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RESEARCH ARTICLE

HUMAN PERSPECTIVES ON ROOFTOP GARDENING FOR ENSURING FOOD SECURITY IN COVID-19 SITUATION IN DHAKA CITY, BANGLADESH

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ABSTRACT

Introduction: To ensure greenery in this busy city, the trend of growing vegetables on green roofs has gained momentum as a way of promoting agricultural sustainability in Dhaka City. However, due to the pandemic havoc caused by COVID-19 outbreak, people now a days have realized the extensive need for such green practice in urban areas to ensure their own food security. Objections: The objectives of this study were to explore the necessity of small-scale gardening or rooftop gardening (RTG), how it helped people by providing their food demands during this pandemic situation. By following the purposive random sampling technique, a total of 100 respondents (who were already practicing RTG) took part into the survey from two city corporation areas named Mirpur, Uttara (Dhaka North City Corporation) and Dhanmondi, Malibagh (Dhaka South City Corporation) areas of Dhaka city. Results and Discussion: Results of the study showed that more than 60% of the respondents got direct support from their roof top gardening during this COVID-19 situation. Almost 41% of the respondents claimed that this food supply was enough for them to sufficiently meet their need for vegetables for a single day. Most importantly, more than 90% of the respondents shared that, if provided with proper training and necessary supports, roof top gardening can be the best solution to ensure food security in post pandemic world. Conclusion: In the end, some recommendations have been suggested on how it can be used to ensure food security in countries with less agricultural lands like Bangladesh.

KEYWORDS

RTG; Food Security; Low-Cost Farming; COVID-19; Global Pandemic Situation.

1. INTRODUCTION

Since its independence, the economy of Bangladesh is mostly dependent on its agriculture. But with the recent changes in its economy, urbanization and industrialization have taken over agriculture and as a result, the country's net available cultivable land is being decreased day by day. Today in this urban planet, 54% of the world's population are living in urban areas and the share is expected to increase to 66% by 2050 (United Nations, 2014). Dhaka the capital of Bangladesh, is one of these cities which will be a megacity by 2030 with 27 million people and by 2050 with 35 million having a present population density of 50000 per square kilometer (Bdnews24.com., 2014; The Daily Star, 2019). With this rapid as well as unplanned urbanization, incidence of urban poverty and food insecurity has been escalating alarmingly in Dhaka city (Choguill, 1995). Because of urban sprawl and settlement scheme for the growing population, the rate of land transformation in these areas is very high which is posing a great threat to meet the demand of urban inhabitants with sufficient nutritious food (Thornbush, 2015). It is a common practice to use the suburb area to satisfy the daily food demand of city dwellers basically fruits and vegetables. As the rate of urbanization increases over time, food production sites should be increasingly located near main consumption centers (Grigoletti et al., 2014). Moreover, many cities in the world are facing problems like rapid decrease in green space and increase in heat island effects. Urban agriculture or farming is promoted as a potential solution to these problems (Smit et al., 2001).

Implementing rooftop farming can be a possible solution to reduce the food supply problems, make urban living more self-sufficient and make fresh vegetables more accessible to urban individuals. It is estimated that 10,000 ha space of Dhaka city can be brought under rooftop farming and the residents of the city can taste fresh vegetables as well as over 10 percent of the demand can be fulfilled through rooftop farming (Wardard, 2014).

During the ongoing global pandemic situation, the people of the world first faced the challenges of economic falls followed by a price hike in food supplies particularly in fresh vegetables. Dhaka City as the capital faced it intensely as it has more than 17 million people to support with almost lesser agricultural fields nearby where most of the local supplies come from the rural areas. So, in the beginning of the lockdown situation, people were mostly helpless just because they had to solely rely on their supplies, and they had no alternatives than purchase goods at a higher price than regular.

The aim of this study was to address the importance of RTG and how it can be an emerging alternate of conventional cultivation method and to explore the best possible ways of utilizing vacant spaces in roof top for urban farming that can bring about possible changes in ensuring sustainable small scale agricultural practices in urban areas through agricultural extension. Moreover, the study also focused to find out the percentage of people who are practicing RTG in some places of Dhaka City Corporation areas and to find out the significance of this practice from the perspective of their socio-economic condition.

