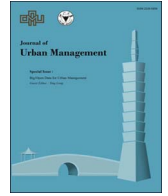




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# Present practice and future prospect of rooftop farming in Dhaka city: A step towards urban sustainability<sup>☆</sup>



Mastura Safayet\*, Md. Faqrul Arefin, Md. Musleh Uddin Hasan

Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology (BUET), Bangladesh

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## ABSTRACT

Dhaka, the capital of Bangladesh is one of the most populated megacity in the world and the population growth in this city is extremely high. To support growing food demand of increasing population, food supply should be secure and sustainable. On the other hand, with the pace of urbanization built-up areas are increasing; hence supply of roof space is also increasing. Rooftop farming can provide solution to increased food demand and also can promote a sustainable and livable city. Local fresh and safe food can be ensured through roof gardens in Dhaka city. The aim of the study is to explore the present practice and challenges of rooftop farming that was encountered by practitioners. Mirpur and Mohammadpur areas have been selected as study areas. Two practitioners are interviewed and 60 non-practitioners are surveyed. Results show that rooftop farming can support environment by improving air quality, reducing carbon in the atmosphere and can benefit society by reducing storm water management cost. One of the significant findings from the non-practitioner survey is that maximum people are willing to practice rooftop farming and want to provide at least 50% of roof space for rooftop farming. Finally some recommendations have been suggested to improve rooftop farming practice and encourage more people to practice rooftop farming in future.

## 1. Introduction

Today in this urban planet, 54 percentage of the world's population are living in urban areas and the share is expected to increase to 66 percentages by 2050 (United Nations, 2014). Rapid urbanization and urban growth is placing massive demand on urban food supply systems. Moreover, many cities in the world are facing problems like rapid decrease in green space and increase in heat island effects. Urban agriculture or farming is promoted as a potential solution to these problems (Smit, Nasr & Ratta, 2001). As the food is produced locally, there is no need to travel far to get fresh foods which reduces use of fossil and consequently has a positive impact on the environment (Sprouting Good Urban Farming Sydney, 2014). Rooftop farming can reduce the temperature of roofs and the surrounding air that contribute to overall cooling a local climate (RIES, 2014) and can help reduce urban heat island effect (Hui, 2011). Roof farms can also absorb carbon emissions and noise (Dubbeling, 2014; Hui, 2011). Rain water is captured and absorbed by the plants and overflowing impact on infrastructure is reduced (RIES, 2014). Rooftops filled with vegetation can be a great place to relax. This kind of farming can easily offer employment to people (Sprouting Good Urban Farming Sydney, 2014). Farming in rooftops helps to increase biodiversity and provide habitat for a variety of insects and birds (Higher Ground Farm n.d.).

Farming on the rooftop of the buildings in urban areas is usually done by using green roof, hydroponics, organic, aeroponics or container gardens (Asad & Roy 2014). The first benefit of this practice is increased local supply of fresh food. In Singapore, while

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\* Corresponding author.

E-mail addresses: [masturabuet510@gmail.com](mailto:masturabuet510@gmail.com) (M. Safayet), [fahim1015027@gmail.com](mailto:fahim1015027@gmail.com) (Md. F. Arefin), [musleh\\_uddin@urp.buet.ac.bd](mailto:musleh_uddin@urp.buet.ac.bd) (Md. M.U. Hasan).

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current local vegetable production can meet only 5% of Singapore's present-day needs, if rooftop farming is implemented across public housing estates, the share would increase to 35.5% and Singapore's carbon footprint would decrease by 9052 tons of emissions annually (Astee & Kishnani 2010). In Bologna, Italy, if all suitable flat roof space is used for urban agriculture, rooftop gardens in the city would supply around 12,500 tons of vegetables annually which would meet 77% of residents' needs for vegetables and an estimated 624 tons of CO<sub>2</sub> would be captured each year (Science for Environment Policy, 2015). Lufa Farms, Montreal produces over 25 varieties of vegetables and production is adequate to supply the needs of over 1000 people (Carrot City, 2014a). The farm of Brooklyn Navy Yard grows more than 50,000 pounds of organic produce annually. The Gary Comer Youth Center of Chicago grows 450 kg of food per year (Clarke, 2015). Rooftop urban farming also offers many environmental and social benefits to high density urban cities like Hong Kong (Hui, 2011). By utilizing rooftops for urban farming, it is possible to attain social, economic and environmental sustainability for the buildings in urban cities. Because it can contribute to the development of urban food systems by increasing local food production, meet the nutrition demand of the people by access to nutritious food, mitigation of air pollution, increasing storm water retention capacity, improvement of public health, enhancement of the aesthetic value of the urban environment and enhancement of community functions (Bay Localize, 2007).

