

Flat Rooftops as Productive Landscapes in Birmingham

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Abstract: Due to the changing global environment, sustainable development has become a goal that many cities strive towards. Producing nutritious food is a component of sustainable development. The primary purpose of this paper is to assess Birmingham's suitability for flat rooftop farming. This study explores two examples of rooftop farms: Brooklyn Grange in New York and Thammasat University, the largest rooftop farm in Asia, and they transformed the roof into a productive rooftop farm. This paper proposes the tops of the buildings at Birmingham City University to be converted into a flat roof farm with an additional survey into the dietary habits of Birmingham inhabitants. With a productive landscape, one can achieve societal ideals such as urban or communal food self-sufficiency, reduce food imports, transit expenses, and consumer prices, encourage human interaction and connection, and at the same time provide diversified and healthy food.

Keywords: Sustainable Development Goals (SDGs); Sustainable development; Flat rooftop farm; Productive landscape; Food health level

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1. Introduction

The UN forecasts that 66% of the world's population will live in cities by 2050^[1]. Future urban population growth is almost certain, yet modern cities rely almost entirely on imports. Importing food and other commodities to support cities creates dangerous greenhouse gases^[2]. Birmingham's challenges include transforming low-carbon cities in light of increased food consumption^[3]. This project aims to evaluate if Birmingham's rooftops could be turned into farms.

This paper examines two successful rooftop farm case studies. Besides, it analyzes how accepting and educated Birmingham citizens are of rooftop farms and the need for healthy, safe, and diverse food.

Many methods have been used to carry out this study including surveys, interviews, and questionnaires, observations, and documentations to obtain accurate results. References from the Internet were also used in this paper.

Birmingham is the second largest city in England^[4]. The productive terrain of the roof needed to be explored because many residents wanted fresh, non-imported produce. Birmingham's 6.1-month growth season runs from April 25 to October 29^[5]. A productive urban landscape transforms nature, e.g. agricultural production increases local economic values^[6]. Birmingham has the conditions to achieve productive rooftop landscape construction, which will bring positive effects. Firstly, urban self-sufficiency can be achieved through producing fresh and diverse vegetables, fruits, and other foods which are also healthy. Secondly, the import and transportation costs and losses of consumer food can be reduced. Thirdly,

a rooftop farm can encourage more social interaction, create more job opportunities for locals, and provide social spaces and opportunities for youth. Besides, planting food on the roof reduces environmental overexploitation and ensures healthy food.

2. Literature review

It is no doubt that urbanization will increase in the future ^[7]. Urban food and agriculture are prioritized. Urban growth requires a productive urban landscape. Productive urban environments minimize energy, transportation, and import costs, promote self-sufficiency, and ease urban production and land conflicts ^[3]. Food farming affects a city's structure, design, and function ^[8]. According to a case study in Hong Kong, green roofs lowered indoor temperatures by 3.4°C ^[6]. It improves urban microclimate, boosts biodiversity, and provides employment opportunities for residents. Hence, rooftop farms are an effective method for resolving food and social ecology challenges.

Six Canadian provinces banned junk food sales in 2005 to promote healthy eating and minimize illness and obesity. A five-year study was done on students. Students at fast-food-free schools were discovered to have lower BMIs. Students in schools that serve junk food were found to be 2 lbs heavier than students in schools that do not serve junk food ^[9]. Imperial College of London purchases food from local farmers to enhance agricultural economic growth and food security ^[10]. Singapore imports food considering the size of its land, cost of living, and local consumption. Large cold-chain imports jeopardize food security. (1) Climate change affects transportation due to higher temperatures which affects the storage of food. (2) Climate instability limits farming. (3) The supply of imported food might be affected, especially with more competitive importing countries and blocked ports. (4) Perishables may lose freshness during transit, risking foodborne illness ^[11].

