Malaysian Journal of Sustainable Agriculture (MJSA)

ISSN: 2521-2931 (Print)
ISSN: 2521-294X (Online)
CODEN: MJSAEJ

DOI : http://doi.org/10.26480/mjsa.02.2019.31.34

RESEARCH ARTICLE

STUDY ON THE STATUS OF ROOF TOP GARDENING IN SELECTED RESIDENTIAL AREAS OF DHAKA CITY, BANGLADESH

Mahmuda Islam, Abdullah Al Nayeem*, Ahmad Kamruzzaman Majumder, Khandokar Tanjim Elahi

Department of Environmental Science, Stamford University Bangladesh, Dhaka- 1209
**Corresponding Author Email: nayeem.env58@gmail.com*

ARTICLE DETAILS

Article History:

Received 01 February 2019
Accepted 14 March 2019
Available online 12 April 2019

ABSTRACT

ABSTRACT

The rapid increment of low and middle-income consumers is exerting pressure on the food supply in urban areas. The objective of the study was to identify the present status of rooftop gardening. The study was conducted in the 4 selected residential areas of Dhaka city through plot to plot interview by using questionnaire. Land use nature is divided into four categories like residential, commercial, educational and mixed. Field survey was conducted on 1376 buildings in Dhanmondi, 391 buildings in Lalmatia, 272 buildings in Mohakhali Defense Officers Housing Society (DOHS) and 697 buildings in Uttara 13 no. Sector. Study found that, 39.1%, 59.2%, 36.6 % and 22.2% buildings have rooftop gardening in those selected locations respectively. The study reveals that, nearly one-third of the buildings (36.4%) contain rooftop gardening which basically depends on the aesthetic sense and moral values of individuals. Government should appreciate initiatives and consider proper planning policy to motivate citizen of the urban areas for planting fruit plants and vegetable in their roof. RTG system may also contribute to achieving the Sustainable Development Goals (SDGs). The proposed study identifies the need for long-term policy measures for rooftop gardening that can become the basis for a sustainable approach for urban agriculture.

KEYWORDS

Urban Agriculture, Green City, Ecological Balance, Food Security.

1. INTRODUCTION

On the verge of the rapid growth of urbanization in today's world the sustainable agriculture become a challenge. Due to the pull factors of cities over 50 % of the world population is now living in urban areas which would be 70% by the end of 2030 [1]. In case of developing world this proportion will be 80% [1, 2]. More people mean more food production which needs more arable land and it has been found that, 109 million hectares of new land would be required to feed the world population in 2050 by conventional farming [3,4]. But a study shows that the agricultural area decreased by 0.19% in between 2005 and 2011 [5]. It is a common practice to use the suburb area to satisfy the daily food demand of city dwellers basically fruits and vegetable. As the rate of urbanization increases over time, food production sites should be increasingly located near main consumption centers [6]. 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 [7]. Dhaka the capital of Bangladesh, is such a 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 [8,9]. With this rapid as well as unplanned urbanization, incidence of urban poverty and food insecurity has been escalating alarmingly in Dhaka [10]. In a consequence urban agriculture is getting relevance like all over the world and it is more important to adopt new approaches to ensure the food supply and food security of those who live-in urban atmospheres [11]. Moreover urban agriculture is very efficient since its potential yields is up to 50 kg per m^2 per year and more which can be even 4.5 times compare to the production from conventional farming as seen in Havana [1,2,4].

With the recent development of urban centers two very important concepts are also emerged to make the development sustainable; ecological citizenship and ecological footprint [12]. The concept of ecological citizenship uses the metaphor of 'ecological footprint' in which each of us is responsible for taking up a certain amount of ecological 'space' (both for resource use and capacity burden), expressed as a personal footprint left on the Earth [13,14]. Although it is assumed that an equal allocation of the available space on Earth would result in 1.8 available global hectares per person, the footprint of the average European resident is actually 4.9 ha while in the USA up to 9.2 ha and for Bangladeshi it is only 0.5 ha [15-17].

