Chapter 20
Urban Agricultural Practices in the Megacities of Dhaka and Mumbai

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Abstract Dhaka city in Bangladesh, with a population density of approximately 27,700 people per square kilometre, is one of the densest cities in the world. The urban morphological characteristics and urban design and planning provisions in the high-density city restrict land availability for growing food locally. As a result, the food, especially vegetables and fruits available in the local market of Dhaka, are transported from the rural regions of the country, with high food miles, mostly adulterated with preservatives for longer shelve life. Evidence shows that this megacity is adopting useful pathways to integrate safer local food production or urban agriculture within the built environments. Unsafe available food is not the only problem of this city. In more than 30 years, Dhaka city has lost enormous amounts of open spaces, decreasing from 44.8% to 24.1%. As a result, the city has lost its agricultural land, other food producing spaces such as home and community gardens, small vegetable farms, and recreational spaces such as neighbourhood parks. Local food production on rooftops can be a gateway for safer food production, as well as adding extra green spaces to the city.

The aim of this research is to review existing and emerging urban agricultural practices and current planning policies in the city of Dhaka and selected high-density cities of the world, using an exploratory literature review and analysis of two case studies from these cities. One innovative case study from Dhaka would be analysed and compared to one relevant case study from Mumbai, India, considering productive spaces, current performance, potential to grow local food, and ability to make social awareness which would cause other people of the city to adopt urban agriculture as a part of their urban life.

The outcome of this research will provide a realistic view of the status of Dhaka's urban agricultural system and practice, in comparison to another high-density city's food production practices. This will give a clear idea about current research and planning, and urban design policy of urban agriculture. Mainly, it will identify the

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research gap this practice creates, and would provide some recommendations for integrating local food production within the city to improve and to build a resilient future.

Keywords Urban agriculture · Rooftop garden · Dhaka · Mumbai · Food security

20.1 Introduction and Context

Dhaka is one of the major cities and the capital of Bangladesh. It has a population of 12 million and a population density of approximately 27,700 people per square kilometres. It is predicted that the population of Dhaka will be over 20 million people by the year 2020. Although this population is contributing to the economy of the country, but it is simultaneously causing unbearable pressure on the city's infrastructure. Due to land scarcity and topography, the land price of Dhaka is very high even compared to other developed countries (Baker 2007). Figure 20.1 presents photos from Dhaka and Mumbai.

On the other hand, Mumbai is situated almost 2300 km away from Dhaka and is regarded as the economic capital of India. Similar to Dhaka, this city is highly populated, with a population of 23.5 million people, almost the double as Dhaka's current population. The population density of Mumbai is about 20,482 persons per square kilometer, making it the ninth most crowded city of the world.

This paper focuses on the urban agriculture practices in these two dense cities, which are located in the same region of the world. Although agriculture is not one of the principal activities of most of the cities in the world, in a number of specific countries, there are many urban dwellers who rely solely on urban agriculture for food and livestock production for their supply of nutrition and food security (Zezza and Tasciotti 2010). Urban agriculture can play a major role in making these cities self-sufficient through local food production. Many cities in the world are currently

Fig. 20.1 Two high density cities. (Photos by M. Islam and K. Faiz)

practicing urban agriculture within city limits. Cuba showcases a good example of how urban agriculture practices can flourish in a country to tackle food supply crisis. In 1989, when Cuba was cut off from the Soviet Block and was also under US embargos, a food crisis began to take place on the small island nation. Hunger became a part of Cubans' daily life. Not only the food import stopped, but also import of other agricultural materials such as animal feed, fertiliser, and industrial equipment were also stopped. This crisis led the government to take initiate urban organic farming in Cuban cities such as Havana (Clouse 2014). Among South East Asian countries, Dhaka and Mumbai are the two high-density cities that have been impacted by rapid urbanisation. But when it comes to formal urban agriculture, both cities have a culture of growing food within the city as a hobby, but not as a strong urban component. Compared to Bangladesh, India has more major cities, and urban agriculture is slowly getting its position in the urban fabric. For example, urban agriculture is a new concept in the city of Hyderabad in India. More than 400 households of this city practice urban agriculture, and the horticulture department of the government has a subsidy system for citizens who want to initiate farming of their own. Despite having this promising initiative from the government, there is hardly any noticeable urban agriculture in the core areas of the city. This is because the city is very dense and tenants do not have access to spaces where they could grow food. Some of the residents have received this subsidy from the government and applied it to practices of growing food in the outskirts of the city (Awasthi 2013).

