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ORIGINAL ARTICLE **SCIENCE & ENGINEERING**

EXPLORING THE POTENTIALS OF COMMUNITY GARDENS AS GREEN SPACE ON VACANT LAND IN KHULNA CITY

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Abstract

Community garden (CG) is a form of urban green space. It provides social, economic, health and environmental benefits to the urban people in a city. Bangladesh's third largest city is Khulna, which is dominated by agriculture, two of the Wards of this city namely Ward no. 17 and Ward no. 20 are selected as the study area for this study. In many established and developing countries, community gardening is a common feature of urban development, but it is a new concept in Bangladesh. The study aims at exploring the potentials i.e., factors or favorable reasons of introducing community gardens in Khulna City. A wide range of related literature on community gardens are reviewed. A total of 300 households of the study Wards are surveyed through semi-structured questionnaire, key informant interviews of urban planners, civil engineers, architects, agriculturist, environmentalist and sociologist are conducted with review of Khulna City master plans, and other reports and publications. The study finds that approximately 3. 67 acres and 2.43 acres land in Ward no. 17 and Ward no. 20 remain vacant respectively. Also, after knowing the pros and cons of CG, 58.33% people in Ward no. 17 and 60% people of Ward no. 20 become interested to participate in CG. If it is possible to utilize the vacant land for community gardening, community gardens on one acre land having 17 decimal or 10.30 katha land of each community garden will be capable to sequestrate about 3.5 tons of carbon per year and depending on the size and duration of rain event, will be able to hold about 2000-10000 cubic ft. of storm water per year. The study also proposes some sites for the development of community gardens in future.

Keywords: Community gardens, green space, vacant land, Khulna city

Introduction

A community garden is defined as 'any piece of land gardened by a group of people, utilizing either individual or shared plots on private or public land' (Egli et al., 2016). In other words, community gardens are the most valuable space within a neighborhood which provide space for individuals of the community who do not have enough space to participate in agricultural activities and also an opportunity to utilize the underused space of the neighborhood (Grow, 2011). It is one of the most temporary types of land use because it is mostly constructed on those vacant lands which are awaiting for constructions as an interim use. In US, more than 98% of the community gardens were temporary (Colding & Barthel, 2013). Dead space, derelict landscape, and/or wasteland all seem to be the terms used to denote vacant land (Coleman, 1982; Newman et al., 2016). There are also some modern remedies and solutions for such urban vacant land issues. Vacant land can be turned into green infrastructure in the form of open green space or urban agriculture to create a more sustainable environment (Ara, 2018; Schilling & Logan, 2008; Gough & Accordino, 2013; Draus et al., 2014). At the start of the last decade, seventy US cities had upwards of 15% of land that was vacant or abandoned (Pagano & Bowman, 2000). Many vacant plots in Philadelphia, Detroit, and Chicago now have plots of sunflowers, root vegetables, and rows of corns growing in temporary community gardens (Németh & Langhorst, 2014) which demonstrate that if vacant land is effectively handled, it can provide both ecological and social advantages (Kim et al., 2015; Kim et al., 2016).

Depending on the needs of the society and the purpose of construction, the community gardens can be of different types. If the local people construct it only to get fruits and vegetables then allotment garden is the best option. In allotment system, each family take lease of different plots individually and cultivate fruits and vegetables

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according to their own choice. On the other hand, shared community garden is mainly created to strengthen community bonding as here members have access to all plots to work together. Another advantage of this type of community garden is that it requires comparatively less land than allotment garden. If there is enough space, combination of these two types of community garden is also possible. Generally, community garden can be constructed on the land of public open space, vacant plots of residential area, community meeting place, educational institutions, religious institutions etc. (Lilith, 2014).

The environmental benefits of community garden includes environmental sustainability, organic food production, waste minimization and permaculture (Davis et al., 2015; Liau, 2009). It also ensures environmental sustainability through restoration of neglected and low-valued plot of a neighborhood (Krasny & Tidball, 2009). Another important environmental aspect of community garden is preservation of agricultural biodiversity, especially by expanding the range of fruit and vegetable (F&V) varieties available beyond what is commonly available in supermarkets. The role of community garden in providing a relatively cheap food supply through direct interaction with nature (i.e., gardening) has been proposed as a solution to the problem of urban food insecurity (Shisanya & Hendriks, 2011). When traditional fruits and vegetables are inaccessible, community garden helps to make them available (Guitart et al., 2012; McCormack et al., 2010). Greenery also helps to improve the quality of life of the people, focuses mostly on local climate stabilization via air filtration, cooling through shade provision, increase carbon storage and sequestration, and reduction of total energy consumption (Yoong et al., 2017). But at the edge of 21st century, urbanization has accelerated to such a rapid rate that most of the open spaces of the cities are swiftly being converted into built environment. Despite the fact that India is one of the world's least urbanized countries, with only 31.30 percent of the population residing in urban areas, the country is experiencing a significant urban growth dilemma. This urbanization movement is no longer limited to plain areas only. The Himalayan Mountainous areas are all now witnessing the urban revolution. According to a study, there was significant urban sprawl in and around the city of Dehradun from 2004 to 2014, where 6.13 sq. km of agricultural land, fallow land, and vacant land was converted into built-up area (Bhat et al., 2017). In this situation, the concept of community gardening is broadly utilized in modern community to make the environment more livable (Agustina & Beilin, 2012).