A number of studies have found that, the vital role played by urban vegetable gardens in improving human well-being through the provision of both ecosystem services and food supply to the city dwellers [11,18,19]. Throughout the city area, urban agriculture and green spaces can be linked to one another, forming a network of Green Infrastructures (GIs) [20]. The possible green cover of most of the bare areas of a city could be a potential ecological frontier and could become a reality in many cities [21-23]. GIs may reduce a city's Ecological Footprint (EF) by reduction of pollution and noise, the absorption of CO_2emissions and the control of the Urban Heat Island (UHI) effect by shading [13, 24]. Rooftop 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 [21,25]. Furthermore, RTGs, while being aesthetically appealing, can play a vital role to biodiversity conservation in the urban environment, achieving sustainable cities, including those necessary for the production of food and improve the overall quality of urban life [26-29]. RTGs can produce an average of 19.5 kg m^{-2} $year^{-1}$ against 1.3 kg m^{-2} $year^{-1}$ found in conventional urban gardens [23]. In a study conducted in South Delhi of India, it is seen that on

an average size of roof with one to three plants of each vegetable can give 6 kg of vegetable and the common varieties are tomatoes, brinjal, bitter gourd, capsicum, corn, zucchini and lady finger [30].

RTG, although is being practiced in the city in many form for years in the past, there have been hardly any concerted effort on part of the Government, community organizations along with the general residents to integrate it to urban agriculture. Taking into consideration the above circumstance, a study of the rooftop gardens of densely populated Dhaka is a crying need. The present study focuses on the status of roof top garden and tries to find out the influencing factor and their relationship with the RTGs which can help to identify the long-term policy measures for RTG that can become the basis for a sustainable approach for urban agriculture.

2. STUDY AREA

To study the status of RTG in Dhaka city four residential areas are selected. They are Dhanmondi, Lalmatia (Mohammadpur), Mohakhali DOHS and 13 no. sector of Uttara. Though the main land use of these areas is residential, they also have some commercial uses of lands except in Mohakhali DOHS.

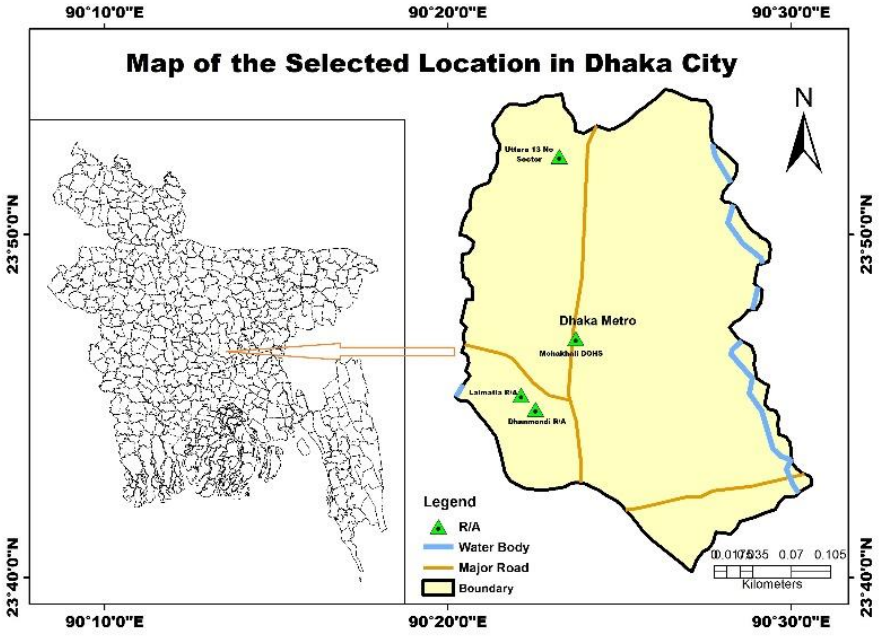

Figure 1: Map of the Study Area

3. METHODOLOGY

In this study a plot to plot population survey method was adopted. All 1376 buildings of the Dhanmondi Residential Area, 391 buildings of the Lalmatia residential area, 272 buildings of the Mohakhali DOHS and 697 buildings of the Uttara Sector 13 residential area were surveyed for the study. Data on rooftop garden, geographic and demographic characteristics, year of building, arrangement mainly rooftop garden and building expenditure in different sector and stove design etc. were collected through interview by using questionnaire. Data processing and analysis, the coding, data entry and required analysis were done by using SPSS and Microsoft Excel.

4. RESULTS

The survey finds out that among all 2736 buildings in Dhanmondi, Lalmatia, Mohakhali DOHS and Uttara 13 no. Sector, only 36.4% (997) building has the RTG and most of them (19.66% of total building surveyed) found in the Dhanmondi which isa very old and well known residential area though now a day some buildings are also used for commercial purposes (Table 1). If we see the area wise proportion, it is found that Mohakhali DOHS is in better position having 59.20% of buildings with RTG and the poorest condition is in the Uttara 13 no. Sector with only 22.20% of buildings having RTG in compare to other three.