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2. Significance of Roof -Top Gardening (RTG)

2.1 Ensuring sustainability and food security

Urban sustainability means that a city can be organized without excessive dependence on the surrounding countryside and be able to power itself with renewable sources of energy. The purpose is to create the least possible ecological footprint and to produce the minimum quantity of pollution possible, to efficient use of land, compost used materials, recycle it or convert waste-to-energy and to make the city's complete contribution to climate change minimal. Urban sustainability can be achieved through the sustainability of social, economic and environmental issues. Along with other initiatives and activities, urban rooftop farming, therefore, has an important role in contributing towards the future sustainability of cities (Safayet et al., 2017).

A recent study addressed that, the increase in local food production and sale, increase in food security and property value, improvement of roof durability, reduction in building cooling load and energy costs, increase availability of biofuels etc. are means of economic sustainability through rooftop farming. It is possible to achieve environmental sustainability through reduction in carbon emission food transportation, reduction of wastes by generating less packaging, recycling of organic wastes by composting, mitigation of urban heat island, increase in biodiversity, improvement of air quality urban storm water management, capacity of sound insulation and noise absorption etc (Hui, 2011).

Roof top gardening (RTG) can be an effective method in ensuring food supply and satisfying nutritional needs of the inhabitants as well as can reduce the expense of heating and cooling and at the same time improving urban air quality (Peck, 2003; Walters et al., 2018). It is the practice of cultivating different vegetables, flowers, plants, and herbs for aesthetic purpose on roof. Cultivation on the rooftop of the buildings in urban areas is usually done by using green roof, hydroponics, organic, aeroponics or container gardens (Asad et al., 2014).

2.2 Variations in farming methods across the world

According to previous study, in Singapore, inorganic hydroponics is considered the more appropriate farming option in Singapore, compared with conventional soil culture, in the government housing buildings as it has higher yield, lower labor requirement and needs only lightweight systems, which can be easily assembled over an existing roof (Astee and Kishnani, 2010). Various vegetables like lettuce, black cabbage, chicory, tomato, aubergine, chili pepper, melon and watermelon are grown by rooftop gardeners either in plastic pipes, recycled pallets filled with compost or on polystyrene panels floating in tanks, also made from recycled pallets in Bologna, Italy (Science for Environment Policy, 2015).

Based on a study stated that, as different kinds of kitchen wastes are produced in houses, canteens, mess and hotels in the form of vegetable and fruit waste of different types (fruit, vegetable, vegetable and fruit remains and peelings), eggshells and coffee sediments, tea and coffee filter bags, tainted food, non-liquid cooked food waste, bones, stale bread and biscuits, tissues, paper towels and paper sacks that are biodegradable, so these wastes can be converted into humus by composting by various micro-organisms including bacteria, fungi and *actinomycetes* in the presence of oxygen. Later on, this humus can be used in rooftop vegetable production that is extremely useful (Wilson, 2009).

A study, expressed that, approximately, 25 vegetables are grown in the rooftop gardening in Bangladesh. It is estimated that in Dhaka city brinjal (61%), Indian spinach (47.8%) and chilli (45.3%) and gourds (25%) are produced in rooftop farming (Mamun et al., 2018). It is also calculated that in Chattogram city brinjal (48%), Indian spinach (35.7%), gourds (35.6%), lady's finger (31%), tomato (23.7%), red amaranth (23%), bean (18%), cabbage and cauliflower (7%) are grown. Agricultural Extension Division provides training and necessary logistics to the individuals for roof gardening and horticultural development. Roof Garden Association (RGA) in Bangladesh is conducting "Green Roof Movement" which focuses on technical and financial aspects of roof gardening (Uddin et al., 2016).

2.3 Economic benefits of RTG

A study reported that the purpose concerning financial gain from roof gardening is a very minor concern (4% only) in Dhaka Metropolitan city of Bangladesh (Sajjaduzzaman and Muhammed, 2005). On the other hand, there described the economic and social benefit of rooftop gardening including fresh food supply for urban residents, converts the hard surface into a soft green surface, energy saving, etc. (Rashid et al., 2010).

