

# Rooftop gardening in the globe: advantages and challenges

## Abstract

Due to rapid increase of global urbanization food demand is rising for the urban inhabitants, especially, massive consumption demand for green vegetables and fruits. Rooftop gardening is a valuable mode of getting these fresh and nutrition rich food for urban dwellers. Also, roof farming is an alternative means of land use and in the countries with less agricultural lands. This farming system serves the healthy foods and progress in food security of the urban people. It improves urban atmosphere through reducing pollution, enhance greening environment and provides households' recreation. Thus, a review study has done to know the scenario of rooftop farming in the urban community along with advantages and challenges. Previous research denounced that insight and consciousness of roof gardening has enriched and affords wellbeing, social value and enjoyable farming to the building residents. Knowledge and awareness of gardening should be disseminated, commercial roof farming should be popularized and the challenges regarding urban rooftop gardening should try to overcome.

**Keywords:** agriculture, rooftop, urban farming, food, challenges

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**Abdul Quddus**

Department of Agricultural and Applied Statistics, Faculty of Agricultural Economics & Rural Sociology, Bangladesh Agricultural University, Bangladesh

**Correspondence:** Abdul Quddus, Department of Agricultural and Applied Statistics, Faculty of Agricultural Economics & Rural Sociology, Bangladesh Agricultural University, Bangladesh, Email aqdds1957@gmail.com

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## Introduction

Urban agriculture as an industry placed in a town, a city or a metropolis,<sup>1</sup> precious contributor to convene the food and nutrition demand of urban dwellers<sup>2</sup> and produces mostly in response to the daily demand of consumers using intensive production methods with natural resources.<sup>3</sup> It is progressively documented as a valuable instrument of sustainable foodstuff and nutrition source assesses the urban agriculture for indication founded food scheduling and a progressive form of agriculture distorted from outdated agriculture and modern agriculture. Urban farming exists mainly in homestead, rooftop and balcony gardening. The practice of cultivating food on the rooftop of buildings is referred to as rooftop farming and its aim is to household consumption and local supply of fresh food. The exercise of farming vegetables, fruits and flowers on the top of buildings is termed as rooftop gardening, which is done by using green roof, hydroponics, organic and container gardens.<sup>4</sup> With the step of expanding urbanization through all over the world, food demand is increasing for elevated population. A vast quantity of vegetables and fruits are needed to meet the massive consumption demand of the huge people. Rapid reduction of green space and increase in heat island, also, effects the large portion of urban dwellers and hence urban agriculture is endorsed as a likely clarification to these difficulties.<sup>5</sup>

Progressive expansion of rooftop farming may improve foodstuff demand and able to encourage a livable urban community by ensuring local fresh and safe foods, especially, fruits and vegetables through roof gardening. It assists to decrease the overall heat absorption of the building and relief to urban lifestyle. It can add in creating year round fresh vegetables and fruits, reduces expenses on acquisition of these foods to the urban dwellers and contributing greatly to built environment as a countless friend.<sup>6</sup> Rooftop gardening helps additional supportable existence of urban inhabitants across delivering crisp healthful food and prices such as in relaxation, sightseeing and strengthen involvements.<sup>7</sup> More prominently, it makes fresh food more affordable and prime for health and suitability and emphasizes more for food consumption by its residents and sharing. There is limited access to fresh, healthy, culturally appropriate and affordable food in the cities and unable to obtain fresh and nutritious produce. The production of fresh fruits and vegetables on the rooftop garden can increase nutritional status of household members<sup>8</sup> and it will make a positive contribution to the green environment. Also, it may provide

in attaining food security and safety by increasing the production and consumption of fresh fruits and vegetables<sup>9</sup> and has ability as a small-scale business that can speed up extra household income<sup>10</sup>. It can reduce air pollutions and protect home from different usual disasters such as storms and cyclones<sup>9</sup> and preserves biodiversity and natural resources.<sup>11, 12</sup> Promotion and sustainability of rooftop gardening of fruits and vegetables seem to be a remedy to high price of foods and inability of most households to buy or provide adequate amount of nutritious food make them vulnerable to disease. Therefore, a study is essential to know the benefits and constraints of rooftop gardening. The objective of the study is to review the scenario and methods used in rooftop farming and discuss the benefits and challenges of fruits and vegetables gardening (Figure 1).