Birmingham has land for greenhouses and rooftop farms. Roofs are recommended because they maximize space ^[12]. Rooftop gardening saves space and provides a cheap way of producing food as well as sustainable energy. Eco-friendly farming involves agricultural air circulation as crops give out oxygen ^[13]. Urban environmental issues, pollution, and food safety create stress. Therefore, people started focusing on the advantages of agriculture in cities and started paying attention to urban agriculture and ecological development. Ecosystem services help achieve environmental and socioeconomic goals ^[14].

3. Case study

3.1. Rooftop farm Brooklyn Grange

The Brooklyn Farm houses organic fruits and veggies. The 2.5-acre tower farm produces 50,000 pounds of organic vegetables annually. It opened since May 2010.

14% of kitchen waste in landfills may be transformed into fertilizer. Since 2010, the farm has recycled tons of trash ^[15]. Farms produce most of the urban food. City farms can be opened on underused roof space. Rooftop farms can improve city life, provide jobs, and supply fresh food. A wedding was hosted on Brooklyn rooftop farm in 2020 as the couple's wedding plans were interrupted due to COVID-19. Rooftop farms educates urbanites about agriculture and the environment. The review describes rooftop farming's benefits like reducing pollution from urban pollutants such as lead and car exhaust ^[15].

3.2. Thammasat University – Asia's largest organic rooftop farm

Climate change hotspots include Bangkok and Southeast Asian cities. LANDPROCESS has utilized abandoned areas to generate food sustainably ^[16] by building a rooftop farm in Bangkok's Thammasat University.

There are many abandoned concrete roofs in densely populated cities. The designer proposed to turn abandoned locations into green spaces rather than using undeveloped lands or leaving empty concrete

surfaces. They utilized landscape design to balance urban ecological health and growth, including public green space, urban organic food sources, and water management systems to cope with climate change ^[17].

Thaamasat University Rooftop Farm grows 135,000 pieces of rice for the community each year. It is a paradigm for urban green roof building, promoting commercial and environmental sustainability as well as green economy. It converts urban heat island effect into clean electricity, creates green manufacturing space, and restores the city's ecosystems ^[17].

4. Research method and primary research

This research examined if rooftop farms can be built on Birmingham's flat rooftops. Based on the aforementioned case studies, it is clear that any flat rooftops can be converted in to rooftop farms. A professional staff can be employed to manage the rooftop farm. Birmingham City University has outbuildings which contains flat roofs that are suitable agriculture. Rooftop farms can generate social value, money, and jobs. Two surveys and interviews will be used to examine food safety and Birmingham residents' acceptance of a roof farm. A separate survey was also done on Birmingham City University staff and students about cafeteria food and rooftop farms.

5. Findings

In this paper, two surveys were conducted on different populations and scopes.

6. First survey and analysis

The health level and degree of diversity of food and statistics for roof farms and school or workplace cafeterias were studied. Most Birmingham residents or former residents believe rooftop farming is good. Data from 72 valid interviews were collected. Over 90% of employees and kids often eat in the school or corporate cafeteria, thus more diverse foods and sustainable development are needed to cope with the high demands for healthy food. 90% preferred restaurant food as only fast food, like hamburgers, fried chicken, and chips are available in their school or workplace cafeterias.

Most respondents liked the idea of rooftop farms. The group that totally accept rooftop farming. found roof farm space beneficial for city's sustainable development. 92.73% expect the roof farm to be healthy, green, and economically beneficial. Some respondents thought that rooftop farms provide social employment and educational value.

7. Conclusion of first survey

Firstly, Birmingham citizens like the idea of rooftop farms. Most people prefer eating in the workplace or school cafeteria and desires an increase in the diversity of cuisines and vegetables. Rooftop farms could improve social, educational, and employment prospects, enhancing the viability of Birmingham's rooftops as a productive environment. The city's concrete roof has use-value and space, promoting sustainable growth.