3. Methods

3.1 Study area

During this research, the Dhaka City Corporation (DCC) area was taken into consideration as study area since the percentage of rooftop gardeners are promising in number.

3.2 Data collection

This study was carried out mostly based on primary data more specifically questionnaire survey by a walk and talk interview. The survey was carried out between Mid-May to Mid-July, 2020. By following the purposive random sampling technique, a total of 100 respondents (who were already practicing RTG) took part into the survey from two city corporation areas named Mirpur, Uttara (Dhaka North City Corporation) and Dhanmondi, Malibagh (Dhaka South City Corporation) areas of Dhaka city. Secondary data was collected from recent publications from articles of newspapers and scientific journals.

4. Results and Discussion

4.1 Demographic status of the respondents

The interesting part of this section is that, both male and female respondents who were engaged in the survey were equal in number. From the educational perspective, the respondents were from secondary to post graduation though majority of the respondents were highly educated. One of the interesting things is that, none of the respondents have done any training on gardening, yet they are just doing it from their own interest and using their own knowledge which reflects their eagerness in gardening.

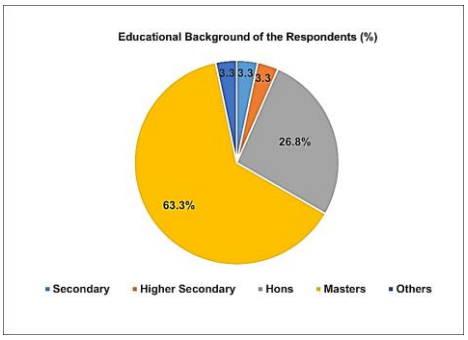

Figure 1: Educational Background of the Respondents (Source: Field Survey 2020)

4.2 Types of gardening area

The study found that majority (43%) of the respondents used their rooftop for gardening whereas 17% used their front yard for gardening which reflects that most of the gardening practices are done on rooftops compared to front yard as lack of space is also a matter of concern in Dhaka. 40% of the respondents have also utilized their balcony for farming purpose (Figure 2). It is promising that people have been utilizing their vacant spaces for gardening purposes as free spaces are available to a limited extent in urban areas.

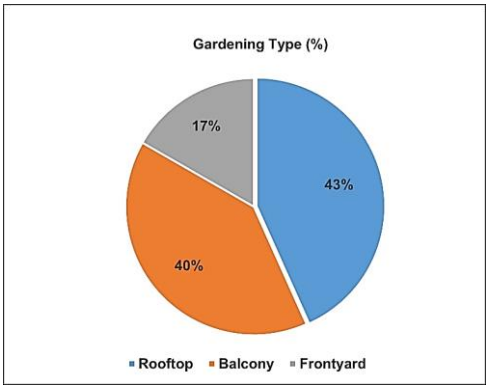

Figure 2: Types of Gardening area (Source: Field Survey 2020)

Almost 42% of the respondents' housing areas are in between 400-1000 sq. ft whereas only 13% respondents' housing areas are more than 2200

sq. ft. but area of housing did not impart any problem in practicing gardening. If we look at the percentage of gardening shown in Figure 3, half of the respondents claimed to have used their 50% of the total area for the purpose of gardening though the minimum percentage was found 10%. It reflects that, people are practicing gardening within their limited space.

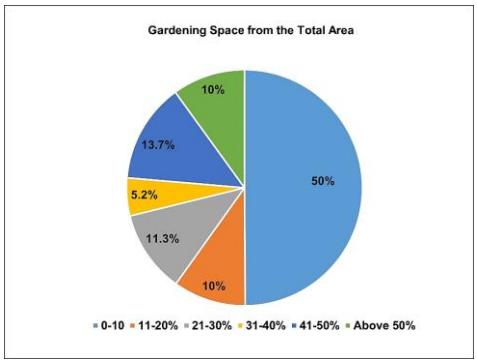

Figure 3: Percentage of gardening from the total area (Source: Field Survey 2020)

They also claimed to (almost 53%) have been practicing mixed farming (includes vegetables, flowers and fruits) method, whereas 30% of the respondents only cultivate flowers. The remaining 17% of the respondents used their space for both vegetable and fruits farming. The study also found that majority of the respondents (83.3%) used their household wastes particularly kitchen wastes as fertilizers for this type of gardening (Figure 4). A very little percentage of the respondents used chemical fertilizers for farming.