In today's world, one of the major challenges of the governing authority is to ensure a proper and inclusive solid waste management system, where a huge portion of the municipal solid waste is organic. In Denmark, about one fifth of municipal waste is green with per capita generation of about 119 kg per year. Most of the green waste in Denmark is used for composting (Ten Hoeve et al., 2019). Community gardens lessen the amount of waste as a major portion of organic waste is used for composting which in return reduce the cost of collection and treatment of household waste (Ayilara et al., 2020; Jaradat & Al-khashman, 2013).

Working in the garden gives the gardeners immense pleasure which in turn have an effect in their health condition. One of the leading motivations for the local people to participate in the gardening activities is enhancement of their health condition, both in terms of mental and physical health (Firth et al., 2011). Gardening involves regular and enjoyable physical activities which helps to control different health related problems like cardiovascular disease, diabetics, blood pressure, orthopedic problems etc. It also offers meditative space and a soothing environment which are very beneficial for mental health (Bonow & Normark, 2018; Khurram et al., 2022; Rindels, 2019; Soga et al., 2017; WHO, 2018).

Bangladesh, as one of the world's fastest urbanizing countries, has seen an unplanned and rapid rate of urbanization in recent years (Angeles, 2022; Hasan & Nazem, 2015; UPPRP, 2011). Its urban sector generated more than 65% of the national gross domestic product (GDP) in 2011, which is now about 75% (Ahmed, 2022; Choe & Roberts, 2011). As a consequence of such socio-economic improvement in recent decades, Bangladesh has experienced unplanned urbanization leading to the territorial extension of each city and growth center as well as to the changes in land use (Hassan, 2017). In this transformation, Bangladesh, like many other countries, faces a tremendous difficulty in proper planning and managing urban expansion, ensuring effective use of urban vacant land and achieving a sustainable urban development (Li et al., 2018; Islam et al., 2018). Table 1 shows the land use land cover change statistics of some major cities of Bangladesh. Only the built-up area has a positive changing trend among the four land use classes, whereas the other three have negative gradients against time. The extraordinary and shocking fact is that the amount of unoccupied land in Dhaka city grows with time, and its value is really high. The concept of community garden is completely new as well as unfamiliar in Bangladesh, though it has huge potentials in respect of neighborhood planning in a developing country like Bangladesh. This study is conducted in Khulna city, the heart of the southwestern part of the country. As a whole the study is conducted to determine the

benefits of installing community gardens on vacant land of the selected area, Ward no. 17 and Ward no. 20 of Khulna City Corporation (KCC).

Table 1. Land use land cover change statistics of some major cities of Bangladesh during 1989-2014

City	Land use type	2013-2014(ha)	%	1999-2000(ha)	%	1989-1990(ha)	%
Dhaka	Vegetation and Cultivated land	2232.63	16.04	3009.6	21.63	5414.67	38.91
	Built-up	7970.67	57.26	7268.4	52.25	4759.92	34.20
	Water bodies and wetland	799.65	5.74	1166	8.38	1715.4	12.33
	Fallow land	2917.44	20.96	2467.9	17.74	2026.71	14.56
Chittagong	Vegetation and Cultivated land	8194.52	48.94	10609	63.36	13228.38	79
	Built-up	7711.83	46.05	5052	30.16	2367.99	14.14
	Water bodies and wetland	746.46	4.46	974.4	5.81	967.23	5.78
	Fallow land	57.51	0.34	84.33	0.50	173.52	1.04
Khulna	Vegetation and Cultivated land	1017	18.61	1836	33.5	3107	56.70
	Built-up	3772	68.83	2798	51.06	1614	29.45
	Water bodies and wetland	635	11.59	767	14	646	11.79
	Fallow land	53	0.97	79	1.44	113	2.06
Rajshahi	Vegetation and Cultivated land	1927	36.74	2619	49.93	3575	68.17
	Built-up	2708	51.63	1864	35.54	966	18.42
	Water bodies and wetland	546	10.41	675	12.87	617	11.76
	Fallow land	64	1.22	87	1.66	87	1.66

Source: Hassan, 2017; Moniruzzaman et al., 2018; Hasan & Nazem, 2015; Mamun et al., 2013

Materials and Methods

Concept Building

As the concept of community gardening is very unfamiliar in context of Bangladesh, several international and national research papers, newspaper article, reports and books are reviewed to enrich the concept. A reconnaissance survey was done to get the overall idea and information about the study area.

Study Area Profile and Sample Size Determination

Ward no. 17 and Ward no. 20 of KCC were chosen as the study area. Ward no.17 has two planned residential areas developed by Khulna Development Authority (KDA). They are Sonadanga Residential Area (1st Phase) and Sonadanga Residential Area (2nd phase).

Ward no. 20 has a large unplanned residential area named Sheikhpara. Table 2 shows a detail description of socio-geographic and land use data of the study wards. Figure 1 shows different land uses, especially of vacant lands and open green spaces as potential sites for community gardens.

Sample size of the household questionnaire survey is determined by using the following equation:

$$N = \left(\frac{Z\sigma}{E}\right)^2$$

Where N is the sample size, Z is the critical value of the normal distribution, σ is the standard deviation and E is the difference between the observed and actual mean. For this study, 95% significance level and 5% error margin are considered. Using the above formula, the sample size was determined 300, where 200 was for Ward no. 17 and 100 was for Ward no. 20). About 30% of the existing vacant plots are surveyed based on their size and locations.

