. Comparing policy instruments of Dhaka city with the city of other countries

<i>Policy Instruments</i>	<i>City/ Country that Practices the Policy Instrument</i>	<i>Status in Dhaka, Bangladesh</i>
Green roof bylaw	Toronto, Canada (Green Roof Bylaw, 2017)	City corporations do not have green roof legal instruments.
High Tech Urban Agriculture such as hydroponics, indoor horticulture and vertical farming	Shanghai, China (Hosseinifarhangi et al., 2019)	Lack of high technology in rooftop gardening.
-The urban garden produces marketing facilities and quality assurance measures. - Awards the city gardener. - Develop a rooftop garden and provide a training course for city farming	Bangkok, Thailand (Boossabong, 2019)	- Marketing facilities for rooftop garden produce are not available. - Rooftop gardeners are awarded on a limited scale in a national vegetable fair organized by the agriculture ministry.
Support set-up of the urban garden, including rooftop garden through incentives	Taipei, Taiwan (Hou, 2020)	To some extent: recently government launched a pilot project; through this, it set up a demonstration of rooftop gardens in residents' buildings and school premises.
Established Urban Agriculture Division (2004)	Municipality of Villa Maria Del Triunfo, Peru (Villa María Del Triunfo, Peru: Urban Agriculture Policy, 2005)	Dhaka South City Corporation and Dhaka North City Corporation lack an agriculture division.

### 3.3.2 Formulation of Urban Agriculture Policy

Most agriculture professionals surveyed (88.7 %) thought the government should formulate an urban agriculture policy. Government and university agricultural professionals interviewed said that national agriculture policy does not specify how to expand rooftop gardening. The existing agriculture extension approach focuses on rural areas; urban areas are not appropriately addressed. Formulating a separate policy on urban agriculture is needed to address the present demand. During the interview discussion, a city resident said:

*Before formulating the urban agriculture policy, identifying constraints of this sector is important. For effective coordination among several organizations, formulate separate policies in urban agriculture to specify the role of different stakeholders and the pros and cons of the gardening practices in the city. The government should formulate urban agriculture policy considering the social structure.* (Interviewee 4: City resident).

According to another city resident interviewed:

*Agriculture is changing; we should cope with the changing environment and science; government should incorporate the essential things in the new policy* (Interviewee 5: City resident).

### 3.3.3 Urban Agriculture and Legal Obligations

In the case of provisions of introducing legal obligations for rooftop gardening, survey participants showed a mixed reaction. City residents sought legal obligation to rooftop gardening (49%) and considered that tenants have the right to garden on the building rooftop (44.3%). When agricultural professionals in government and university were asked whether legal requirements could enhance rooftop gardening, 24% strongly agreed, 40% agreed, and 24% neither agreed or disagreed.

During interview discussions, city residents had mixed reactions. One resident said

*legal provision is very much needed to address the issues such as multiple ownership of building, tenants and landlords rights preservation, building developers for constructing a permanent gardening structure in the rooftop, before complete handover garden set up by the developers.* (Interviewee 5: city resident)

While another resident thought that

*legal bindings may not be fruitful as lots of laws are enacted but not become effective. Motivation and mutual settlement should give priority before legal impose.* (Interviewee 1: City residents).

Agricultural professionals interviewed made suggestions regarding flat tenants, flat owners, and developers' legal obligations. They said:

*Tenants should rent a portion of the rooftop to establish the rights for gardening like renting the car park. Building developers should construct the permanent structure for cultivating vegetables and vine-type plants on rooftop and water reservoirs for watering the plants.* (Interviewee 2: agricultural professional).

*While handing over the flat, the developers can make a garden on rooftop and hand over the garden to the flat owners' association; association can appoint a gardener for full-time management of the garden* (Interviewee 3: agricultural professional).

*Real Estate and Housing Association of Bangladesh can agree that all the developers must construct a permanent structure for rooftop gardening in the building. Rajdhani Unnoyon kartrepakkho (City development Authority) engineers will be responsible for the supervision of the permanent structure* (Interviewee 9: agricultural professional).