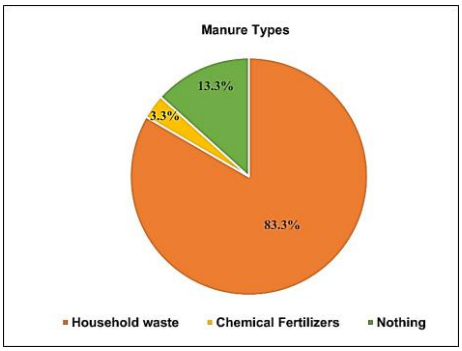

Figure 4: Types of manure used (Source: Field Survey 2020)

4.3 Gardening as a support in covid-19 situation

This study also revealed some interesting facts that have been reflected through Figure 5. 63.3% of the respondents had claimed that they had received food support from their own gardening during this pandemic situation. Most of them were from freshly harvested vegetables that they had grown in their garden. It also helped them to minimize a portion of the total costs from their daily shopping list. Meanwhile, it also helped them to combat the initial price hike of vegetables that was observed in local markets during the beginning of this pandemic situation. They did not solely depend on their grocery shopping rather was dependent on their RTGs for vegetable supply.

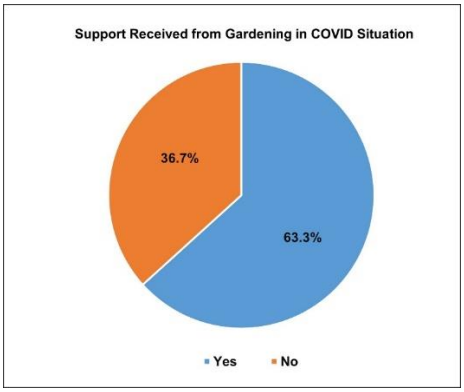

Figure 5: Support Received from Gardening in COVID-19 Situation (Source: Field Survey 2020)

Moreover, the respondents also managed to send some of their surplus harvested vegetables to their relatives' house though 37.9% of the respondents had nothing left after meeting up their own demands (Figure 6). So, it can be clearly said that they got enough supply directly from their harvested crops from their own garden.

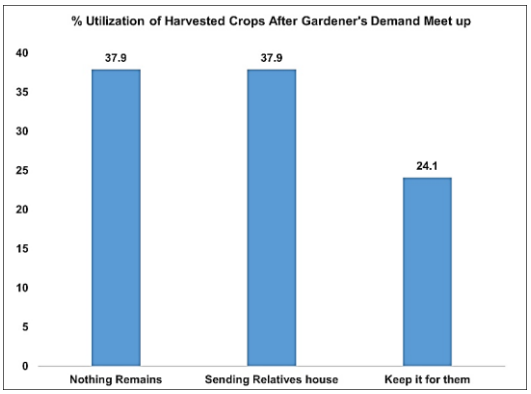

Figure 6: Utilization of remaining products (Source: Field Survey 2020)

Moreover, 40.9% of the total respondents claimed that the harvest was enough for them to sufficiently meet their need for vegetables for a single day though 45.5% respondents did not find it pretty much sufficient (Figure 7). The reasons may be due to the lack of proper space or insufficient growth of plants or maybe the harvest was not as expected. Reasons may also include lack of proper monitoring, or the quality of plants or seedlings used for the purpose may not have served very well in their output.

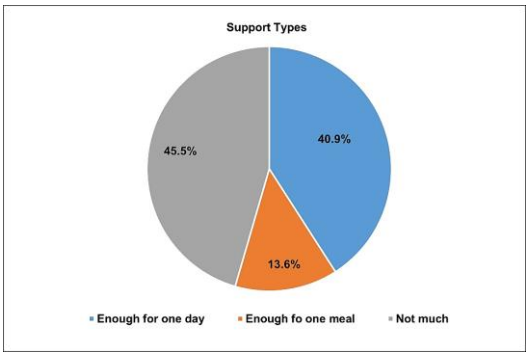

Figure 7: Percentages of Support Received from the Gardening (Source: Field Survey 2020)

Data also shows that, majority of the respondents were satisfied of their gardening. Almost 47% of the respondents were satisfied and 20% of the respondents were highly satisfied (Figure 8).