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Table 2. Study area profile

	Ward no. 17		Ward no. 20	
Area (acre)	572.34		120.72	
Name of localities and mohallas	Choto Boyra Dakshin (South), Khulna Textile Mills, Paschim (West) Sonadanga, Purba (East) Sonadanga, Shibbari, Sonadanga Madhaya (Middle) and Sonadanga New Market.		B. K. Roy Road, Deben Babu Road, Farazi Para, Ferryghat (Barada Datta Lane) and Sheikhpara.	
Population	33163		16624	
Density per acre	58		138	
Sex Ratio (M/F)*100	98.676		103.576	
Literacy Rate (%)	70.10		73.20	
Total Household	7710		3689	
Household size	4.2		4.4	
Land use details	Area (Acre)	Percentage	Area (Acre)	Percentage
Agricultural land	70.30	12.28	0	0.00
Park	6.10	1.07	0	0.00
Vacant land/plot	3.67	0.64	2.43	2.01
Urban green space	0.24	0.04	0.04	0.03
Waterbody	48.80	8.52	2.06	1.71
Built-up area	443.23	77.44	116.19	96.25

Source: Author, 2019 & Roy, 2013

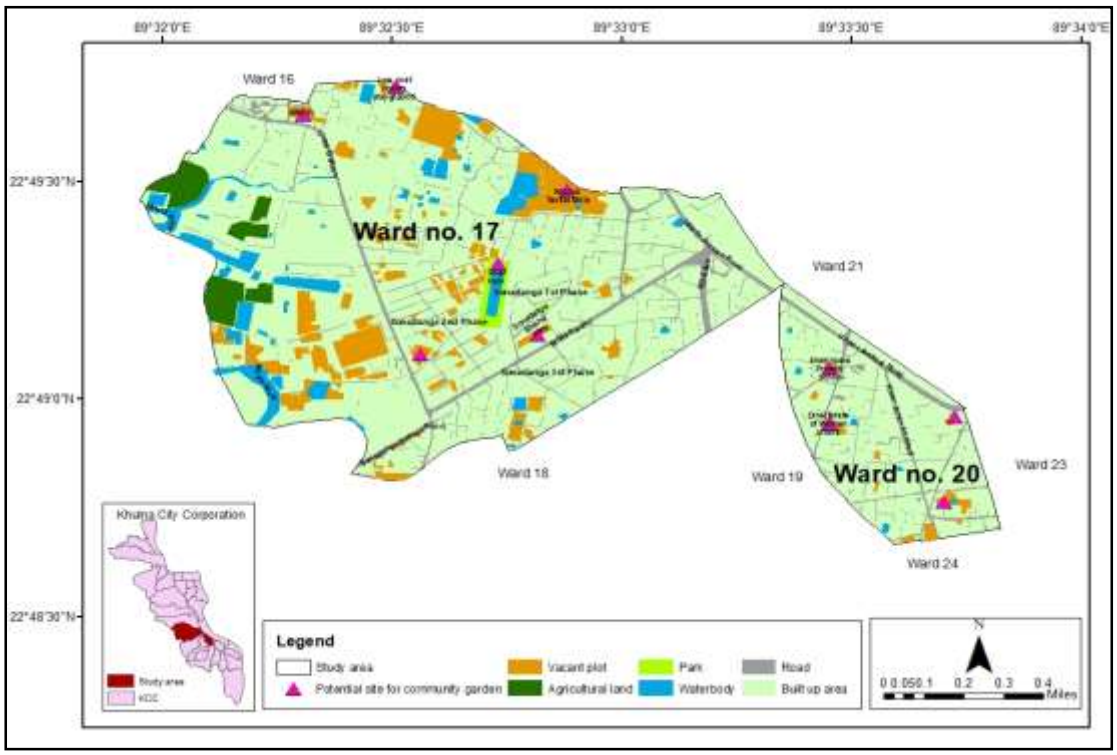

Figure 1. Map of study area with different land uses and potential sites for community gardens

Questionnaire Preparation and Data Collection

Some variables namely availability of vacant land, socio-economic and environmental benefits i.e., impact on solid waste management, and health benefits of community garden are selected for this study to explore the potentials of community gardens in the study area. Both primary and secondary data are collected. After preparation of the questionnaire, primary data are collected from the household survey. Opinions and views regarding the potentials of community gardening in Khulna city are collected from the key informant interview (KII) of urban planners, civil engineers, architects, agriculturist, environmentalist and sociologist. Data on population, infrastructural details and details of existing community services are collected from KCC, KDA and Bangladesh Bureau of Statistics (BBS). Satellite images are used for preparation of the land use map.

Data Analysis

The collected data are analyzed using the statistical software SPSS. Different tables, charts and analytical figures are prepared to show the comparisons and trend analysis of particular sections. Land use land cover (LULC) change of the study area is analyzed applying NDVI method in Arc GIS.

Findings and Recommendations

Based on data analysis and findings, the study provides some recommendations and potential sites for developing community gardens on the vacant and unused lands of Khulna city. The study finally proposes a guideline for introducing community gardening at neighborhood level in Khulna City.

Results and Discussions

Availability and condition of vacant land e*xisting Condition*

Ward no. 20 has very small amount of vacant land, which is approximately 2.43 acres in total. There are only about 40 vacant plots of different sizes ranging from 3 katha to 5 katha (Average 4 katha or 6.6 decimal). On the other hand, approximately 60 plots of total 3. 67 acres land are vacant in Ward no. 17. Figure 2 shows the current condition and use of the vacant plots. In Ward no. 17 most of the vacant plots are remaining unused (about 33.08%) followed by storage of construction materials (about 25.61%). Waste dumping is the most common use of the vacant plots in Ward no. 20. Vegetables gardening is the rarest use of vacant plots in both the wards.