20.2 A Review of Urban Agricultural Practices in Dhaka and Mumbai

Islam's (2002) research established that almost 78% of rooftops in Dhaka had already incorporated some forms of gardens. This city has not introduced any formal 'Urban Agriculture' (UA) system and there is very limited literature available on this specific topic (Das 2017; Sajjaduzzaman et al. 2005; Shariful Islam 2002). Although approaches to UA practices in Mumbai are different from Dhaka, limited work has been conducted on UA research for this city. The only notable urban agriculture typology that exists in the Dhaka city is a rooftop garden. The community garden concept did not progress, because communities could not afford to invest in a land area for community garden due to high land price in Dhaka, and this is not a common cultural practice (Zinia and McShane 2018). However, in Mumbai, three typologies of UA system are widely practised such as (1) farming along the railway tracks, (2) community garden, (3) rooftop garden (Satterlee 2015).

Historically, UA in Mumbai was informal and had only existed in the form of a terrace or balcony garden (Satterlee 2015). These are popular as part of a food production system in Mumbai, especially to meet one's personal recreational need (Vazhacharickal 2014). Simultaneously, Mumbai's community gardens are run by a group of people or non-government organisation with various goals, such as creating

awareness on local food production with local people and to teach them gardening techniques so that they are inspired to start gardening themselves. Produces from these community gardens are usually distributed between the garden members, and sometimes get donated to nearby churches and hospitals (Satterlee 2015).

The Indian Railway plays a major role in Mumbai in implementing a government-initiated food production system in the city. This organisation has allocated their unoccupied land to employees with lower socio-economic profiles to farm and grow vegetables. The project is called "Grow more food", and has protected Indian Railway's unoccupied lands from illegal encroachment. The huge farming culture in the city is also linked to cultural practices of many agricultural migrants from the adjacent rural areas (Vazhacharickal 2014). Produces from these farms are usually consumed by the farmers, and they sell the extra vegetables to the local markets (Satterlee 2015). Sadly, this innovative approach towards urban agriculture farming is threatened by the overuse of fertilisers and pesticides by the poor farmers who lack formal training and knowledge about organic farming and are motivated only to increase the production. Lack of knowledge on organic farming and its benefits have led to the high chemical contamination in vegetables that farmers grew in this project (Vazhacharickal 2014). Nevertheless, this is the only formal approach from the government's side to encourage urban farming for food production in this city (Satterlee 2015).

Similar to Mumbai, there is little to no involvement from the government's side to promote urban agriculture in Dhaka. As discussed earlier, community gardens or gardening on land is difficult in the city, due to the unaffordable land price and unavailability of land. However, rooftop gardening has significant potential in the city. The dense built environment of the city provides a larger roof space area available, and a huge opportunity for city dwellers to grow their own food on the rooftop gardens. Also among the many green adaptation methods, rooftop gardening is one of the most affordable methods for the Dhaka dwellers to increase the number of green spaces in the city (Zinia and McShane 2018). When Shariful (2000) interviewed the current food growers of Dhaka, he found out that, usually, homeowners prefer to have gardens on the rooftop but they are not very willing to let their tenants practice gardening on the rooftops of their houses. Each rooftop gardener in Dhaka spends around $50–$80 Canadian dollars annually as an expense on the garden and half of the gardeners have prior experiences of gardening and in agriculture (Shariful Islam 2002).

Several types of planters are used in Dhaka's rooftop gardens and are made out of permanent to temporary materials. Using of Permanent structures such as cemented platforms are less (approximately 5%). Up to 83% of these planters are clay pots, and the rest of the planters are plastic drums (Sajjaduzzamanet al. 2005). Unlike Dhaka, Mumbai's UA farmers mostly upcycle un-biodegradable waste by using them as planters and other gardening materials (Satterlee 2015). Where Dhaka's UA is hobby-driven, Mumbai's urban agriculture aims to help improve waste management practices within the city. Every community garden or rooftop garden has a provision for using waste as compost for the plants (Satterlee 2015).