In Dhaka, one of the world's fastest growing mega cities, open and cultivable land has been converting to built-up area indiscriminately and thus agricultural land has been decreased at an alarming rate (Islam & Ahmed 2011). Implementing rooftop farming can be a possible solution to reduce the food supply problems, make urban living more self-sufficient and make fresh vegetables more accessible to urban individuals. It is estimated that 10,000 ha space of Dhaka city can be brought under rooftop farming and the residents of the city can taste fresh vegetables as well as over 10 percent of the demand can be fulfilled through rooftop farming (Wardard, 2014). A survey shows that most of the roofs of Dhaka city are suitable for gardening and do not require major improvement work, sometimes only need some modifications (Islam, 2004).

This study aims at exploring the existing practice and associated challenges of rooftop farming. What makes this study unique is the identification of benefits from urban sustainability perspective and calculation of the monetary value of economic and environmental benefits of rooftop farming in Dhaka.

## 2. Urban sustainability and rooftop farming

A sustainable city is the city which meets the needs of the present without sacrificing the ability of future generations to meet their own needs (The Science Museum, 2004). The international community is already started to address the issue of urban sustainability. Urban sustainability is the idea that a city can be organized without excessive dependence on the surrounding countryside and be able to power itself with renewable sources of energy. The purpose is to create the least possible ecological footprint and to produce the minimum quantity of pollution possible, to efficient use of land, compost used materials, recycle it or convert waste-to-energy and to make the city's complete contribution to climate change minimal (The Crystal n.d.). Urban sustainability can be achieved through the sustainability of social, economic and environmental issues. Along with other initiatives and activities, urban rooftop farming, therefore, has an important role in contributing towards the future sustainability of cities. Hui (2011) and others have listed out social, economic and environmental sustainability to be achieved by urban agriculture and rooftop farming. In summary, social sustainability can be achieved by active community participation and cohesion in community green space and gardens on the rooftop; by community cohesion while sharing individual experiences, collecting fresh food; by creating local employment; by creating common amenity space for exercise and recreation and by producing common aesthetic benefits. Economic sustainability through rooftop farming means the increase in local food production and sale, increase in food security and property value, improvement of roof durability, reduction in building cooling load and energy costs, increase availability of biofuels etc. Environmental sustainability can be achieved through reduction in carbon emission food transportation, reduction of wastes by generating less packaging, recycling of organic wastes by composting, mitigation of urban heat island, increase in biodiversity, improvement of air quality urban storm water management, capacity of sound insulation and noise absorption etc. (Hui, 2011).

## 3. Review of rooftop farming methods throughout the world

There are fascinating projects and initiatives on rooftop gardens throughout the world. In Singapore, inorganic hydroponics is considered the more appropriate farming option, compared with conventional soil culture, in the government housing buildings as it has higher yield, lower labor requirement and needs only lightweight systems, which can be easily assembled over an existing roof (Astee & Kishnani 2010). The fiber glass containers and raised beds set up are used for the roof farming in cities of Hong Kong (Hui, 2011). Rooftop gardeners grow lettuce, black cabbage, chicory, tomato, aubergine, chili pepper, melon and watermelon, either in plastic pipes, recycled pallets filled with compost or on polystyrene panels floating in tanks, also made from recycled pallets in Bologna, Italy (Science for Environment Policy, 2015). In Montreal, Lufa farmers utilize sustainable hydroponics methods, which poses less environmental impact, to produce foods (Carrot City, 2014a). The farm at the Brooklyn Navy Yard practices 100% organic farming techniques (Clarke, 2015). In the rooftop of Gymnase Vignoles of France organic gardening is practiced (Carrot City, 2014b). In recent years, some people in Taiwan are trying to develop effective growing methods for promoting rooftop farming (Hui, 2011).

## 4. Challenges and incentives to rooftop farming – a review of literature

Though there are numerous benefits of rooftop farming, rooftop gardeners are facing several challenges, too. Slope of the roof, load bearing capacity of the building and roof etc. are important considerations. So, it is important to look at the structural

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