



Status of Rooftop and Homestead Gardening in Bogura

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Abstract

A survey was conducted to assess the status of rooftop and homestead gardening in Sadar upazila of Bogura in Bangladesh. The study revealed that 66% rooftop gardeners and 70% homestead gardeners preferred gardening for production of healthy and fresh food. According to the survey there were about 80 types of plants in rooftop gardens and 87 types in homestead gardens. These plants were fruits (97%), vegetables (86%), flowers (64%), spices (72%), medicinal plants (64%), ornamental plants (23%) and plantation crops (12%). The amount of time they had to invest for gardening ranged from only less than half-an-hour to an hour. About 28% homestead gardeners received training on gardening from GOs and NGOs while most of the rooftop gardeners gained knowledge from agro-based television programs. The study revealed that a very few gardeners (18%) considered rooftop gardening for economic benefit while a remarkable number of homestead gardeners (24%) considered gardening for economic return on top of producing fruits and vegetables for family consumption. Finally this study concluded that both rooftop and homestead gardening can be complementary means for increasing the production and consumption of fresh fruits and vegetables and thus can contribute in achieving food security and safety.

Key words: Bogura, Gardening, Homestead, Rooftop

Introduction

Gardening is an important popular practice from the initiation of the human settlement in the earth. Gardening may be practiced in various places, it includes homestead area, rooftop, park, office, road side, embankment of river, area of railway, educational institution based area etc. For the first time in history, the world's urban population exceeded its rural population; by 2030 approximately two-thirds of the world's population will be living in urban areas (FAO, 2007). Bangladesh has limited land resource to feed a huge population. To fulfill the unemployment and demand of shelters for the increasing number of people in Bangladesh, the total area of cultivable land is converting into industrial area and residential area. It is a great challenge for our nation. Research work relates to rooftop garden is very scanty and homestead gardening is limited in Bangladesh. Rooftop garden can provide space for growing additional crops while, cultivable land is declining. Rooftop gardening is important contribution in urban agriculture. This method is referred to as rooftop farming and is usually carried out with the help of container gardens, air-dynaponics systems or aeroponics, hydroponics or green roof (Walker, 2013). There are potentials to enhance urban food security through rooftop gardening and food production. Though our government is conducting a project named "Sobuj Dhaka" for the development of rooftop garden as a source of environment protection (The Daily Bangladesh Protidin, 5 June, 2016) but the practice is not wide-spread across our country.

There are opportunities for enhancing food productivity through homestead and rooftop gardening.

The general recommendation for fruit and vegetable intake is at least 400 grams per day, or five servings of 80 grams (Sachdeva, 2013). So, if well planned, it can fulfill daily requirements of fresh fruit and vegetables for those families. Rooftop gardens not only positively contribute to the environment, but also in the production and supply of fresh fruits and vegetables for the urban citizens. As like as homestead gardening, rooftop gardening also has a promising potential as a small scale business that can accelerate additional family income (Uddin *et al.*, 2016). Rooftop gardening improves the food security and meet nutritional deficiency to the gardeners (Rahman *et al.*, 2013). Urban agriculture also contributes to food security by increasing the supply of food and by enhancing the quality of perishable foods reaching urban consumers (Islam, 2004). The current survey was conducted to find out the major activities in gardening including assessing cost-return from gardening and relevant problems and suggesting possible solutions.

Materials and Methods

Location and the study period

The study was carried out in Bogra Sadar upazila (Fig 1.) during August 2016. Bogra is a northern district of Rajshahi division of Bangladesh. It is situated between 24° 78' " and 23° 27' " North latitude and 88° 54' " and 89° 35' " East latitude (Fig. 1). The study area includes Agro Ecological Zone-25.