#### 3.3.4 Financial Support for Rooftop Gardening

City resident and agricultural professional participants agreed that policy support in the form of financial support would enhance rooftop gardening practices (Figure 4). In more detail, those interviewed made suggestions on the type of financial incentives and corporate service local governments could provide Participants said:

*Government should give financial incentives for rainwater harvest and rooftop garden structure construction for both government and private projects* (interviewee 2: agriculture professional).

*Government may assist by giving some sorts of seeds to encourage, for instance, the government can distribute vegetable seeds among household owners at the beginning of the season; though the price is not high, this is a token of togetherness for motivation and encouragement* (interviewee 4: city resident)

*Motivation and technical guidance are helpful for the effective rooftop garden. Arranging a motivational tour in a model garden can encourage people to garden; they need the security of the building and the garden, technical support and marketing channel and formula of sharing revenues among building residents* (interviewee 5: city resident and interviewee 9, agriculture professional).



Figure 4. Level of agreement towards policy support in the form of financial support to enhance rooftop gardening

### 3.3.5 Stakeholder Engagement: From Urban Gardening Production to Social and Commercial Activities

Agriculture professionals (78.9%) agreed that large commercial and corporate building structures in the city could practice rooftop gardening. This agrees with statements from city residents interviewed:

*“At least 50% of the rooftop space of government and private office buildings must bring under gardening through government directives. The government should consider rooftop gardening in a strategic policy plan. Establishing sell centers in public office buildings so that employees can buy their office building grown fresh fruits and vegetables”* (interviewee 1: city resident).

*“Government can motivate the corporate bodies by awarding and recognition for the contribution to greening the city; these should well circulate in newspaper and media so that other organizations are motivated”* (interviewee 4: city resident).

*“Professional bodies can look for vacant rooftop spaces in the city, motivate the owners, and provide professional gardening services, such as technical advice, supplying materials, and skilled labourers to ease the garden management operations”* (interviewee 5: city residents).

Urban gardening clubs could be formed for likeminded people to meet, share rooftop gardening experiences, and exchange plant materials. Agricultural professionals largely agreed that the formation of the Urban Gardening Club could engage more people effectively in rooftop gardening (28.3% strongly agreed and 52.8% agreed). Forming an urban gardening club could boost gardening in the city and act as an extension service platform. These clubs may serve as collection points and sales centers for rooftop gardening products. City corporations and government agricultural extension departments could incentivise and reward rooftop garden owner through environmental department initiatives such as the 'Environment Friend Resident' award to recognize green activities.

Supermarkets, such as ‘Super shop’ could establishing a urban farming products sales corner in their supermarket stores to attract more people into rooftop gardening. Although marketing rooftop gardening products could be a problem because crop production is often low (as shown in table 1), and production cost is higher than growing in the ground, resident and agricultural professionals said that:

*“Super shop and Horticulture Export Development foundation can connect to the rooftop gardener; they can sign a memorandum of understanding and rooftop gardener sell their products to super shop with good price”* (interviewee 2: agricultural professional).

*“Super shop in the city can keep a corner for selling planting materials, rooftop gardening materials, as*

*well as buying and selling of rooftop gardening products. Super shops can make a garden in a large building in the city, and they can produce and sell in their shop” (interviewee 4: city resident, and interviewee 8 agriculture professional).*

Coordination of stakeholder organisations through the establishment of the "Urban Greening Development Authority" was thought to be necessary to enhance rooftop gardening in the country. Survey participants agree on the importance of establishing a government body to facilitate urban greenery and agricultural practices (34.6% strongly agreed and 42.3% agreed, while 13.5% strongly disagreed). Participants interviewed made the following recommendations:

*Provision of government authority dedicated to urban greening and urban agriculture, for instance, 'Urban Green Development Authority' or 'City Environment Development Authority.' can ease the complication of urban greenness and coordinate the organizations involved in urban management.” (interviewee 5: city resident).*