**Figure 1** Flower and vegetables gardening in rooftop in Dhaka city.

## Scenario of rooftop farms growing throughout the globe

Urban agriculture makes use of community agriculture, personal agriculture, industrial agriculture, similarly as indoor farming. Indoor farming includes techniques like aquaponics, agriculture, top

greenhouses, etc. Top agriculture may be a viable choice for urban agriculture on account of decreasing agricultural land. It will play a big role in urban environmental management and enhance the continually deteriorating quality of air whereas giving organic and fertilizer-free manufacture. Social, economic and environmental property is also achieved by top agriculture. It even helps in protective high nutrient content, which regularly depletes to 0.5 by the time product reaches totally different markets. With the expansion of a lot of property and nutrient-rich food, there'll be a rise in food diversity and security. The primary example of top farming was seen within the Nineteen Eighties, however the amount of top farms failed to reach a peak till 2010.<sup>13</sup> Rooftop agriculture is gaining quality across the planet, largely in North America and Europe. Top farms may be classified into 2 classes like top greenhouses - farms with protecting structures covering them and alfresco top farms - don't have protecting structures. Top greenhouses shield crops from cold and wind and permit cultivation throughout the winter however alfresco top farms area unit easier to construct and fewer big-ticket. There are five times a lot of alfresco top farms than there are unit top greenhouses within the world. Researchers have found that the perceptiveness and awareness in top agriculture has been enhance throughout the planet. It may improve the well being of building residents, providing them with opportunities to socialize and facilitate with enjoyable agriculture. Most samples of top farms area unit in developed countries, whereas there's still not a lot of happening in less-developed countries however it might facilitate with the food security of the individuals living in that if top farming inflated in these countries.

In Singapore, inorganic agriculture is taken into account a lot of acceptable farming choice within the administrative houses because it has advanced harvest, lesser workforce demand and desires solely light-weight systems, which might be simply assembled over associate degree existing roof<sup>14</sup> compared with typical soil culture. The fiberglass containers and raised beds got wind of area unit consumed for the top farming in cities of Hong Kong and a few individuals in Taiwan try to develop effective growing strategies for promoting top farming.<sup>15</sup> Roof gardeners grow lettuce, black cabbage, chicory, tomato, chili pepper, melon and watermelon, either in creation, plastic pipe, reprocessed pallets crammed with compost or on polystyrene panels floating in tanks, additionally made up of reprocessed pallets in Bologna, European nation (Figures 2&3).<sup>16</sup> In city, Lufa farmers utilize property agriculture strategies that possessed less environmental impact, to provide foods. Exercise of the Brooklyn farm shipyard showed 100 percent organic farming techniques.<sup>17</sup> Tokyo is that the initial town to permit house vegetation that has to represent 2 hundredth of each latest creation. In recent, urban cultivation and food safety have paid attention respectable concern in several Canada's cities. The inexperienced roof by law passed in twenty-nine provinces, where over six stories buildings with over 2000 m2 of floor house should have at least 20% roof leafage.<sup>18</sup>



**Figure 2** Orange gardening in rooftop in Dhaka city.



**Figure 3** Lemon gardening in rooftop in Dhaka city.

Egypt has started rooftop farming and aquaponics with some encouraging and inventive thoughts delivering a fresh and healthy food free from pesticides. A more innovative method is farming fish following to helping the plants to produce healthier to retain it fresh by absorbing the ammonia so that the fish get some nutrients from the roots of the plants.<sup>19</sup> The planting substances and correct types of plants are allocated in low spaces in so a high produce grown from it as deficiency of planting substances are a serious difficult in rooftop gardening.<sup>20</sup> There might be some environmental disorders from rooftop gardeners' response regarding gaining organic and fresh vegetables and required nutritional elements from the garden in Nepal and they believe that rooftop farming is helpful in climate change as it increased the plant density.<sup>21</sup> The role of a rooftop garden in carbon confiscation explained by<sup>7, 20, 22</sup> that the gardeners got positive response regarding the aid of rooftop farming in climate change in Nepal. Rooftop gardens in the Bologna city in Italy would provide 12,500 tons of vegetables per year which would convene 77% of residents' needs for vegetables and an estimated 624 tons of CO<sub>2</sub> would be captured each year if all suitable flat roof space is used.<sup>16</sup>