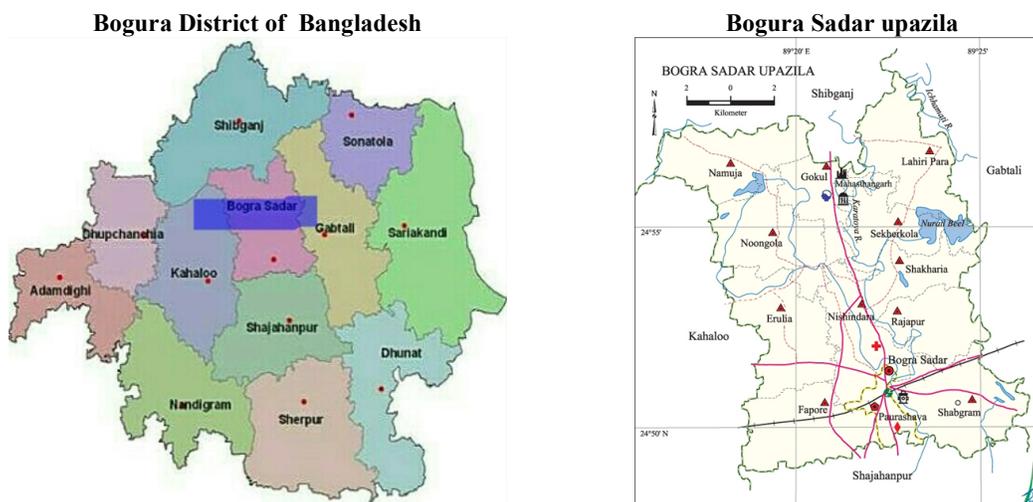


Fig. 1. Maps of Bogura District and Bogura Sadar Upazila indicating the locations of the study area

Sampling process

Bogra Municipality consisted of 21 Wards having 63,931 households, of which the number of building was 39,977 and the total household of 11 Unions under Bogra Sadar upazila was 50147 in the year 2016. A total number of 100 households was randomly selected for the study, including 50 rooftop gardeners from Bogra Municipality and 50 homestead gardeners from 5 Unions of Bogra Sadar upazila. Thus the survey covered 10 Wards of Bogra Municipality representing rooftop gardeners from 19,903 building owners and 5 Unions of Bogra Sadar upazila representing homestead gardeners from 20,805 households.

The questionnaire and data collection

An interview schedule was prepared for collecting the following information of the gardeners such as their age range, educational qualification, annual income, profession, working experience, gardening entrepreneur, aim, agricultural knowledge, main maintain, growing medium for rooftop garden, horticultural crops, irrigation and drainage system, fertilizer application and intercultural operation, agricultural equipment, benefit of gardening, opinion of gardener on gardening, training on gardening, source of agricultural information, agricultural institution on gardening, attack of insect pest, control of insect pest and disease, gardeners Knowledge on weather and climate, problem and solution of gardening.

Data on different aspects of gardening including functionality, benefits, scopes, problems and related solutions were collected using pretested questionnaire from rooftop and homestead gardeners selected randomly during August 2016. The questions were asked systematically and explanation was given whenever it was necessary. The data provided by the gardeners were recorded directly on the note book. The information was checked after completing the interview to minimize errors.

Data analysis

Data collected from the respondents were scrutinized and a total of 47 rooftop and 45 homestead gardeners were finally analyzed. The collected data were arranged on the basis of Statistical Package for Social Science program (SPSS). Different statistical measure was used to describe this study such as, number, frequency, percentage, distribution range, mean and standard deviation.

Results and Discussion

Gardener’s status and their gardening activities

Age, education and annual income of the gardeners

The age ranges of most of the rooftop gardeners were 36-55 years and of homestead gardeners were 56-75 year. Among the rooftop gardeners 58% achieved graduation and post-graduation degree but only 14% homestead gardeners completed graduation and post-graduation and 4% homestead gardeners were illiterate gardeners. Among the homestead gardeners 42% operate business but 46% rooftop gardeners were service holders. Annual income ranged 6-10 lakh taka for most of the rooftop gardeners while 0.5-5 lakh taka for the homestead gardeners.

Planting materials and planting time

Rooftop and homestead gardeners specially used seed for vegetable production but in case of fruits, more vegetatively propagated plant materials were used by rooftop gardeners compared to homestead gardeners. All the gardeners were pretty knowledgeable on planting materials and planting time. Afternoon is the best time for tree plantation. About 98% rooftop gardeners and 54% homestead gardeners collected planting materials from nursery, market, fair, as well as from neighbors, relatives or friends.

Gardeners working time/day

The gardeners used their leisure time and the time spent by the rooftop gardeners ranged from 31-60 minutes but it was 15-30 min for homestead gardeners (Table 1).