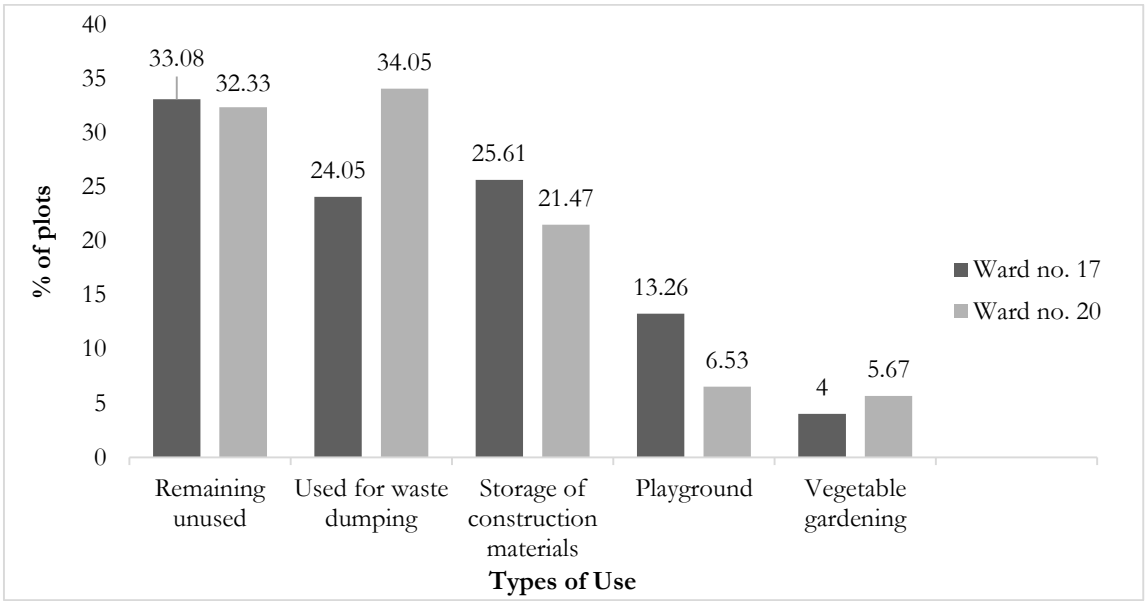

Figure 2. Current use of vacant plots in Ward no. 17 and Ward no. 20 (*Source: Field Survey, 2019)*

Chronological Analysis

Huge amount of land in both the study wards remained vacant for many years before construction of buildings on that. As the land owners gradually construct buildings at their convenience of getting money and wealth in hands, the buildings age varies widely. Figure 3 shows that about 30.46% buildings of Ward no. 17 are constructed 15-20 years ago but most of the buildings of Ward no. 20 are older than 20 years. About 38.21% buildings are constructed more than 20 years ago. Most of the building owners responded that they did not use their vacant plots for any other significant use before construction of buildings. As a result, those vacant plots could not play any role in the socio-economic and environmental development of the city.

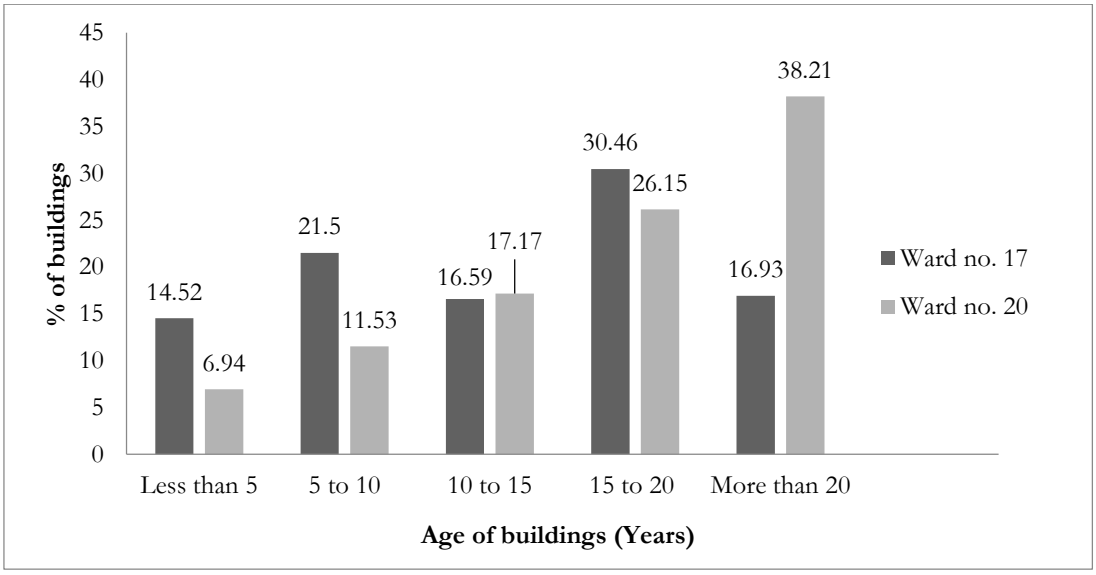

Figure 3. Age of buildings in Ward no. 17 and Ward no. 20 (*Source: Field Survey, 2019)*

The amount of vacant land in both the wards has drastically reduced during the period of 2000-2010. The socio-economic development of the people of Khulna city as well as of the country is one of the main reasons of rapid urbanization, land transformation and land use change in the cities and towns (Hasan, 2017). Table 3 shows that the amount of vacant land in Ward no. 17 has lowered at 7.01 acres in 2010 from 18.93 acres in 2000. In ward no. 20 it has lowered from 30.25 acres in 2000 to 10.42 acres in 2010.