Concerning twenty five vegetables are unit full-grown within the top agriculture in Bangladesh of that, brinjal, Indian spinach chili, gourds, lady's finger, tomato, purple amaranth, bean, cabbage and cauliflower are most significant.<sup>23</sup> The gardeners used their leisure time and spent 31-60 minutes per day, production of fresh and safe food was the main motive of 66% rooftop gardeners considered gardening as a dependable source of safe foods (18%) and they preferred growing winter vegetables and summer fruits in Bogara district of Bangladesh.<sup>9</sup> Both organic and inorganic fertilizers were used by 46%, organic fertilizers by 22% and chemical fertilizers by 6% gardeners. Cow-dung and urea were the most frequently used fertilizers whereas kitchen waste were used by 42% gardeners and only 10% gardeners had knowledge about the amount of the fertilizer.<sup>9</sup> Agricultural Extension Division delivers coaching and essential provision to the people for roof agriculture and farming development. Roof Garden Association (RGA) in Bangladesh is conducting inexperienced roof movement that focuses on technical and monetary aspects of roof agriculture<sup>10</sup>. Standing of top and homestead agriculture in East Pakistan and ascertained that sixty-six top gardeners most well liked agriculture for growing healthful food<sup>9</sup>. Concerning eighty kinds of plants in top gardens were fruits (97%), vegetables (86%), flowers (64%), spices (72%), medicinal plants (64%), decorative plants (23%) and plantation crops (12%). About 10,000 ha space in Dhaka city can be taken beneath rooftop gardening and its inhabitants can take flavor of fresh vegetables as well as over 10% of the requirement be able to achieve through rooftop gardening.<sup>24</sup>



## Advantages and challenges of rooftop gardening

Urban top farming be ready to contribute the event of city foodstuff regularities by improving native foodstuff assemble, convene the nutrition demand of the individuals by access to nutritive food, rising tempest aquatic holding capability, upgrading of community health, improvement of the artistic price of the urban atmosphere and sweetening of public functions.<sup>25</sup> Implementing top farming is a probable reply to cut back the food provide issues and house food value, contributes to food safety by rising cultivates provide and up the standard of spoilable food to urban customers<sup>26</sup> and build urban living additional self-sufficing and build recent vegetables additional accessible to urban individuals. It is a crucial role in causative towards the longer-term property of cities. Social property is achieved by enhancing inexperienced areas and gardens on the top, aggregation fresh foods, making common comfort area for exercise and recreation, up of roof sturdiness and handles of biofuels and reduction in building cooling load and energy prices.

It may offer ornamental and hydrological blessings, fine arts sweetening, and even have ecological advantages. It improves the worth of urban atmosphere through greening and reduction in pollution, providing recreational services to urban voters and provides a big contribution to the urban fresh foods provide chain. Rooftop farming will cut back the hotness of roofs and therefore the encompassing atmosphere to total refrigerating an area environment and absorbed rainwater by the plants and flooding impression on set-up is reduced<sup>27</sup> and may additionally absorb carbon emissions and noise.<sup>28,15</sup> An inexperienced top garden preserves accompaniment substantial profit to food production,<sup>29</sup> cut back noise and build economic facilities through its backward and forward relations.<sup>30</sup> Farming in rooftops assistances to boost multifariousness, stipulate environment for a diversity of insects and birds.

One of the main advantages of rooftop farming is that it doesn't contend with different land uses and provides property in production and system.<sup>31</sup> Household demand for vegetables and fruits is towards a stress on safety, quality and convenience. Preference of vegetables might vary depends on amount demand and seasons. The growing demand for vegetables and fruits presumably can save an honest share of house expenditures on food if top farming is enforced properly. Rooftop horticulture is the most effective thanks to guarantee food security by providing with correct coaching and necessary supports and it is wont to guarantee food security in countries with less agricultural lands.<sup>32</sup> The rooftop gardening has an ability to use four times fewer water than usual farming<sup>14</sup> and also potential in terms of energy savings.<sup>33</sup> Its performance as insulating stratum to the building<sup>34</sup> and could result in a protecting up to 15% of a building's annual energy intake.<sup>35</sup>