75% of gardeners who grow food on their rooftop gardens in Dhaka's context are from middle-class backgrounds. Rich and poor classes are less involved in rooftop gardening in Dhaka (Sajjaduzzaman et al. 2005). The economic conditions of Mumbai's urban farmers present variations of social and economic statuses who participate in urban food production. While rooftop and community gardeners are usually the upper-middle class, railway farmers fall directly below the poverty line in Mumbai (Satterlee 2015).

20.3 Analysis of Roof Garden Case Studies from Dhaka and Mumbai

20.3.1 Rooftop Gardening Project in Dhaka

The Food and Agriculture Organization of the United Nations (FAO), in collaboration with Department of Agricultural Extension (DAE), Ministry of Agriculture, Bangladesh, had funded a rooftop gardening project in two major cities of Bangladesh, Dhaka and Chittagong. The project was implemented for two years, from 2015 to 2017. On record, this is the only formal urban agricultural project in Bangladesh where a global organisation worked solely on food production in a rooftop garden. The main objective of this project was to increase awareness about rooftop gardens as a medium to achieve food security and nutrition in growing agricultural produces; reducing air pollution and if possible to generate income, strengthening the local economy. In this project, in two cities, around 250 demonstration rooftop gardens were established, and the same number of house owners received training and knowledge on latest rooftop garden technologies from the experts from three non-government organisations, one public university and a research institute. Compared to the total population of the city, the share of householders included was very minimal. Still, under this project, almost 800 people received basic training on rooftop gardens, and 45 young people with limited educational backgrounds received training to be an aspiring gardener (Das 2017). Apart from this personal training provision, this project also took an initiative to educate school children. The result of this project commenced an incentive from the government and two city corporations declared 10% rebate on holding tax for any building which has a green roof on it (Das 2017).

20.3.2 A Rooftop Garden Case Study in Dhaka

A rooftop garden was selected as a case study for Dhaka is situated in Uttara, Sector 06, at the fringe of Dhaka. The area is comparatively new, so it is more planned and organised than other parts of the city. The selected rooftop garden attracted

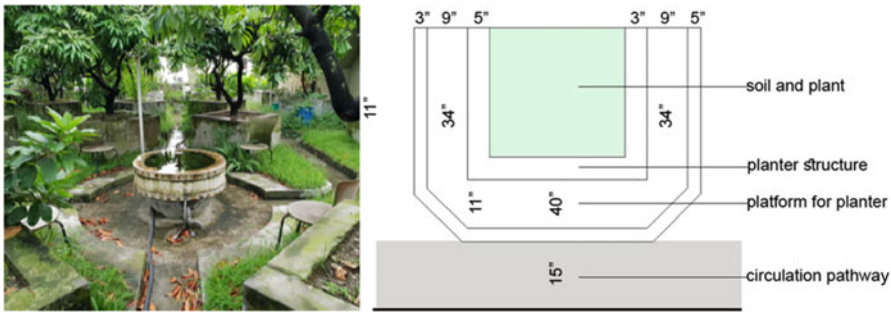

Fig. 20.2 A rooftop garden case study in Dhaka (Photo by the author) and the plan of a planter box. (Source: Drawn by the author)

significant media coverage, a TV Show entitled 'Rooftop farming' was hosted by a celebrity agriculture enthusiast, Shykh Seraj has showcased this garden in their TV show. Figure 20.2 presents a photograph of the rooftop garden case study in Dhaka, and a plan of the planter box placed on the rooftop garden.

The selected rooftop garden is set upon the roof of a five-story privately-owned house. The total area of the house is about 229.9 m^2; 50% of the total rooftop is dedicated to growing food and includes mainly fruit trees planted in concrete boxes. It has permanent structures to accommodate trees on the rooftop. Structures of the garden are planned and constructed accordingly to sustain the extra loads of the trees in the garden. The garden is a notable example; not common in the city of Dhaka and also compared to other urban agricultural practices of Dhaka. Preplanning of this garden at the design stage before construction began and the owner's enthusiasm for gardening and recreating a green space in a dense urban area, make this garden an outstanding example in Dhaka. The built-up areas, roads and green spaces on the three adjacent blocks of the selected case study show that all the plots are almost of the same size; have a good road connection with each other, but the setback between buildings are very narrow. Satellite imagery of this planned part of this dense city indicates that this city lacks in green or open spaces. From this image, it is also noticeable that the rooftop garden on the building of the selected case study contributes a reasonable amount of green space in the neighbourhood. An aesthetically designed artificial fountain and seating areas to relax on the rooftop garden indicate that the garden functions as a social space for family and friends.