8. Second survey and analysis

The scope of respondents of the second questionnaire was narrowed down. Discussions regarding food diversity, food health level, and rooftop farms to improve school cafeterias were carried out at Birmingham City University. 8 employees, 15 pupils, and 4 guests participated.

29.63% of respondents never eat the school cafeteria, 40.744% eats there once a week, 22.22% eats there twice a week, and 7.41% eats every three weeks. Generally, the respondents are discouraged to eat there because of the unhealthy food served.

Most individuals think Birmingham City University can be a pioneer in rooftop gardening (77.78%),

with no one opposing the idea. Most of them think that rooftop farms can provide healthy food. 74% of respondents think that rooftop farm improves greening, environmental ecology, and social communication. 55.56% stated rooftop farms provide education and employment opportunities. Several students stated that the fast food provided in the cafeteria only served the purpose of providing energy instead of being an enjoyable experience.

9. Conclusion of second survey

Most people desire for a change in the food served in the school cafeteria according to a second survey. Localizing food improves quality, diversity, and reduces carbon emissions and transportation costs. Green roofs insulate and regulate campus climate. The rooftop farm can be a place for students and employees to hangout and increase social interaction. Besides, it can also provide education and publicity, which will affect the city, society, and landscape and farm occupations. Birmingham City University's roof might be a pioneer in rooftop farming, food supply and in being a productive landscape.

10. Results

Birmingham aims to be a climate change and green revolution leader. However, Birmingham's green basis is lacking. Birmingham City University's roof is underutilized. Therefore, rooftop farms is a sustainable way to feed the institution and city. Rooftop farming improves landscapes and provides financial, environmental, and social benefits. Hence, landscape architects should utilize the relationship between the landscape and the urban society.

Roof farms promote social ideals better. Food-university relationships must be flexible. The rooftop farm enables communication and meetings. Staff and students can plant and harvest crops in the university, bringing farming to towns. This paper proposes that a rooftop farm can be built at Eastside City Park of Birmingham City University to improve cafeteria food.

Birmingham City University's facilities are a half-mile east of downtown. A rooftop farm can be built to produce healthier food, improve the university's microclimate, and offer employment to maintain the farm. Besides, it increases food and cultural diversity, and conserves land for more green space. Growing food instead of aesthetic plants can enhance campus interaction and achieve self-sufficiency. However, due to the uncertain weather and conditions at the rooftops, a weather-resistant environment needs to be created or build a greenhouse.

Rooftop farms reduce noise and heat. Plants reduce solar radiation. Rooftop farms causes indoor temperatures to drop 5-6°C in the summers and increases indoor temperatures by 2-3°C in the winters. Green roofs save 0.7% peak electricity ^[18] and is in line with the UN's Sustainable Development Goals (SDGs)

11. Conclusion

Agricultural culture is essential for a sustainable civilization. We should develop the city's productive landscape to reduce energy consumption, improve the quality of life of the citizens, and improve food production. Economically valuable foods can replace cement roofs and turn urban building roofs into material producers and the output values should be maximized. (1) Food self-sufficiency reduces food transportation expenses. Protecting a building's roof increases its value and service life, and boosts urban economic development. (2) Fresh, healthy and more varieties of food is produced, which decreases carbon dioxide, reduces pollution, and enables positive development of the city's microclimate. (3) Social advantages: it will enhance living environment, increase employment opportunities, and optimize economic, ecological, and social benefits of a productive landscape. (4) Health benefits of rooftop farms include providing healthy and safe food and reducing pollution.

Birmingham City University can be a pioneer in rooftop farms on campus. Students pursuing a Master's in landscape architecture can work with the University's Food and Nutrition Department to improve food health and nutrition level. A rooftop farm, creating university community structure, enables food self-sufficiency, improves school canteen service, and impacts the society. Rooftop farming uses less electricity. Tractors, harvesters, and transport trains are unnecessary; thus, their emissions can be avoided. More people will support a good concept as word spreads.

Disclosure statement

The author declares no conflict of interest.

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