In spite of global interest and expression of active and useful ability of rooftop farming,<sup>36,37</sup> gardeners still facing the challenges that have limited the adoption of this exercise on a better position, mainly because of high primary costs, indeterminate yields of investment, as well as a lack of development strategies<sup>38</sup> and insights and recognition of modern farming methods like hydroponics hamper the probable rooftop agriculture development.<sup>39</sup> Though there square measure various advantages of top farming, rooftop gardeners face many other challenges. Slope of the roof, loadbearing capability of the building's roof are square measure necessary issues. So, it's necessary to appear at the structural composition of the building and retrofit them consequently or design of latest building ought to contemplate it from the terribly starting.<sup>15</sup> Thus, rooftops need special care and design as well as renovation accordingly and even landscape architects and structural engineers can help the house owners to build modified rooftop gardens according to their needs and demands. Urban roof gardening also faces challenges related to resource scarcity, accessibility, environmental contamination,<sup>40</sup> heavy metal

and air pollution that can lead to crop toxicity. Some species such as pea, bean, pepper, tomato, and melon have the ability to slowly uptake heavy metals.<sup>41</sup>

Keeping the hale soils and creative may be difficult as top physical earths square measure completely dissimilar from ground-layer soils.<sup>42</sup> Great airstreams and high heat square measure typically a difficulty, fences and warm-liberal produces ought to be utilized in the rooftop surroundings. Unplanned and casual rooftop gardening may not carry an effective produces and proper knowledge of gardening and collecting productive soil and healthy plants are required to harvest proper results. Fertile soil is essential to get productive plants, which is mostly unusual in the city gardeners and using chemical pesticides and fertilizer can have a very bad impact on the health of the family.<sup>43</sup> Chemical use in densely inhabited areas may be a retardant and plenty of top gardeners go along with organic farming for this reason.<sup>44</sup> Several of the urban residents don't have coaching in top farming. Beginning farming while not correct coaching could cause disappointing outcomes, which could lead to disposition of the folks in initiating new comes.<sup>26</sup> Lack of enough free time for farming, crisis of labor, lack of needed technological data, lack of coaching and don't having appropriate farming data square measure the important limitations of top farming within the less developed countries. Short coaching on rooftop gardening, advice, and the right directions from skilled and experienced persons can benefit the beginner. Rooftop gardening needs well-thought planning of the rooftop, easy supply of water, airflow, enough sunlight exposure, protection from scorching sun's heat, and so on.

Still now there is an enormous lacking in roof gardening though it is very much popular and likely for expanding in Bangladesh. In spite of having numerous gains, it faces some clear challenges to its extensive uses like container, green roofs, and hydroponics gardens. Lack of incentives, subsidy, water supply, safety, the severity of rooftop environments and roof load capacity are the key obstacles. Lack of technological and farming knowledge is also the challenge for less practicing in Bangladesh and has an extremely scarce opportunities for obtain these knowledge. A study claimed that people are not willing to exercise this practice of which 25% for lack of knowledge, 19% buy from adjacent marketplace effortlessly, 15.5% confronted difficulty regarding no manpower, and 7.2% had no adequate area as their roof is consumed by other purposes.<sup>7</sup> The buildings are constructed by the developers in Dhaka city where the flat holdings have limited right to use as the roof is regarded as shared and this circumstances may be stunned by the holders association as combined scheme. Government and various organizations might be searched for endorsing and promote roof gardening.

## Conclusion

Existing the prompt evolving city greater demand for quality food and fresh air is required that accelerate to adopt rooftop gardening provide a sustainable and beautiful city with quality fresh food free from pesticides and healthy environment. It brings the well being of residents, chances to socialize, helps in climate change, and improves the urban atmosphere through greening and reducing pollution. Rooftop farming reduces warmth of roofs, absorb rainwater by the plants, absorb carbon discharge and noise, and lay down atmosphere for a diversity of insects and birds. Rooftop farming practices should be more popularized to increase greenery and fresh food supply by following the proper farming techniques. Proper training and awareness program should be initiated to spread the knowledge of gardening. Roof gardening used mostly for social and recreational purposes whereas commercial rooftop farms are still rare even with their high food production capacity. Rooftop urban farming still has to face the challenges to practice on a larger scale, specially, high initial costs and indeterminate yields and lack of policies for developing this

sector. Heat acceptance and windbreaks produces should be employed to the roof surroundings and organic farming practices should be preferred in place of pesticides uses.

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## Conflict of interest

The author declares that there has no conflict of interest to publish this manuscript.

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