This garden has two sizes of planters to grow trees. The larger planter is 101 cm × 101 cm with a depth of 50 cm. The smaller planter is a permanent structure and is 66 cm × 53 cm with a depth of 50 cm. There are altogether 25 planters on the rooftop, out of which 19 are of a large size, and the remaining six are of a smaller size. However, on this rooftop garden, the owner has comparatively larger size trees, such as mango or star fruit trees, which generally grow on the ground. On the site visit to the rooftop garden case study, 12 types of fruit trees such as mango, star fruit, lemon, guava, lychee, tamarind, etc., and exotic fruit trees,

such as avocado and Thai longan were recorded. There were some vegetables such as spinach, mint, pumpkin, and others growing in the garden.

They have created two types of visible drainage system for the garden. The first type is linked to the planter to drain out excess water after watering the plants from the planter to the rooftop garden. The second type of drainage system is to drain the water draining out of the planters and rainwater from the rooftop garden to the ground level.

One of the main problems was that the movement paths were narrow and were only 38 cm wide, although pre-designed. The spreads of the large trees at lower heights at some points make it difficult to walk through these paths, and this also poses a problem for regular maintenance of the garden. During the site visit, it was observed that drainage was blocked at several points making these paths water-logged and slippery.

20.3.3 A Rooftop Garden Case Study in Mumbai

Mumbai Port Trust's central kitchen rooftop garden is selected as the case study. It is a celebrated institutional garden in Mumbai and is different from a private residential rooftop garden case study in Dhaka. It was founded by the catering officer, Preeti Patil as a way of recycling enormous food waste created by the thousands of meals prepared in this kitchen (Satterlee 2015).

The rooftop of the central kitchen of Mumbai Port Trust Authority building is about 229.9 m^2 in size (Marielle Dubbeling 2012). In 2002, this garden started with only five plants, but it now contains about 150 different types of plants in the garden (Marielle Dubbeling 2012; Pendharkar 2008). The garden not only has fruits and vegetables, it also has a separate section for growing medicinal plants and herbs (Pendharkar 2008). The photos and research studies indicate that the garden was not pre-designed, rather it was designed organically at the post-construction phase when the building was already operating. Similarly, the materials used as planters are mostly recycled waste. 90% of the waste generated by 30,000 employee's meal preparation are recycled in this garden (Marielle Dubbeling 2012). Figure 20.3 shows the sketch of the organic organisation of the garden, the use of different types of material as planters, and plants of different types and sizes.

This garden had started as a small initiative, just to solve an immediate problem. However, over time, it has become a model garden for many urban gardeners in Mumbai and in India. After the success of this garden, Preeti Patil founded one of the most successful organisations named 'Urban Leaves' to inspire and help people with farming knowledge and techniques ('MbPT Terrace Garden and the philosophical and practical base of Urban Leaves').

Both the rooftop gardens in Dhaka and Mumbai in two different settings have similarities, as they are creating food forests in two high-density megacities. Table 20.1 compares the two selected rooftop garden case studies in Dhaka and Mumbai.