Table 1: Status of Roof Top Gardening

Study Area	Number of Building	Frequency		Percentage		Percentage (in Total)	
		Yes	No	Yes	No	Yes	No
Dhanmondi	1376	538	838	39.10%	60.90%	19.66%	30.63%
Lalmatia	391	143	248	36.60%	63.40%	5.22%	9.06%
DoHS	272	161	111	59.20%	40.80%	5.88%	4.06%
Uttara 13 no. Sector	697	155	542	22.20%	77.80%	5.66%	19.81%
Total	**2736**	**997**	**1739**	---------	---------	**36.4**	**63.6**

Figure 2 represents the nature of land use in these four areas. From this figure it can be said that, among the four types of the land use the percentage of having garden in the rooftop is more in the residential land which is 61.5% and then the commercial one having percentage of 45.9%.

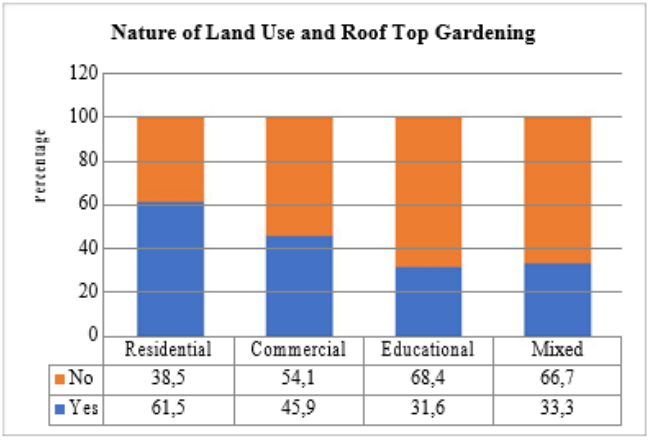

Figure 2: Nature of Land Use and Roof Top Gardening

Again in case of the type of ownership, RTG is mostly seen in independent housing (60.0%) and regarding to type of building the highest percentage of RTG is seen in other types of building that means and the rest two; individual and apartment is very nearer having percentage of 39.3% and 34.0% (Table 2).

Table 2: Prevalence of roof top gardening regarding to type of ownership and type of buildings

Category		Total	Yes	
			Frequency	Percentage
Type of Ownership	Developer	1185	377	31.8%
	Independent	1551	931	60.0%
Type of Building	Individual	1232	484	39.3%
	Apartment	1500	510	34.0%
	Others	4	3	75.0%

5.DISCUSSIONS

The table 1 shows that the prevalence of RTG is more in Mohakhali DOHS having the percentage of 59.00% which is a part of housing scheme for retired army officer and taken as one of the posh area of Dhaka city. The rest three areas (Dhanmondi, Lalmatia and Uttara 13 no. Sector) have the RTG in less than 50% buildings. Therefore, it can be said that having rooftop garden may be affected by the type of ownership of the buildings which also can be depicted from table 2. Some literature has been found on RTG in Bangladesh conducted in Dhaka, Chittagong and Sylhet metropolitan city [31-34]. But most of them concentrated on the finding out of the variety of fruits and vegetables produced in the RTG, the benefits and the constraints. Furthermore, no international standard is found in this regard. Therefore, it is not possible to evaluate the status of the RTG of Dhaka city.

From table 2 it is seen that the percentage of rooftop garden is two times more in the independent housing than the developer one. Sometimes lack of accessibility to the roof is a great barrier to gardening for the tenants. Again the persons are now in any type of service they don't have enough time to engage themselves into gardening. This is very much relevant with the findings of Uddin, 2016 which says that businessman, retired person and housewives are mainly contributing to the RTG in Dhaka and Chittagong city [33]. But in Sylhet city the RTG is mostly done by government job holders (25.56%) and then the retired employee (17.33%) [32]. Furthermore, RTG has a strong positive and significant relationship (Table 3) with the nature of land use which can also be depicted from figure 1. Hence another reason of having more RTG in Mohakhali DOHS is that it is fully residential but the other three are not like that. They are more or less mixed area having some extent of commercial and educational uses of land. Type of buildings might not have any influence on the RTG since their relationship is not significant (Table 3). Overall it can be said that having garden at the rooftop may also get influenced by the aesthetic sense, moral and ethical values and personal likings of the individuals. This is also parallel to the findings of the Rahman, 2014 where it is seen that people are interested in RTG mainly for mental satisfaction (95.3%), leisure time activity (87.8%), aesthetic value (82.9%) and environmental amelioration (54.9%) [32].