Table 1. Gardeners working time/day in case of rooftop and homestead garden

Working time (min)	Number of RTG	Mean	SD	Percent respondent	Number of HSG	Mean	SD	Percent respondent
15-30	13	23.08	4.83	26	24	19.52	5.58	48
31-60	20	47.63	7.66	40	12	45	6.39	24
61-90	3	83.33	5.77	6	6	59.06	6.87	12
91-120	7	112.14	7.93	14	2	74.44	7.45	4
121-150	2	93.33	5.77	4	0	-	-	-
151-180	2	172.5	10.60	4	1	160	-	2
	n=47			94	n=45			90

[RTG=Roof Top Gardeners, HSG=Home Stead Gardeners, SD=Standard Deviation]

Experience of the gardeners

Most of the gardeners were quite experience in gardening ranging from 13-24 years for rooftop

gardeners and 25-36 years for homestead gardeners (Table 2).

Table 2. Gardening experience of the gardeners in Sadar upazila of Bogra district

Gardening experience (years)	Number of RTG	Mean	SD	Percent respondent	Number of HSG	Mean	SD	Percent respondent
1-12	41	7.48	2.73	82	37	4.88	2.76	74
13-24	6	10	1.19	12	7	16.14	3.93	14
25-36	0	-	-	-	1	36	-	2
	n=47	-	-	94	n=45	-	-	90

[RTG=Roof Top Gardeners, HSG=Home Stead Gardeners, SD=Standard Deviation]

Main operators and the motive of gardening

Involvement of females were lower than males in rooftop and homestead gardening. About 54% males and 32% females worked as main operators in homestead garden while the number of males were 48% and females were 42% as main operators in rooftop gardening. Production of fresh and safe food was the main motive of 66% rooftop gardeners and 70% homestead gardeners. Rahman *et al.* (2013) also reported that the main aim of gardeners was production of fresh and healthy food.

Different type's container with their durability

More than 3 types of containers were used by each rooftop gardener and 28 gardeners' preferred concrete based containers (Table 3).

Table 3. Different type of containers and its probable durability

Type of container	Probable durability of the containers (year)
Earthen pot	3-5
Plastic pot	24-25
Tin	7-8
Tin (color)	10-12
Wall and slab (Bricks, sand, cement)	30-40
Bag of cement	1-2
Shelf (wood)	5-6
Shelf (concrete)	25-28
Concrete (Sand, cement, rod)	12-15
Slab	20-24

Classification of the rooftop gardens

Following the guideline of International Green Roof Association, the responsive rooftop gardens (47) were into grouped in to three classes, such as extensive (6), semi-intensive (26) and intensive garden (15). About 80% gardeners used to change soil regularly with a maximum duration of recycling the same soil for 9-11 years.

Intercultural operation and gardening equipment

A great majority of gardeners had traditional knowledge on intercultural operation. As regards to tilling the soil, 94% of rooftop gardeners and 90% homestead gardeners practiced tillage. About 56% rooftop gardeners and 62% homestead gardeners practiced 2 times weeding in every month. Only 8% rooftop gardeners and 30% homestead gardeners practiced mulching. Nearly 94% rooftop gardeners and 90% homestead gardeners practiced thinning and pruning operations. Around 84% rooftop gardeners and 90% homestead gardener's maintained proper planting distance. Almost 100% rooftop gardeners and 92% homestead gardeners received some sorts of training. About 4% rooftop gardeners and 46% homestead gardeners were aware of use of plant hormones. Only 30% rooftop gardeners and 27% homestead gardeners hired labor for gardening purpose. Gardeners generally used spade, hoe, knife, rope, secateurs, pail, jug, mug, spray bottle etc. for different type of agricultural practices.

Application of fertilizers

On the rooftop, 46% gardeners used both organic and inorganic fertilizers, 22% rooftop gardeners used only

organic fertilizers while 6% gardeners used only chemical fertilizers. About 64% homestead gardeners used both organic and inorganic fertilizers, only 42% used organic fertilizers and 4% gardeners did not use any fertilizers in their gardens. Most frequently used fertilizers for both the gardeners were cow-dung and urea. In the rooftop, 42% gardeners used kitchen waste. In the homestead, 68% gardeners used kitchen waste and 4% gardeners had no idea about this. Only 10% rooftop gardeners and 6% homestead gardeners had knowledge about the amount of the fertilizer that was essential for the plants. As they did not have enough information about the amount of fertilizer needed for gardening, availability of more information through training and education would be beneficial to improve their gardening skills.