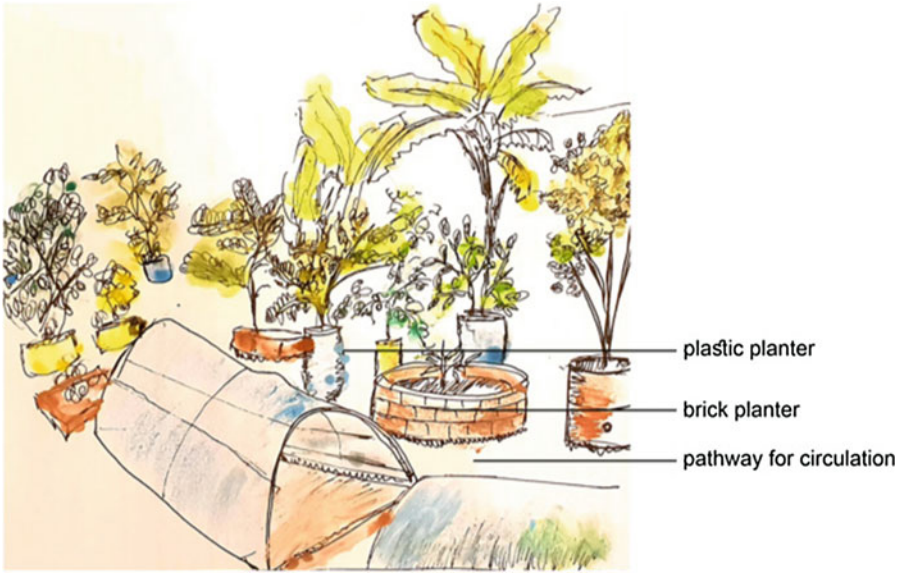

Fig. 20.3 Sketch of a rooftop garden case study in Mumbai (drawn by the author). (Source: http://cityfarmer.info/mumbai-port-trust%E2%80%99s-%E2%80%98wild%E2%80%99-kitchen-garden-india/)

Table 20.1 A comparison of rooftop garden case studies in in Dhaka and Mumbai

Category	Rooftop garden, Dhaka	Rooftop garden, Mumbai
Land use	Residential	Institutional
Area	278.7 m^2	229.9 m^2
Concept	Pre-planned	Organic
Purpose	Hobby garden	Waste management
Produce type	Mainly fruits, partially vegetables	Mainly vegetables, partially fruits and herbs
Planter type	Permanent, cemented	Recycled waste, temporary

20.4 Discussion

A literature review of urban agricultural practices in two megacities, Dhaka and Mumbai, from the same geographical region, has been conducted in this paper. An critical comparison of two selected roof garden case studies has also been completed. Dhaka and Mumbai have very similar urban conditions and are considered as comparatively very dense cities of the world. Although the scarcity of the available land areas exists, these cities are still putting efforts to grow their own food locally. Balcony and rooftop gardens are popular forms of urban agriculture in both cities. Community gardens play a huge role as a small-scale urban agricultural typology for Mumbai, whereas in Dhaka, community garden typology is absent in the local food growing scenario. In Dhaka, the majority of urban farmers in rooftop gardens are

from middle-class backgrounds, but in Mumbai, members of upper-middle-class society are more involved in growing food in community and rooftop gardens within the city.

The literature on quantitative data and core aspects of the garden, such as the amount and types of produce, growing seasons, expenditure, quality of food produced, and how much food is distributed at the outlets, is not available for Mumbai nor Dhaka. Limited and almost no planning or food policy that aims to improve the uptake of urban agriculture in that region is available. Urban agriculture is appreciated for its potential to grow food for the city dwellers worldwide. However, the potential of urban agriculture in this specific region is yet to be explored. Future research should explore and compare how cultural practices, affordability, and people's behaviour impact climate and other issues and provide varied urban performance linked to food for moving towards a resilient food future.

From both case studies, apart from their differences, one aspect is common: that a fully functioning food-producing rooftop garden is a possibility in both Dhaka and Mumbai. In both case studies in Dhaka and Mumbai, one individual and a private group, respectively, dedicated themselves to grow food voluntarily. However, their small initiatives have contributed towards increasing two small green spaces and providing access to nutritious food in the city. If the governments of these two cities are able to implement intervention techniques and planning and food policies for urban agriculture, it could have broader and more effective benefits to offer. Building capacities in people to use efficient farming techniques; developing guidelines on the types of suitable plants that could be grown on the rooftop gardens and measuring how rooftop local food production could improve micro-climate of cities would be very beneficial. All these benefits collectively could make a positive difference in the overall performance of cities.

20.5 Conclusion

This paper analysed literature references from two selected cities from neighbouring countries, Dhaka and Mumbai, to study the urban agriculture practice in both places. Analysis of two case studies of rooftop gardens were also conducted, to comprehend their similarities and differences in practice methods and to portray these urban agricultural practices as examples of functioning food production systems on the rooftops of these dense cities. Literature and case studies both indicate possibilities of implementing successful urban agriculture practices in these cities, but more research is needed on this field along with efficient and effective policies from government's side to promote urban agriculture in Dhaka and Mumbai.

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