Table 3. Chronological analysis of the amount of vacant land in Ward no. 17 and Ward no. 20

Year	Ward no. 17 (Acres)	Ward no. 20 (Acres)
1990	36.73	55.38
2000	18.93	30.25
2010	7.01	10.42
2019	3.67	2.43

Source: Google Earth Images of Khulna City & KDA, 2018

Environmental Benefit

Existing condition

Greenery is largely shrinking in both the study wards with rapid urbanization over time. Table 4 shows a chronological change of greenery in the wards in different years, from 2013 to 2020. Existence of greenery with practice of gardening is very rare in Ward no. 20, where most of the area is built-up i.e., 96.25%. There is no agricultural land in this Ward. Its sparse vegetation has reduced at only 1.33 acres in 2020 from 8.67 acres in 2013. But the amount of greenery in the form of sparse vegetation, gardening and agriculture in Ward no. 17 is quite

satisfactory. The Ward has agricultural land of about 70.30 acres (12.28%) in 2019 (Table 1). Sparse vegetation in Ward no. 17 has reduced at 38.89 acres in 2020 from 214.39 acres in 2013, which is a massive change.

Table 4. Changes in sparse vegetation coverage in the study area during 2013-2020

Year	Ward no. 17 (in acre)	Ward no. 20 (in acre)
2013	214.39	8.67
2017	83.18	2.22
2020	38.89	1.33

The study has also found that nowadays KCC, Department of Agricultural Extension (DAE), Forest Department (FD), District Administration, some NGOs and nurseries are taking programs to motivate local people in tree plantation, rooftop gardening and urban greening. This is contributing to increase the amount and coverage of greenery in Khulna city. Table 5 represents the relations between the house ownership and gardening practice. In both wards, most of the gardening practitioners are the owners of house (80% in Ward no. 17 and 80.67% in Ward no. 20) and very few tenants of the Wards are involved in gardening (20% in Ward no. 17 and 19.35 % in Ward no. 20).

Table 5. Relation between house ownership types and gardening practice

Area		Ownership Type	
		Owner	Tenant
Ward no. 17	Involved in gardening	80.00%	20.00%
	Not involved in gardening	41.80%	58.20%
Ward no. 20	Involved in gardening	80.67%	19.33%
	Not involved in gardening	44.08%	55.92%

Source: Field Survey, 2019

Among the non-practitioners, most of the respondents are interested about gardening but cannot participate due to lack of available space and time. Figure 4 shows the reasons for not being involved in gardening by the residents.

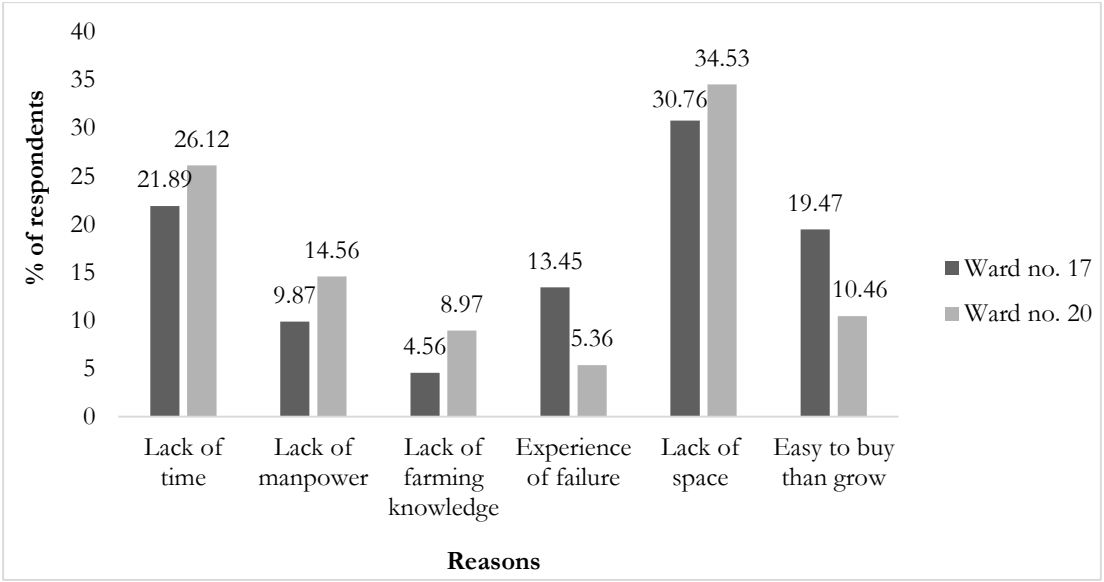

Figure 4. Reasons for not being involved in gardening (*Source: Field Survey, 2019)*

In Khulna City, agriculture comprises only 16.30% land of the total urban land use (Roy et al, 2019). Most of the practitioners in both the Wards are practicing small scale gardening, where the average number of plants in a garden is 12 and 15 in Ward no. 17 and Ward no. 20 respectively. The practitioners cannot expand their gardens due to lack of high value space, less availability of seeds, fertilizer and other logistic supports.