Irrigation

Irrigation water requirement for rooftop gardens was higher than homestead garden. 46% gardeners used tap water and hose pipe for irrigation in rooftops while 62% gardeners used bucket and mug for irrigation in homestead gardens.

Insect, pest and disease

Both type of gardeners encountered different types of insects, pests and diseases on their garden. Only few of them had knowledge on specific pesticide to control insects, pests and diseases. Ripcord was generally used by both type of gardeners to control insect attacks in fruit plants, especially in mango, guava and jujube. Insects such as fruit borer, fruit fly, ant, aphid, hairy caterpillar, white fly, leaf roller, thrips were reported to infest the garden crops. Leaf curl, leaf burn, leaf rot, wilting, fruit rot, and damping of seedling were common diseases in both rooftop and homestead gardens.

Sourcing of agricultural information

The study suggests that only 28% homestead gardeners received training from different agricultural institutions. The rooftop gardeners did not receive any training from agro-based institutions in the study area. Gardeners reported that *Mati-o-Manush* from BTV, *Ridoye Mati-o-Manush* from Channel I and *Sobuj Bangla* from RTV were the popular programs on agriculture. Some rooftop and homestead gardeners regularly contacted agricultural officers of GO or NGOs for agricultural information. Rahman (2016) also showed that 61.43% growers received information from TV programs and educated growers regularly read newspaper for information.

Opinion of gardeners on horticulture centre

Though 84% rooftop gardeners had knowledge about Horticulture Centre, only 12% homestead gardeners were aware about it. Few gardeners purchased plants from Horticulture Centre. Most of the gardeners bought plants from different nurseries.

Knowledge on climate change

About 55% rooftop and 56% homestead gardeners mentioned that destruction of plants causes the earth to warm up while 45% rooftop and 44% homestead

gardeners considered that global warming is caused because of the increased gaseous element that comes from different industries. All gardeners believed that their garden had good impact on the environment.

Plant species in the rooftop and homestead gardens

Different types of plants, including fruits, vegetable, medicinal plants, spices, flowers and ornamentals were found in the study areas. Among the vegetable crops Indian spinach and water spinach and Basil and American life plant were grown in rooftop gardens whereas eggplant, papaya, bottle gourd, water spinach and some medicinal plants like neem and American life plant were grown in the homestead gardens. As for fruits, jujube, hog plum, olive, pomegranate, orange and Dragon fruits were generally grown in rooftop garden. Mango and jackfruit were found as common fruit trees in the homestead gardens. Of the spices, chilli was common in the rooftops and ginger and turmeric in the homesteads. Among the flowers, roses, Madagascar periwinkle, four-o'clock were commonly found in both types of gardens. Some ornamental plants were found in the balcony of 24% buildings. Though ornamental plants were rarely grown in homestead garden, cactus, bonsai and garden croton were commonly found in the rooftop gardens. Plantation crops were only grown in the homestead areas.

Benefits from gardening

Gardening was reported to be beneficial for both rooftop and homestead gardeners in many ways.

Reliable and economic supply of safe food

About 18% rooftop and 24% for homestead gardeners considered gardening as a dependable source of safe foods which also helps them saving money. These gardeners preferred growing winter vegetables and summer fruits. Calvet-Mir *et al.* (2012) also reported that home gardens contribute to income generation, improved livelihoods, and household economic welfare. Devaux (2002) mentioned that urban agriculture creates a space of food security by producing food. About 80% rooftop and homestead gardeners had good knowledge on vitamins and their sources but they had no idea on the amount of fruits and vegetables that are essential per day for an adult or for a child. Kumar and Nair (2004) mentioned that, output from home gardens supplement the staple-based diet by adding nutrient-rich food items that contain proteins, vitamins, and minerals.

Environment for healthy living

All the gardeners mentioned that gardening in the rooftops and homesteads can minimize air pollutions in the urban and suburb areas and can protect home from different natural calamities such as storms and cyclones. Blanckaert (2004) and Albuquerque (2005) also found that home gardens serve as the primary unit that initiates and utilizes ecologically friendly approaches for food production while conserving biodiversity and natural resources.