*City Development Authority, namely 'Rajdhani Unnoyon Katripakkha', can establish a rooftop gardening section to construct and maintain. The public works departments can increase the workforce in roadside plantations so that road dividers can utilize cultivable spaces in the city. Department of Agricultural Extension (DAE) can establish an urban agriculture wing to provide advisory service in the city. City corporation can establish urban agriculture section so that they can visit the garden and confirms the rebate entitled flat owners and building owners”(interviewee 1: city resident).*

*City corporation can take the leadership in RTG in the city; People are familiar with city corporation, and they are used to city corporation services so that they lead the urban gardening in the city” (interviewee 4: city resident).*

*Department of Agricultural Extension (DAE) can play a significant role in rooftop gardening; to promote the green movement in the city; DAE can provide best quality effort in expansion of rooftop gardening in urban areas”(interviewee 9: agricultural professional).*

### 3.4 Policy Procedures Needed to Enable Stakeholder Institutional Recommendations on RTG to Be Implemented

There is widespread support to introduce policy initiatives in favor of Rooftop Gardening (RTG). Most city residents considered it essential for their food security, good for the environment, and a important contributor towards achieving the goal of sustainable cities. Whereas most city resident have not adopted it as a viable commercial activity, almost all were willing to do so if suitable opportunities, financial support and technical information were provided. They thought existing policy frameworks and institutions were inadequate to support RTG, and that. the government should initiate new policies and design and strengthen the existing institutional framework to support RTG. It is also important to note that city residents thought that RTG can protect them from uncertainty, just as it did during the time Covid-19 restrictions were implemented.

Agricultural professional and members of the academia, agreed with city residents on the potential of RTG, the limitations of current government policies and the necessity of new policies. Furthermore, they provided several policy suggestions. Overall, there was strong support and agreement regarding the necessity of a policy for RTG. However, despite this agreement, RTG has not become a part of the policy agenda, and there was no demand for a RTG policy. Therefore, the question remained, why had RTG not succeeded in gaining the necessary attention and support to implement it?

It is crucial to consider the policy process e to find an answer to the failure of RTG to be a part of the policy agenda through the general policy cycle model. The policy cycle model starts with agenda-setting and then shows how the policy experts work in findings solutions to a problem once the agenda is set (Smith & Larimer, 2018). The problem with RTG is that it has not reached that stage where policymakers would work on finding solutions. As we are neither trying to identify winners and losers in the case of RTG (where social construction would have been helpful) nor trying to explore the process of policy change (where punctuated equilibrium would have been suitable) (Givel, 2010; Helen Ingram, Anne L. Schneider, 2007; Jones & Baumgartner, 2012; Schneider & Ingram, 1993). From this perspective, the Advocacy Coalition Framework (ACF) is also ineffective.

Conversely, the Advocacy Coalition Framework (ACF) shows how two contrasting coalitions can reach a consensus about a policy solution incrementally (and make compromises along the way) while working through stable and dynamic policy parameters. By working through their deep core, policy core or secondary belief, in the case of RTG, we cannot see two contrasting coalitions fighting for the government's attention. Instead, in this case, one group comprising the city residents and agricultural experts are trying hard to frame RTG as a solution to a policy problem while not defining that problem in political terms. In other words, they are not facing challenges

from a rival coalition; instead, they are just waiting for opportunities to reach out to the policy actors (Jenkins-Smith & Sabatier, 1994; Sabatier, 1998; Sabatier & Weible, 2019).

The Multiple Stream Framework (MSF) developed by (Kingdon, 1993) provides a better explanation. According to MSF, three different streams work simultaneously in formulating a policy: the problem stream, the policy stream and the politics stream. The problem stream mainly deals with the policy problem and allows a 'public problem' to draw national attention; in this stream, an issue eventually becomes an agenda. However, the transformation into an agenda does not necessarily mean that the problem would draw the attention of the policymakers. In parallel to the problem stream, the policy stream deals with solutions; in this domain, the policy experts work to find solutions. (Kingdon, 1993) made an important point 'whereas the common understanding is that the problem will look for a solution, in practice, it can go the other way around', i.e., in some cases, the solution may search for a problem. In other words, it means that the experts can work on a problem and find its solutions without having a clear idea of when the policymakers will adopt the solution. The solution remains stored, and when a problem requiring a quick action arises, the policy experts may pick up the already formulated solution and attach it to the problem. This assertion indicates that having a problem and a solution does not ensure the adoption of a policy; this is where the politics stream comes into play. For a policy to be adopted, the political actors need to focus on a specific problem that they would desperately try to solve. In effect, the political actors have to deal with several problems at a time, and only a few draw their attention.