Figure 5 shows the types of gardening and the types of produced vegetables and plants in the gardens. Most of the practitioners are becoming interested in rooftop gardens or pot planting in both areas due to lack of space or lack of permission by owners and family members to use the available vacant space for gardening. Flower plants, fruit plants and vegetable plants are more popular and common in the area. The most common flower plants are Rosa (Rose), Dahlia (Dahlia Pinnata) and Cosmos (Cosmos Bipinnatus) etc. Among fruits and vegetables, Cucumber (Cucumis sativus), Spinach (Spinacia oleracea), Tomato (Solanum lycopersicum), Lemon (Rutaceae) etc. are more common. A very small number of ornamental plants such as Cactus (Cactaceae) and Money Plant (Epipremnum aureum) etc. is also found.

Except homestead gardens at household level, for serving the recreational and environmental need of the local people, there are two parks, named Solar Park and Sonadanga Shishu Park in Ward no. 17. In Solar Park, there is also a waterbody having an area of 3.01 acres. But there is no such parks or open space in Ward no. 20. Table 6 shows a detail description of the two parks of Ward no. 17.

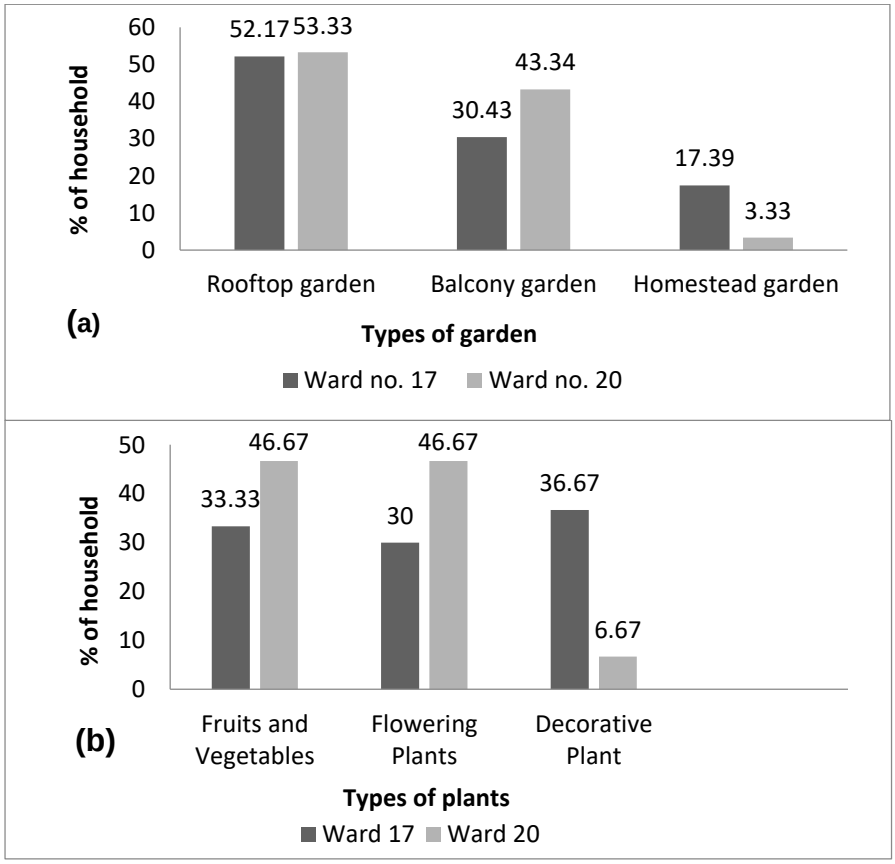

Figure 5. Types of gardening (a) and types of plant in the garden (b) in the study area (*Source: Field Survey, 2019)*

Environmental Benefit Achieved by Community Gardening

Community garden helps to manage and improve the environmental quality in several ways such as sequestrating carbon, management of storm water, maintaining air temperature and air quality and many others. This study aims to quantify two of the most significant environment benefits of community gardening: (i) carbon sequestration and (ii) storm water runoff retention. It is assumed that the area of each of the proposed community garden will be 0.17 acres or 10 Katha or 7200 sq. ft.

Carbon Sequestration

In the tropical region of South East Asia, a typical community garden of 1 hectare sequestrates about 14.46 tons of carbon on an average in a single year (Choudhari et al., 2014). This amount highly depends on growth rate, age, and species of the particular tree. Warm and wet climate of tropical region enhances plant growth and plant with higher growth rate significantly sequestrates carbon at a faster rate than a plant of slower growth rate. The given equation is mainly used in this study to estimate the amount of total carbon that will be sequestrated by the proposed community garden:

C=No. of plant*survival factor*annual sequestration rate $_{(A,T)}$ (US Department of Energy, 1998)
where:

C=Total Carbon sequestrated
A=Age of greenery
T=Type of greenery

From several different literature review, it is found that general number of vegetable plants per hectare or 2.47 acres is 10,000, survival factor is 0.798 and annual sequestration rate is 2.2 lbs Carbon/plant/year on an average. A proposed community garden on 10 katha or 7200 sq. ft. or 0.17 acres land under this study having 688 vegetable plants will sequestrate 0.60 tons of Carbon per year. The calculation is as shown below:

C = 688*0.798*2.2
= 1208 lbs
= 0.60 tons

Table 6. Details of parks in Ward no. 17

Features	Solar Park	Sonadanga Shishu Park
Establishment Year	2007	1981
Location	Sonadanga Residential Area (2nd Phase)	Sonadanga Residential Area (1st Phase)
Area (acres)	4.33	0.46
Presence of Waterbody	Yes (3.01 acres)	No
Managing Body	KCC	KCC
Facilities	Play space, jogging tract, security guard and guard room, lighting facilities, sitting arrangement, CCTV, training center on solar and renewable energy etc.	Play space, rides, sitting benches, paved internal roads etc.