Table 3: Relationship of roof top gardening with land use nature and type of building

Category	Yes			
	R value	Degree of Freedom	P value	Comment
Land Use Nature	0.99	3	0.0003	Strong positive relationship and significant
Type of Building	0.99	2	0.0784553	Strong positive relationship but not significant

6. CONCLUSION

The necessity of urban agriculture in ensuring a sustainable and secured food supply is now approved by worldwide. It is a very fact for a city of a developing country like Dhaka where the rate of urbanization is very high but the quantity of arable land to ensure the sufficient food supply is becoming less. Among the different models of urban agriculture RTG is the suitable for densely populated Dhaka city as many buildings do not have space for the other types of gardening. Hence this study was done to find out the present situation of the RTGs in Dhaka city. Here sampled areas are selected purposively by assuming that residential areas would have more RTG than commercial or mixed areas. The study finds out that the frequency of RTG in comparatively newly developed and organized residential area is better than the older residential area in which some buildings are now also used for mixed purposes. Hence the conditions of commercial and mixed area might be worse than the residential areas. This is also analogous to the findings that more than 50% of the residential buildings have the RTGs. In most of the cases there is a restriction on the using of roof in developers building which lead to the conclusion that individual owners are favorable to rooftop gardening. In this sector government can play an important role. 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. 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 foot print and providing with ecosystem services. The policy makers and urban planner have to think radically to make this dusty Dhaka as a beautiful green city. For this a long term policy to go for green is needed which not only lead the city towards green city but also help to achieve the 11th, 12th and 13th goal of SDGs. 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. Studies should also be carried on the environmental aspect of RTG like as a medium of carbon sequestration, ecological footprint reduction, temperature and air pollution reduction etc. to encourage the citizen of Dhaka for getting involved in RTG rather wasting their spaces.

REFERENCES

[1] Eigenbrod, C., Gruda, N. 2015. Urban vegetable for food security in cities. A review. Agronomy for Sustainable Development, 35 (2), 483-498.

[2] Bakker, N., Dubbeling, M., Guendel, S., Koschella, U.S., deZeeuw, H. 2000. Growing Cities, Growing Food, Urban Agriculture on the Policy Agenda.

[3] Dickson, D. 2013. Vertical farming infographics. Retrieve from: https://verticalfarming.net/vertical-farming/vertical-farming-infographics/ (From FAO and NASA.

[4] Juniawati, Hayuningtyas, M. 2017. Urban Agriculture Development: A Strategy to Support Food Security Juniawati. 2nd International Conference on Sustainable Agriculture and Food Security: A Comprehensive Approach, KnE Life Sciences, 701–713.

[5] Foley, J.A., Ramankutty, N., Brauman, K.A., Cassidy, E.S., Gerber, J.S., Johnston, M., Zaks, D. P. 2011. Solutions for a cultivated planet. International Journal of Science, 478, 337–342. https://doi.org/10.1038/nature10452

[6] Grigoletti, G.D.C., Pereira, M.F.B. 2014. Carbon dioxide emissions of green roofing – case study in southern Brazil. In 30th International Plea Conference, 1–8).

[7] Thornbush, M. 2015. Urban agriculture in the transition to low carbon cities through urban greening. AIMS Environmental Science, 2 (3), 852–867. https://doi.org/10.3934/environsci.2015.3.852

[8] Bdnews24. 2014. Dhaka will be sixth largest mega city in 2030. Retrieve from: https://bdnews24.com/bangladesh/2014/12/09/dhaka-will-be-sixth-largest-mega-city-in-2030-scientist

[9] Daily Star. 2019. The dark side of Dhaka's urbanization. Retrieve from: https://www.thedailystar.net/supplements/28th-anniversary-supplements/avoiding-urban-nightmare-time-get-planning-right/news/the-dark-side-dhakas-urbanisation-1703425.

[10] Choguill, C.L. 1995. Urban Agriculture and Cities in the Developing World. Habitat International, 19 (2), 149-235.

[11] Orsini, F., Gasperi, D., Marchetti, L., Piovene, C., Draghetti, S., Ramazzotti, S., Bazzocchi, G., Gianquinto, G. 2014. Exploring the production capacity of rooftop gardens (RTGs) in urban agriculture : the potential impact on food and nutrition security , biodiversity and other ecosystem services in the city of Bologna. Food Security.

[12] Bastianoni, S., Galli, A. Niccolucci V., Pulselli, R.M. 2006. The ecological footprint of building construction. The Sustainable City IV: Urban Regeneration and Sustainability, 93,345–356. https://doi.org/10.2495/SC060331

[13] Wackernagel, M., Rees, W. 1996. Our Ecological Footprint: Reducing Human Impact on the Earth. ISBN: 0-86571-312-X. New Society Publishers, Philadelphia.

