

Evolution of Metropolitan Agricultural System— Vertical City Farms

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ABSTRACT

City farm is an agricultural system developed on the roofs of high-rise buildings or other well-lit and vacant sites in the skyscrapers. The vertical city farm system is becoming more and more popular in the era of urbanization, and it is totally essential for the future development of the metropolis. This article mainly studies city farms and their impact on urban residents. This article firstly describes its advantages in terms of environmental purification (heat island effect, CO₂), fresh food supply, economic development and human development. Secondly, the author analyzes the disadvantages of urban farms in terms of high cost and technical difficulty, and based on these factors gives some suggestions for the development of urban farms. Obviously, the benefits of urban farming (Urban purification, food supply, export crops, etc.) will be far greater than the consumption. In the future, this will be a very hot topic, and will continue to explore the structure, advantages and help for the direction of urban development of vertical city farms.

Keywords: *city farm, metropolis, heat island effect, economic development, high cost*

1. INTRODUCTION

High-rise buildings made of concrete are more and more common in today's cities. However, When constructing high-rise buildings, people often overlook that human society is only a part of the world. With the continuous development of human society, people should think more about nature. Extensive construction of high-rise buildings and large-scale construction will affect the natural environment. Although this practice can ensure the temporary growth of interests, for the overall human development, it is tantamount to "overdraft consumption".

Therefore, returning farmland to forests without reducing people's living conditions is undoubtedly an urgent problem for today's social architects. For example, the expansion of the city's green belt, the separation of urban residential and industrial areas, and the energy conservation and emission reduction of factories, and the construction of urban vertical farms. Although people's understanding and popularization of the urban vertical farms are not extensive at present, it does not prevent them from becoming an excellent solution. Therefore, this paper will focus on the definition of urban vertical farm, analyze its advantages and disadvantages with examples, and provide some

valuable reference suggestions for the future development of the city.

2. OVERVIEW OF CITY FARMS

More than half of the world's population now lives in cities, which shows a growing trend. However, with the influx of a large number of people, cities are bound to face several problems (such as how to support such a large number of people, and the further destruction of urban natural environment). Urban vertical farm refers to the use of some neglected areas of urban high-rise buildings for agricultural purposes. Urban farms help to improve the ability of cities to provide food to residents, and bring many positive benefits to society in the field of sustainable development and health, Lyle P., Choi J.H., foth m [1]. It is particularly important to make rational use of building structures and build more stable urban farms. Urban vertical agriculture undoubtedly brings health and convenience to people living in the city, but the development of high-rise concrete building ecosystem needs to consider a variety of possibilities and factors. For example, the proportion of concrete and steel used in each floor of the building can leave room for arable land, whether the excessive proportion of arable land leads to overload damage to the building, and its high construction cost and subsequent investment cost.

Moreover, with the development of society, human beings are facing more and more challenges in all aspects, such as climate warming, energy consumption and so on. According to Njoh A.J., it has to be said that proper development of such agricultural and urban industries can redesign the role of cities and provide more opportunities for people to face the increasingly serious climate, energy and food economy [2].

City farm, as a new building energy industry, can be planted with various crops, poultry and livestock at all levels of the building without damaging the original infrastructure of the city. However, these levels are usually developed based on meeting the natural conditions such as light, because plants need photosynthesis, and animals are inseparable from these natural factors as well. In the process of construction, people should divide the human life office area and the occupied area of the farm, especially the roof and other

places that are most suitable for the use of urban farms. It reduces the waste of building space, it can be completely exposed to the sun, natural wind and other environment, which is beneficial to the growth of animals and plants. People exploit the land in concrete high-rise buildings for sowing, fertilizing, irrigating, and raising livestock. This kind of special agricultural industry is especially suitable for some large cities, because there is not enough arable land for people to cultivate considering the bottom price of the metropolis and the high-rise buildings. But as people's requirements for video become more and more strict, fresh food and crops seem to become more crucial. There are many high-rise buildings in metropolis, and the higher floors provide an excellent convenience for the development of urban farms. Sufficient photosynthesis can make these crops grow more quickly, and effectively avoid the waste of urban space.



Figure 1 Real view of the farm on the roof of the city

People should think about the way to live peacefully with nature, and how people should reasonably live with nature in the future[3]. Therefore, the reasonable development of urban farms is not only the more effective use of land, but also the embodiment of the friendly relationship between man and nature. According to Park, T.-H., & Lee, I. , the second influencing factors will be affected by personal characteristics and vegetable environment, as well as vegetable activities, internal and external communication and community consciousness [4]. People can also have more diversified lifestyles. Through urban farms, people can bring their families closer to agriculture. Now, the city is bigger and bigger. It not only alienates our adults from the countryside, but

also makes the children in the city ignorant of grain [5]. Actually, with the intensified development of cities, the gap between urban and rural areas is growing in some areas. The huge gap in medical care, education and other aspects make people have to move from rural areas to urban areas. Behind the urban population inflation, children are increasingly alienated from the countryside and all kinds of crops. Many city-born children don't even know whether all kinds of seasonal vegetables are herbaceous or woody. This will undoubtedly do great harm to the all-around development of children. The addition of urban farms can also make people take their children to understand how these common crops grow in their spare time.