Source: Karim & Roy, 2012; Khaza et al., 2020

Storm water runoff retention

Community gardens contribute to urban environmental development by storm water management. This benefit is quantified by using the TR-55 method (Gittleman et al., 2017), shown below:

$$Q=\frac{(P-Ia)\hat{}2}{(P-Ia)+S}$$

where:
Q= Runoff in inches for a P-inch rain event
S= The potential maximum runoff after runoff begins
I_a= The initial abstraction in inches
= 0.2S

$$Q = \frac{(P-0.2S)^2}{(P-0.2S)+S}$$

$$S = \frac{1000}{CN} - 10$$

where:
CN= curve number which depends on land cover and hydrologic soil group. Table 7 shows the list of CN for different types of soil.

Table 7. Curve number for different land cover

Land Cover	CN of Khulna Region
Open Space (grass cover >75 %)	74
Bare Soil	91
Paved	98

Source: Gittleman et al., 2017

$$CN = (C_o*A_o + C_b*A_b + C_p*A_p)/A$$

where:
CN= Average curve number
C_o= CN for open green space
A_o= Area of the open green space
C_b= CN for bare land
A_b= Area of the bare land
C_p= CN for paved area
A_p= Area of the paved area
A= Total area

$$R = \frac{Q}{12} * A$$

where
R= runoff volume (cubic feet)

From several different literature review, the general composition of a typical community garden is 83 %green space, 16% paved and 1% bare.

$$CN = \{(5976*74) + (1152*91) + (72*98)\} / 7200$$
$$= 76.96$$

Therefore

$$S = \frac{1000}{76.96} - 10$$
$$= 2.9937$$

Therefore, for a rain event of 1.5″, the runoff value will be

$$Q = \frac{(1.5-(0.2*2.9937))^2}{(1.5-(0.2*2.9937))+2.9937}$$
$$= 0.209 \text{ in}$$

and

$$R = \frac{Q}{12} * A$$
$$= 125.4 \text{ cubic feet}$$

Again, for a rain event of 5″, the runoff value will be

$$Q = \frac{(5-(0.2*2.9937))^2}{(5-(0.2*2.9937))+2.9937}$$
$$= 1.47 \text{ in}$$

and

$$R = \frac{Q}{12} * A$$
$$= 882 \text{ cubic feet}$$

Table 8 shows the impact of community garden on the quantity of surface runoff and also the amount of rain water absorbed or retained by each garden during different rain event.

Table 8. Summary of the effect of community garden on surface runoff retention

Rain Event (in)	Runoff Value (With Community Garden) (ft^3)	Runoff Value (Without Community Garden) (ft^3)	Retention Value by Community Garden (ft^3)
1.5	125	445	320
5	882	2520	1640

Source: Author, 2019

Willingness of the local people

The concept of community garden is very new and unfamiliar to the local people. After informing them all the pros and cons of community gardening, 60% people of Ward no. 20 and 58.33% people in Ward no. 17 become interested to participate in community gardening.

Age-based opinion

The total population is divided into 5 age-groups and their corresponding opinions are shown in Table 12.

Table 12. Age based willingness for community garden

Age	Opinion		Total Respondent
	Yes	No	
20-30	100%	0%	4
30-40	54.55%	45.45%	22
40-50	68.75%	31.25%	128
50-60	51.06%	48.94%	94
60-70	46.15%	53.85%	52
Total			300

Source: Field Survey, 2019

People of all age group are interested in participating in gardening but young people have more interest on it, generally the aged group need some time to become familiar with this new concept.

Gender-Based Analysis

To make the community gardening inclusive and gender sensitive, the willingness of male and female to participate in community gardening is analyzed. The result shows that male participants are more interested than female. The only reason is that women do not feel fully socio-culturally secured in the outside environment than their own families and homesteads. So, the socio-cultural security and related issues for the women must be considered while developing the urban community gardens.

Table 13. Gender based willingness for community garden

	Opinion		Total
	No	Yes	
Female	45.45%	54.55%	110
Male	36.17%	63.83%	190
Total			300

Source: Field Survey, 2019

Education Level and Interest

Literacy is an important factor of initiating any noble work and good deed like community gardening, which contributes to urban environmental development. Literacy rate in KCC area is 73.56%, of which male literacy rate is 76.46% and female literacy rate is 70.29%. Literacy rate in Ward no. 17 is 70.10% and in Ward no. 20 is 73.20% (BBS, 2011). Table 14 shows the relation between people's interest and their education level and the analysis shows

that as people become more educated, they are becoming more concern about environmental and health condition and therefore are more interested about participating in community gardening.