Source of enjoyment and social linkage development

Gardeners mentioned that rooftop and homestead garden can increase the living values, as well as increasing gardener’s knowledge on productivity and creativity with a scope for family gossiping, gathering and organizing social events. Gardeners also enjoyed offering their produce to their relatives, friends and neighbors. Homestead gardeners were in leading position than rooftop gardeners on this practice. Blanckaert (2004) also found that home gardener often exchange or gift planting materials, vegetables, fruits, leaves, herbals and medicinal plants for social, cultural, and religious purpose.

Energy saving

Most of the gardeners mentioned that use of electricity for cooling their house was reduced for the presence of rooftop or homestead garden. Peck and Callaghan (1999) found that indoor temperature of a building with a green roof is usually 3 to 4°C lower than an outdoor summer temperature between 25-30°C. Gardeners of homestead area reported that, branch and leaf of plant can be used as fuel for the kitchen. Salam *et al.* (1994) showed home garden as a convenient source of fuel for the family.

Engagement of physical activity

Some gardeners reported that working regularly in the garden helped them firstly in maintaining the garden and secondly creating an opportunity for physical activities. Peck and Callaghan (1999) mentioned that gardening activity improves a person’s psychological wellbeing and reduces stresses.

Source of children’s entertainment

About 32% rooftop gardeners reported that their children were very much interested in the activities of rooftop gardens and they consider this as entertainment. Blair (2009) cited that children can get engaged in different form of gardening work, such as designing, planting, harvesting and intercultural operation including watering, mulching, weeding etc.

Scope of business

Some rooftop and homestead gardeners reported that they would not only be benefited commercially from their gardens but could also create employment as agri-business. Mitchell and Hanstad (2004) mentioned that home gardens can contribute to household economic wellbeing in several ways. They indicated that it was an easy source of money income by doing business in small scale.

Scope of study and research

Some well-educated gardeners (7%) considered gardening as a scope for study and research and a good researcher can develop a well-planned rooftop gardening system. Fraser (2002) also mentioned that urban agriculture offers unique research opportunities that require alternative methodological approaches.

Cost estimation for rooftop gardening

The study also revealed a projected cost estimation for rooftop gardening. Based on the opinions of some educated gardeners an analysis on the cost projection and economic return for 1200 sq. ft. rooftop garden was done (Table 4). As of the total estimated cost about 92% cost incurred for materials used for the establishment of rooftop gardens and the rest 8% for non-material items. The scope of recovery from the returns in the 1st year was estimated as 32% in general.

Table 4. An estimation of input cost for rooftop garden development in Bogra Municipality

(A) Material cost

Items	Quantity	Rate (Taka/unit)	Cost (Taka)
1. Constructive material			
(a) Bricks	3000 no.	9	27000/-
(b) Sand	120sft	17	2040/-
(c) Cement	6 bags	400	2400/-
(d) Soil	110sft	3.50	385/-
(e) Container of plastic	6 no.	150	900/-
2. Planting material			
(a) Seed for vegetable	0.25 kg	120	30/-
(b) Fruits Seedling/ fruits plants	10 no.	30	300/-
(c) Flowers seedlings/ Flower plants	15 no.	10	150/-
3. Gardening Tools			
(a) Spade	1 no.	150	150/-
(b) Small Spud	1 no.	120	20/-
(c) Hoe	1 no.	80	80/-
(d) Rope	40 ft.	2.5	100/-
(e) Secateurs	1 no.	220	220/-
(f) Knife	1 no.	50	50/-
(g) Bamboo	2 no.	80	160/-

Table 4. Contd.

4. Fertilizers			
(a) Urea	2 kg	16	32
(b) TSP	2 kg	24	48
(c) MOP	2 kg	16	32
(d) DAP	1 kg	30	30
(e) Gypsum	1 kg	9	9
(f) Cow dung	10 kg	3	30
5. Irrigation tools			
(a) Bucket	1 no.	60	60/-
(b) Mug	2 no.	25	50/-
(c) Tap	2 no.	50	100/-
(d) Hose pipe	100 ft.	4.5	45/-
(e) Sprinkler	1 no.	220	220/-
(f) Water tank	1 no.	10000	10000/-
6. Plant protection			
(a) Pesticide	0.25 liter	1500	450/-
Total material cost			45496/-

(B) Non-material Cost

Items	Number of Laborers	Rate/ day	Cost (Taka)
1. Labor			
a) Container, Railing and Store room development	4	400	1600/-
b) Soil preparation	1	350	350/-
Other			
a) Transportation cost			2000/-
Total non-material cost			3950/-

Total Input Cost = Material cost + Non-material cost = (45496 + 3950) = 49446 Taka

Total income

Source of rooftop garden income with amount of money on the basis of different parameter which was measured around one year in a garden.

