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Mini Review

A Mini Review of Research on Urban Agricultural Potential at City Scale

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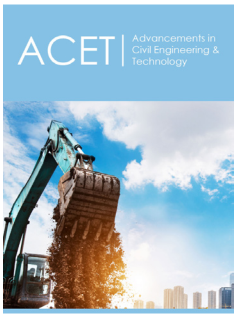
ISSN: 2639-0574



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Submission: February 19, 2021

Published: March 17, 2021

Volume 4 - Issue 4

How to cite this article: Zheng Jie, Lyu Yating, Zhang Yukun. A Mini Review of Research on Urban Agricultural Potential at City Scale. Adv Civil Eng Tech. 4(4). ACET.000593. 2021.
DOI: 10.31031/ACET.2021.04.000593

Introduction

Urban agriculture (UA) is food production, processing and distribution in or around cities, largely in response to the daily demand of consumers within cities, and frequently use and reuse natural resources and urban wastes [1]. UA contributes to food security, health, livelihood, and environment which has been regarded as a solution to global problems such as land use shortage, and waste emissions emerging from the transport of non-local food [2]. As UA has been practiced more all around the world, the potential contribution to local food systems is qualified by some researches and it is proved that agriculture carried out both on vacant land and on tall buildings would create large food security for urban populations.

Review

Goals and results of the research

In terms of research purpose and results, the researches can be divided into 4 types：

1) Some researches aiming at expanding the existing urban agricultural production network and improving the urban food system through local agricultural production. In 2012, Taylor and Lovel conducted a manual analysis of Google Map's high-definition images in the urban area of Chicago, combined with ArcGIS to identify and map the agricultural space containing 4429 public and private food gardens within the research area [3].

2) Some researches assessed the proportion of agricultural productivity that could be provided by UA. In 2012, Ackerman calculated the potential productivity in New York and found that 2% of the city's vegetable consumption could be produced by vacant land in the city [4]. In the case of Oakland by McClintock, a vacant land inventory named Cultivating the Commons had been initiated and whose potential productivity had been qualified in 2013-a land of 622.8ha could be used for UA and 2.9 to 7.3% of Oakland's current consumption would be satisfied under the most conservative scenario depending on production methods [5].

3) In some land inventories, parcels with agricultural potential are located and mapped, including both vacant land and roofs, such as researches in Portland [6], Vancouver [7], Seattle [8], Toronto [9] and Philadelphia [10], Cleveland [11].

4) With geospatial assessment, some potential locations for UA are mapped based on different types of spaces and ways of utility. McDougall et al. [12] classified different land use in Sydney (Australia) with GIS and selected available land for UA like street verges, miscellaneous blocks (e.g. vacant blocks), and yard space and concluded that the entire consumption of vegetable in Sydney would be met if those land could be efficiently used [12].

The methods used in potential evaluation

In terms of research methods, the assessment of the food production potential of urban agriculture at home and abroad is mainly divided into three aspects:

1) Acquisition of spatial information, mainly based on manpower surveying and mapping, remote sensing, airborne sensors or other sources of secondary data to acquire the value of available roof area. In 2011, the assessment of the local food supply capacity of Detroit,

Michigan had been conducted by Colasanti [13]. Using the official dataset and aerial image, vacant parcels were identified and mapped, then their area was calculated using ESRI Arc Info 9.3. Meanwhile, current fruit and vegetable consumption and acreage required to meet local food consumption based on fruit and vegetable yields were calculated to assess the potential production in Detroit about 300 acres could be used and 31% and 17% of the demanded vegetables and fruit, respectively, could be supplied by urban agriculture [13]. A geospatial assessment of urban agriculture potential in Boston was conducted by Mithun [14], in which the available area for urban farming, including both rooftop and ground-level areas was located and qualified with remote sensing and GIS. With the estimated food yield value, the city's food production potential was calculated [14]. Representing an improvement in time and accuracy, methodology using airborne sensors has been developed in recent years, which has been applied in the industrial municipality of Rubi, Barcelona (Spain) [15].

2) Determine Evaluation Indicators and classify the production potential of the obtained urban agricultural space. For example, Vlad Dumitrescu carried out research on the potential of urban agriculture in Rotterdam in 2014, in the context of the Edible Rotterdam Declaration [16]. The research identified the possible types of urban agriculture, mapped the urban agricultural potential, and conducted case studies on urban agricultural spatial systems. On this basis, an agricultural urbanism strategy system including physical, economic, and social indicators was established, with the result of the scenarios of potential locations based on different types of UA-ground based, low-income community garden, rooftop based hydroponic community garden, ground based commercial farm, commercial rooftop farm [17].

3) Evaluate urban agricultural production potential, draw potential maps or establish urban agricultural databases combined with GIS methods, such as Chicago and Rotterdam. This step also often includes system productivity evaluation, which is mainly based on empirical statistics, experimental or simulated data to obtain the crop yield of the planting system. Finally, UA's food production or self-sufficiency index is used to evaluate the overall food security potential of the city.

Brief summary

Urban agricultural land inventory and urban agricultural space mapping are important means to integrate agriculture and urban space, as well as the basic work of agricultural potential assessment. Understanding how much land could be productively used for urban agriculture and how much food could realistically be grown are important steps toward increasing knowledge and establishing a baseline for evaluating the potential costs and benefits of urban agriculture. Based on it, some researchers calculated the potential productivity of UA, and compared it with current consumption or recommended consumption, then have the potential agriculture self-sufficiency rate.

Discussion

Although researchers have mapped the potential land for UA in many cities, only some of these researches, however, estimate the potential productivity and its ability to meet the demands of consumers in those cities. Current researches on urban agricultural land inventory mostly use geospatial technology like remote sensing and GIS, etc. which depend heavily on the availability and currency of spatial data. And some inappropriate research standards may lead to great deviation of results of land inventories. Besides, the methods of high labor cost and low efficiency like field investigation and manual screening are adopted by most researchers which is also a limitation.

Some studies classified the types of UA land use, calculated the production potential of different land-use types and presented the results respectively, such as Rotterdam. However, some other studies had not distinguished the types of land, and mainly studied the agricultural production potential of a single type of land, such as roof, ground, road and lacked research on the integrated method of evaluation system for different types of land. In addition, some studies did not consider differences in yield between different types of crops and under different growing conditions and lacked the evaluation of agricultural growth index to prioritize site suitability based on size, slope, aspect, etc. and to set up an establishment of a comprehensive assessment system for agricultural potential. In further researches, advanced technology like machine learning could be used in the process of land inventory and more results can be visualized in the form of interactive platforms.

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