Table 14. Education based willingness for community garden

	Opinion		Total
	No	Yes	
Primary	53.87%	46.13%	14
Secondary	53.13%	46.87%	54
Higher Secondary	51.28%	48.72%	78
Graduation	35.35%	64.65%	132
More than graduation	36.36%	63.64%	22
Total			150

Source: Field Survey, 2019

Potential sites of community gardens in the study area

Table 15: Potential sites of community gardens in study area with explanations

KCC Wards	Favorable reasons for community gardens
17	Medium dense area (58 persons/acre) having two parks-KCC Solar Park in Sonadanga Residential Area (2nd Phase) and Sonadanga Shishu (Children) Park in Sonadanga Residential Area (1st Phase). One or two community gardens can be established in the Northern and Southern end of the Solar Park. Solar Park is mainly suitable and used for walking, jogging and physical exercise; and passing leisure time in the morning and afternoon. The potential sites where there exist significant amount of vacant/unused/underused land for future community gardens in this Ward are: • Residential Areas and Staff Quarters/Colonies -Sonadanga Residential Area (2nd Phase) having many KDA allotted vacant and underused plots for many years (33 years from 1987 to 2020). -Sonadanga Residential Area (1st phase) has still few vacant plots, where community gardens can be established • Major Establishments -Khulna Medical College (KMC) and Khulna Medical College Hospital (KMCH)-KMC is a 500 bedded government hospital which has beautiful flower garden with good landscaping in its front or main entrance. It still has unorganized and unused land which can be used for community gardens. Research and demonstration type community gardens are preferable for this site as the patients and their family members, students, academics and researchers involved or interested to health and development sectors can be made aware and motivated on community gardens. The attached KMCH also has land for establishing community garden. -Divisional Women Sports Complex (Bibhagio Mohila Crira Complex) -Boyra Secondary Schools -Khulna Art College (Abandoned)
20	High density area (138 persons/acre) with no parks and playground for recreation, leisure, play, sports and physical exercise; significant number of 7+ age unemployed persons (21.82%) might be directly and indirectly involved in community gardening. Modern Khulna District Shilpakala Academy Complex at Shere-E-Bangla Road is situated in this Ward and the pond of this complex has been an attractive place of water-based recreation (bathing, swimming and jumping from building tops) for the children and youths of this locality. The Government, mainly the Directorate of Youth and Sports, Department of Social Welfare, and KCC can take steps to develop a few community gardens on vacant and unused land under government offices (i.e., Social Welfare Office) and educational institutes (i.e., Ahsanullah College, Sheikh Abu Naser Secondary School) in this Ward.

Guidelines for Community Gardening

At least 7200 sq. ft. area is needed for the construction of a standard community garden. There are some other factors which also should be considered such as topographical details, drainage network, and accessibility from all parts of the residential area. After informing the land owners about the pros and cons of community garden, it is important to take some legal permission from the land owners for a specific time period. After site selection, the next step is site preparation and this phase include building boundary walls to properly designate the area, improving the soil quality by removing the existing debris, implementation of organic matter, raising the soil bed level for better aeration, construction of internal roads and other infrastructural facilities like sitting arrangement, some play equipment for children, separate toilets and washrooms for male and female, small vending opportunity, meeting place etc. It is also important to first decide the plant species and ensure the quality of the seeds or plants brought. It is also important to decide whether to plant seeds or transplants and this decision depends on the cost of seed, the plant population needed, the earliness of desired crop maturity, and convenience. Buying required gardening tools, insecticides and fertilizers are also important. To make the community garden projects successful and to ensure the active participation of the people, some decisions at policy level may be introduced like, special discount on land tax for the land owners of vacant plots who will allow community gardening on their plots; to ensure the practice of composting, the provision of charging the house owners and tenants for household waste collection according to the weight of the wastes may be introduced; and conducting some workshops, seminars, dialogues etc. about the merits and demerits of community gardening.

Key Challenges for Introducing Community Gardening

- The concept of community gardening is very unfamiliar and new to the local people so they might need some time to become familiar with it.
- Currently, in most of the cities of the country as well as in Khulna city, the practice of community gardening is almost absent or if present then in very small scale. That is why the common people cannot understand the potential benefits of community gardening.
- There is no existing direct policies and regulatory frameworks for community gardening. Also, there is no clear instructions about community gardening in the master plans of the cities of the country.
- The stakeholders do not have enough knowledge about the benefits of community gardening.
- There is scarcity of pre-requisite inputs for community gardening such as adequate water supply, quality seeds and fertilizers.
- The roles of the Department of Agriculture and other organizations (KCC, KDA, NGOs, CBOs etc.) for community gardening in the cities are not distinct.

Conclusion

Community gardening is a popular component of urban planning in many of the developed and developing countries. Though it is completely a new as well as unfamiliar concept, it has huge potentials in respect of neighborhood planning in a developing country like Bangladesh. As community garden is a good form of urban green space and the cities of Bangladesh have inadequate number of parks, playgrounds etc. as green space for recreation, jogging and physical exercise and for mental relaxation, community gardens can be developed as better alternative options of green space. Community garden is an important component of urban agriculture and every urban area master plan must consider the provision of adequate land for urban agriculture. In Khulna City, like other cities of Bangladesh, there is no formal community garden. But there are some informal gardens for fruits and vegetables in many of the public housing estates or government employee housing areas in different cities of Bangladesh. There exists huge amount of vacant or unused land in the form of public planned residential area plots, private planned residential area plots, land parcel in unplanned or naturally built-up area, and land under different public and private organizations. Community gardens can be developed in such vacant land. Agricultural land is gradually being converted into residential use and horizontal expansion of city is experienced. Extensive practice of community agriculture and community gardening can also counterbalance between reduction of agricultural land and increase of residential land.

Conflict of Interests
The author declares no conflict of interest.

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