3. THE IMPACT OF CITY FARMS ON CITIES (BENEFIT)

3.1. Reducing the pressure of population

According to authoritative data, the population is expected to reach 8.6 billion in 2035, and it is likely to reach 9.7 billion or more in 2050. For a large population, the food issue will be very worthy of attention [6]. Nowadays, young people are concentrating in big cities to seek more opportunities for their own development, perhaps to improve themselves in the future, or to give children a better educational environment. Therefore, the aggregation of regions also leads to the uneven distribution of population in big cities, suburbs and remote rural areas. With the increase of population pressure, big cities will eventually be overcrowded, and more and more cities will become tall buildings. Under the influence of this environment, the vertical urban farm system will play its unique advantages.

3.2. Economic benefits from crop export

In addition, the popularization of urban farms can also promote the development of agriculture in this area to a certain extent. Because in the same area of land, a building not only bears the function of office entertainment, but also bears the function of agriculture and animal husbandry production, so that the land plays the greatest role in value. To take a very intuitive example, the Netherlands exported more than 100 billion US dollars of food. In 2017, it was the second largest food exporter in the world [7]. While the available land area of Netherlands is only 1/237 of the United States (the first food exporter). As people all know, the Netherlands is a low-lying country with only 41528 square kilometers. However, the construction industry in the Netherlands is developing rapidly. Every inch of land can be well used and every inch of land can get benefits. This kind of urban farm system is also reflected in Thailand, the United States and other countries. They make use of the effective combination of urban and rural system to give full play to the greatest advantages of both, and form an effective utilization mode of "1 + 1 is greater than 2".

3.3. Urban farms contribute a lot to the purification of the urban environment

More importantly, with the intensification of industrialization, each country is vigorously developing its industry, which undoubtedly causes more or less damage to the environment, such as air pollution, water pollution and other problems that are now very urgent to

solve. However, due to many factors (driven by interests, the need for industrialization and even the loss caused by war), the urban vegetation coverage is getting lower and lower. According to Peter Kabano, Sarah Lindley and Angela Harris, by 2050, about 68% of the population will live in cities [8]. Many cities have been harmed by natural factors such as climate warming. Vegetation can effectively regulate this phenomenon. However, the trees and vegetation in many southern cities have been exhausted [8]. This phenomenon has had a great impact on the current environmental problems. With the increasing heat island (UHI) effect, the city is likely to be no longer suitable for people to live in. Therefore, the protection of natural vegetation in the city is an imperative trend. The urban farm is also a good way to restore urban vegetation coverage. While planting crops and plants, these plants absorb carbon dioxide and all kinds of carbon dioxide in the city, which may harm human health and play a great role in resisting climate change, heat island effect, haze and Sustainable development of cities. CO₂ produced by construction is helpful to the growth of crops, and the use of crops to purify indoor air is of great significance to human health [9].

4. LIMITATIONS OF CITY FARMS

However, there are also some restrictions on urban farms that must be considered. For example, according to Al kodmani, soil pollution, theft and destruction, high costs (infrastructure, permits, water, housing, etc.), whether the governments of low-income countries have funds to build such facilities, and whether the citizens of low-income countries can consume are controversial [10]. For most less developed countries, the cost of these technologies is not a small expenditure, which will bring some financial problems to the government. Because if the farm is to be built on skyscrapers, building materials, experts and technology research and development are essential, such as the proportion of soil used for sparse farming combined with reinforced concrete; How to maintain the stability of the building in the case of setting up such a vertical farm; Whether the structure will be damaged; And the potential factors such as the corrosiveness of the soil used for domestic farming to the building structure are very important. In addition, some follow-up investment is also difficult to ignore. Because it is built on high-rise buildings, although some crops can grow like normal farmland, the lighting capacity of high-rise buildings is still insufficient. Artificial lighting and heat supply will be particularly important, and these follow-up costs are not a small amount of money. As a result, some less developed regions may not be able to afford the huge cost of these technologies and materials



Figure 2 City farm landscape

5. CONCLUSION

To conclude, urban farms are becoming a more and more popular way of farming. They generally aim to create more value by making use of the most easily wasted and neglected space in the city, and will be gradually accepted in big cities. This kind of vertical urban agriculture can bring many benefits to people, such as bringing people living in cities closer to nature, letting children understand how crops grow, and purifying the urban environment. In addition, it can also help cities resist thermal effects and absorb carbon dioxide, allowing urban residents to enjoy fresh food, and even provide the necessary material foundation for the large-scale expansion of the world's population in the future. However, due to the high labor cost, high technology cost and long-term capital investment after construction. This kind of agricultural structure will be a big expense for some urban governments, so it is generally only suitable for metropolitan cities with large population and lack of agriculture and vegetation coverage. At present, this paper defines the concept of urban farm, and analyzes the advantages and disadvantages of urban vertical farm. Urban farm is expected to be more and more popular in the future metropolis, and it will be a possible trend of future urban development. But there are still many shortcomings to be improved. In the future research, The author will conduct in-depth research on city farms through exhibitions and other means

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