[14] Cubi, E., Zibin, N.F., Thompson, S.J., Bergerson, J. 2015. Sustainability of Rooftop Technologies in Cold Climates. Journal OfIndustrial Ecology, 20 (2), 249–262. https://doi.org/10.1111/jiec.12269

[15] Global Footprint Network. 2005. Retrieve from: https://www.footprintnetwork.org/. Access in: 4 March, 2018.

[16] Seyfang, G. 2006. Ecological citizenship and sustainable consumption: Examining local organic food networks. Journal of Rural Studies, 22, 383–395.

[17] Metcalfe, I. 2015. Environmental Concerns for Bangladesh. South Asia: Journal of South Asian Studies, XXVI (3), 423–438. https://doi.org/10.1080/00856400320001789 61.

[18] McClintock, N. 2010. Why farm the city? Theorizing urban agriculture through alens of metabolic rift. Cambridge Journal of Regions, Economy and Society, 3(2), 191–207.

[19] Brown, K.H., Jameton, A.L. 2000. Public health implications of urban agriculture. Journal of Public Health Policy,21, 20–39.

[20] Mahmoud, N., Mohammed, G. 2012. Green infrastructure connectivity within social sustainability: Case studies around the world. Canadian Journal on Computing in Mathematics, Natural Sciences, Engineering and Medicine, 3, 225–232.

[21] Peck, S. 2003.Towards an integrated green roof infrastructure evaluation for Toronto. The Green Roof Infrastructure Monitor, 5, 4–7.

[22] Kaethler, T.M. 2006. Growing space: the potential for urban agriculture in the city of Vancouver, Retrieve from https://community-wealth.org/sites/clone.community-wealth.org/files/downloads/report-kaethler.pdf. Access in: 25 May, 2014

[23] Grewal, S.S., Grewal, P.S. 2012. Can cities become self-reliant in food? Cities, 29, 1–11.

[24] Wilby, R.L. 2003.Past and projected trends in London's urban heat island. Weather, 58, 251–260.

[25] Walters, S.A., Midden, K.S. 2018. Sustainability of Urban Agriculture: Vegetable Production on Green Roofs. Agriculture, 8, 1–16. https://doi.org/10.3390/agriculture8110168

[26] Miller, J.R. 2005. Biodiversity conservation and the extinction of experience. Trends in Ecology and Evolution, 20 (2), 430–434.

[27] Maas, J., Verheij, R.A., Groenewegen, P.P., DeVries, S., Spreeuwenberg, P. 2006. Green space, urbanity, and health: How strong is the relation? Journal of Epidemiol Community Health, 60, 587–59.

[28] Khandaker, M.S.I. 2004. Rooftop gardening as a strategy of urban agriculture for food security: The case of Dhaka City, Bangladesh. Acta Hortic, 643, 241– 247.

[29] Sanyé-Mengual, E., Oliver-Solà1, J., Montero, J.I., Rieradevall, J. 2015. An environmental and economic life cycle assessment of Rooftop Greenhouse (RTG) implementation in Barcelona, Spain. The International Journal of Life Cycle Assessment, 20 (3), 350–366.

[30] Gupta, G., Mehta, P. 2017. Roof Top Farming a Solution to Food Security and Climate Change Adaptation for Cities. Climate Change Research at Universities, 19–36. https://doi.org/10.1007/978-3-319-58214-6

[31] Islam, K.M.S. 2004. Rooftop Gardening as a Strategy of Urban Agriculture for Food Security: The Case of Dhaka City, Bangladesh. Proc. IC on Urban Horticulture, 241-247.

[32] Rahman, A., Nabi, N.A.K.M., Amin, S.A.M., Abu, S.M., Rahman, S., Hossain, P.R., Rahman, M.H., Hossaine, S.M.M., Mirza, M. 2014. Building Urban Resilience: Assessing Urban and Peri-urban Agriculture in Dhaka, Bangladesh. United Nations Environment Programme (UNEP), Nairobi, Kenya.

[33] Uddin, D.M.J., Khondaker, D.N.A., Hossain, M.M.A., Das, D.A.K., Masud, M.A.T.M.D. 2016. Baseline Study on Roof Top Gardening in Dhaka and Chittagong City of Bangladesh. A final technical report under the project of "Enhancing Urban Horticulture Production to Improve Food and Nutrition Security" (TCP/BGD/3503) funded by Food and Agriculture Organization of the United Nations.

[34] Safayet, M., Arefin, M.F., Hasan, M.U. 2017. Present practice and future prospect of rooftop farming in Dhaka city: A step towards urban sustainability. Journal of Urban Managment, 6, 56–65.