Moreover, since they usually have very little time to react, they cannot wait for a solution for long. Important to note that of different problems, a particular problem may become significant due to a crisis, a substantial shift in public opinion or probably due to political promise. In these cases, the political actors have to respond. According to MSF, the government makes policy when these three streams- politics, policy and problem collide with each other, and this collision opens a very short-lived 'policy window'(Zahariadis, 2019)

Based on this study, if we consider the case of RTG in Bangladesh, it is possible to argue that there is a demand for rooftop gardening, but the 'problem stream' has not been adequately defined yet. Even though there is an understanding among the general population and experts on how RTG could contribute to solving environmental issues and building sustainable cities, these problems have not been defined in political terms. In other words, the 'issue-framing' is missing here, which will make the political actors interested in this particular issue. In effect, the study shows that in the case of Dhaka city, the issue-framing is still at a very early stage. At the same time, it is also important to note that even though the experts understand its value, they have not managed to raise enough awareness on this issue to be actioned.

Consequently, we are not observing a solid support network, issue network or coalition in this domain. Furthermore, the policy stream also needs some work. Stakeholders interviewed proposed several legal measures. However, further evidence would be needed to support them. From this perspective, the experts have not played an adequate 'instrumental' role. As these two streams are weak, they are unlikely to join forces and intersect with the politics stream, where no attention to RTG can be observed at this point. Consequently, we have not seen the RTG issue achieve enough policy momentum. For RTG policy to be implemented through institutional approach any or all of the following should happen:

- Experts come up with strong empirical evidence that show how specific tools or approaches adopted for RTG can make a significant contribution to solving a critical emerging problem (i.e., environmental problem);
- The country or city faces a severe crisis (possibly environmental or food security) where RTG can be considered as a viable policy solution;
- Public opinion in favour of RTG intensifies and the political actors are forced to commit themselves to focusing on rooftop gardening.

Up to this point in time, we are observing neither of the scenarios mentioned. That is why support from the city residents and experts are not necessarily transforming into effective policy intervention.

#### **4. Conclusion**

This study investigated current rooftop gardening (RTG) and policy guidelines in line with other countries to respond to city resident's rooftop gardening constraints and to why it has not emerged as an important policy issue. City residents and agriculture professionals identified a wide range of rooftop gardening constraints. They include the unavailability of rooftop gardening inputs, gardening tools, equipment, technical knowledge, multiple ownership of the building, tenants' lack of a right to garden, and difficulties marketing rooftop gardening produce. They suggested addressing these issues, incorporating agriculture in urban planning, formulating urban agriculture

policy, and introducing legal provisions. In addition, these stakeholders suggested financial support for establishing model rooftop gardens, incentives and recognition for contribution to the urban environment through rooftop gardening, and the establishment of an independent government body to work specifically on rooftop agriculture in the city urban areas. This research is the first in-depth study in Bangladesh for growers and institutional stakeholders to identify the status and possible policy solutions to rooftop gardening in Dhaka. It provides information on the grower's expectations and agriculture professionals' views on addressing the issues. Compared to other countries and cities policy support, the city of Dhaka lags institutional involvement in city management needed to adopt urban gardening policy measures. In recent times policymakers have been considering rooftop spaces as cultivable spaces for the country's Food and nutrition security and urban sustainability. However, such considerations have not translated into policy documents yet. Concrete policy guidelines stating the specific provisions are required to accelerate rooftop gardening in the country's cities and other urban areas.

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