Products	Production (kg or number)	Price/ unit	Value in Taka
a) Fruits	135 kg	65	8775/-
b) Vegetable	180 kg	25	4500/-
c) Flowers	960 (different type of flowers)	2.5	2400/-
Total income			15675/-

This cost estimation was for the establishment of the rooftop garden in the first year. The operational costs for the subsequent years would be minimized with a scope of higher economic returns as the investment would be minimized to maintenance only. The returns from fruits, vegetables, flowers, medicinal plant, spices

and ornamental plants from the gardens could continue for a considerably long period, which may however vary from plant to plant and on the skills and efficiency of the growers. Rahman *et al.* (2013) also reported a cost return analysis that this gardening system can be economically viable if managed properly.

Problems regarding homestead and rooftop gardening

Gardeners indicated several problems related to gardening and further discussions revealed some potential solutions for advancement of gardening (Table 5). The main problems of rooftop gardening were excessive heat, high speed stormy wind but in homestead gardening the main problem was presence of different domestic animals and thieves.

Table 5. Problems identified by the rooftop and homestead gardeners in Bogura township areas and their potential solutions

(A) General problems in homestead and rooftop gardening	Potential solutions
1. Lack of training on gardening	GO or NGO related agricultural institution should be advance in training based program.
2. Unavailability of good seed and seedling	Seedling should be available in any nursery or every NGOs and GOs office relate to agriculture.
3. Lack of knowledge on insect pest and disease control and various nutrition deficiency symptom of plant	All organization relate agriculture should give information relate to insect, pest and disease and nutrition deficiency symptom to the gardeners. Agricultural magazine should be published, which contain lot of information relate to gardening.
4. Lack of monitoring of agriculture officers	Government of our country, Ministry of agriculture and different GO agricultural institution has to increase their monitoring system to ensure gardener's facility.
(B) Specific problems associated with rooftop gardening	
1. Extreme heat in the summer season	Shade system has to be developed to safe-guard plants from extreme heat.
2. Stormy wind	Wind breaker/permanent container/ surrounding wall can protect plants from extreme stormy wind.
3. Selection of crop variety that may be suitable for roof garden	Heat tolerant varieties are generally suitable for rooftop garden.
4. No knowledge about load capacity and soil stability	Gardeners can take information from specialists for soil stability and load capacity.
5. Poor plant nursery services	All nurseries should be regulated by government, for supply of quality planting materials to the gardeners.
6. Lack of time for maintaining the garden	The gardeners who cannot give enough time for maintaining garden; he/she can take labor or can influence any family member to maintain garden.
(C) Specific problems associated with homestead gardening	
1. Economic crisis	GOs or NGOs should provide soft loan to the homestead/rooftop gardeners
2. Attack of animal	Proper fencing system has to be set for protecting plants from animals.
3. Unavailability of exotic vegetable and fruits	Exotic varieties should be made available for the gardeners through facilitation of local nurseries.
4. Attitude of the neighbours	Gardeners should try to change people's attitude who are not interested in gardening or act as a lackadaisical.
5. Shading by large plant	Homestead gardeners should apply strategy to avoid shading.

Conclusion

The unused spaces in the rooftops and homestead are potential areas for urban agriculture. Urban agriculture has huge potentiality to contribute in the production and supply of fresh food, creating healthy environment, enhancing food security and to improve economic conditions of the urban populations. Most of the urban gardeners are amateur in nature. Proper training of the gardeners with sharing of knowledge and skills on crop care including fertilizer and pest management may be useful for success in rooftop and homestead gardening. Thus technical assistance from Department of Agriculture Extension, and other government and non-government agencies would contribute towards expansion and advancement of urban agriculture.

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