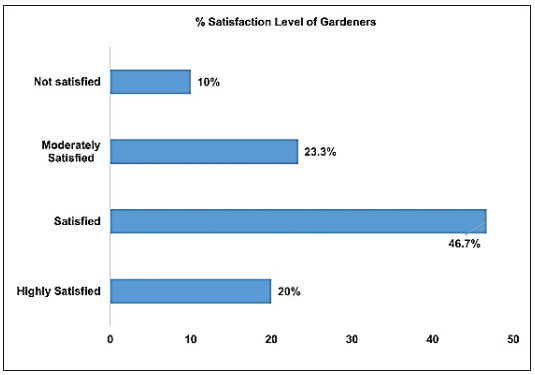

Figure 8: Satisfaction level of the respondents (Source: Field Survey, 2020)

It has become evident from the study that majority of the respondents (90%) agreed that gardening or RTG obviously can be the best solution to ensure food security. The study also revealed that people have the mindset of expanding their gardening practices and they believe that there cannot be an alternative practice of gardening if we want to seek for a practical solution to ensure food security globally.

5. Conclusions

When the concept of conventional agricultural extension is of no use now a days as the land areas are not increasing, an alternate but useful solution to ensure food and nutrition security is RTG. The thought of RTG in towns has been evolved because of the population expansion and the shrinking areas for gardening in cities. Global pandemic situation has made it more distinct, and people have started to realize that now is the time to fight for our own problems. It is the only way through which people can come up with their own food safety and security solution as it is not possible for the government alone to come up and help all its residence once at a time! Considering the overall situation and the findings of the study, we can come up to a solution that there has been no alternative but to promote RTG practices in city areas mostly but before doing so we have some initiatives to take which are as follows:

- The best solution is to create our own harvesting area and stop depending on supplies from the markets. Though some initiatives have been taken by the City Corporation and Department of Environment of Bangladesh, but it is not enough.
- RTG and urban agriculture should be incorporated into urban planning.
- In this regard, Roof Top Gardening (RTG) can be an effective method in ensuring food supply and satisfying nutritional needs of the inhabitants as well as reducing ecological footprint and providing with ecosystem services.
- Proper training and incentives should be provided to people who are willing to establish large scale gardens in their residence premises.
- Government and Non-government organizations should come forward to help establish RTGs and should provide door to door services and monitoring practices to ensure proper utilization of the projects.
- RTG can be a good way to recycle kitchen wastes as well. Kitchen wastes can be recycled to produce organic or compost fertilizers that can be utilized in gardening.

It has become evident that, if we want to fight global food crisis, we must come forward and should have that mindset to grow our own food products with the little land that we have. So, to ensure global food security, we should all come forward to utilize our idle spaces and start growing our own crops and there cannot be any other alternatives except RTG. To accomplish this, studies on the scope of RTG, the rate of food production and varieties, nutritious value of the growing foods in the context of Dhaka city are needed.

Limitations of The Study

Because of the global pandemic situation, it was not possible to collect sufficient data from many sources, so the number of respondents were limited. Moreover, as the primary data collection was completely based on questionnaire survey, so the result may not represent the actual scenario of current situation, it just carries the human perspectives over RTG that has been practiced throughout the study area. Upon further research findings, the prospects of the expansion of RTG with economic value can be properly analyzed.

Declaration

- Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

- Competing Interests

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

- Authors' Contributions

All authors contributed to the study conception and design. Material preparation and data collection were performed by [Zannatul Ferdous] and data analysis and final draft preparation were performed by [Md. Arifur Rahman Bhuiyan]. The first draft of the manuscript was written by [Zannatul Ferdous] and later amended by [Md. Arifur Rahman Bhuiyan]. All authors read and approved the final manuscript.

- Availability of Data and Materials

The data that support this study are available in the article and accompanying online supplementary material.

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