

Exploring Urban Agriculture's Impact on Ecosystem Services and Beneficiary Characteristics

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ABSTRACT

Urban agricultural systems can contribute to the health of the natural ecology and offer more ecosystem services than they demand. Restructuring agriculture, particularly urban agriculture, as a component of a greener infrastructure system might lead to the creation of a network of agricultural systems that enhance the health of the local ecosystem by supplying ecosystem services and avoiding harmful externalities. cities could gain largely from the ecosystem services of urban agriculture in terms of environmental and socio-economic benefits, such as water regulation, enhanced food security, or improved air quality. Urban agriculture has indeed been proposed as a means for delivering ecosystem services like benefits for mental health and cultural enrichment. Ecosystem services are often grouped into four categories: provisioning services example food and fiber, regulating services example climate regulation, and erosion control, supporting services of soil formation, oxygen production), and cultural services example recreational and health benefits. (Millennium Ecosystem Assessment, 2005). This study was conducted in Thiruvananthapuram corporation, the Capital of Kerala, to delineate the ecosystem services provided by urban agriculture as perceived by the citizens of Thiruvananthapuram corporation. Evaluation of the ecosystem services and suggesting suitable strategies for urban planners are the other objectives. 390 randomly selected respondents from 32 wards of Thiruvananthapuram corporation became part of the study. Data was collected through a pretested questionnaire and measured in the Likert Scale. The analytical tools are principal component analysis, mean, percentage, and correlation.

Keywords: Urban Agriculture, Ecosystem Services, Kerala, India.

Introduction

As India's population gets more urbanized by 2030, it is anticipated that 50 percent of Indians and nearly 60 percent of the world's population will live in cities (UN-World Urban Prospectus, 2018). The number of million-plus cities

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in the country, meanwhile, has steadily increased from 23 in 1991, and 35 in 2001, to 53 in 2011 (Census of India, 2011). The transport sector of Indian cities contributes to over 7% of total GHG emissions in India. High vehicular emissions in many cities have raised air pollution to unbearable levels (Ghose et al., 2004).

The creation of sustainable and resilient cities is one of the challenges of policymakers around the globe. Promoting urban green infrastructures represented by all vegetation cover in and around cities, including urban forests, grassland, parks, green roofs, gardens, urban farms, and street trees etc. is widely believed to provide critical ecosystem services and play a vital role in mitigating the negative impacts brought about by urbanization (Bodnaruk et al., 2017).

Urban greening policies are important for revitalizing communities, reducing the financial burdens of healthcare and increasing quality of life. Most policies focus on community benefits, and reducing the negative effects of urban development, such as surface runoff and the urban heat island effect. Green Spaces is a cost-effective ecosystem-based approach for climate adaptation in Indian cities.

Ecosystem services provided by urban agriculture/urban gardens are often grouped into four categories: provisioning services (e.g., food and fiber), regulating services (e.g., climate regulation, erosion control), supporting services (e.g., soil formation, oxygen production), and cultural services (e.g., recreational and health benefits) (Millennium Ecosystem Assessment, 2005). Kerala, the second-most urbanized state in India, has 47.7 percent of its residents, living in cities (GOK, 2018). Thiruvananthapuram Corporation is the largest municipal corporation in Kerala by area and population. Urban agriculture is practiced in city areas widely. But the ecosystem services benefits of urban agriculture remain less discussed. Therefore, the present study is aimed to understand ecosystem services provided by urban green spaces in the Thiruvananthapuram Corporation.

Objectives

The study's main objective was to understand various ecosystem services provided by urban gardens in Thiruvananthapuram Corporation, the capital of Kerala. The profile characteristics of beneficiaries of ecosystem services of urban agriculture were also identified.

Methodology

The present study was conducted in the Thiruvananthapuram Corporation. Six public gardens in Thiruvananthapuram Corporation, where people used to come regularly for recreation and relaxation were purposefully identified. Thirty

gardeners, actively involved in maintaining these six gardens were selected, who were the primary contacts. The data were collected using a pre-tested interview schedule from these primary contacts. By nonparticipant observation and snowball technique, 270 other respondents, who were either regular visitors of these six public gardens or actively engaged in urban agriculture through home gardens/rooftop gardens/community vegetable gardens (residents associations) were also identified as respondents. Thus, the total sample size was 300. The data were collected using a pre-tested interview schedule

As an initial step, 40 ecosystem services were identified using a free listing technique (Bernard, 1999; Vieling et al 2014) and were classified into 4 main categories, which were provisioning, habitat, regulating and cultural services. These 40 services were sent to thirty experts of Kerala Agricultural University and nearby institutions for judge's rating. Their responses were collected on a five-point continuum with options "most relevant", "more relevant", "relevant", "less relevant", and "least relevant" with scores of 5, 4, 3, 2 and 1 respectively. Based on the relevancy rating, 20 ecosystem services, which had the highest relevancy scores, were finally selected.

The 300 selected respondents of the study, were asked to rate benefits derived from the mentioned 20 statements in the five-point continuum. The level of agreement was strongly agree, agree, undecided, disagree and strongly disagree. The scores given were 5, 4, 3, 2 and 1 respectively. The means scores and percentage analysis was further done to analyse the level of agreement.

The data collected were statistically analysed using frequency, percentage analysis, correlation and regression.

Result

1. Ecosystem Services

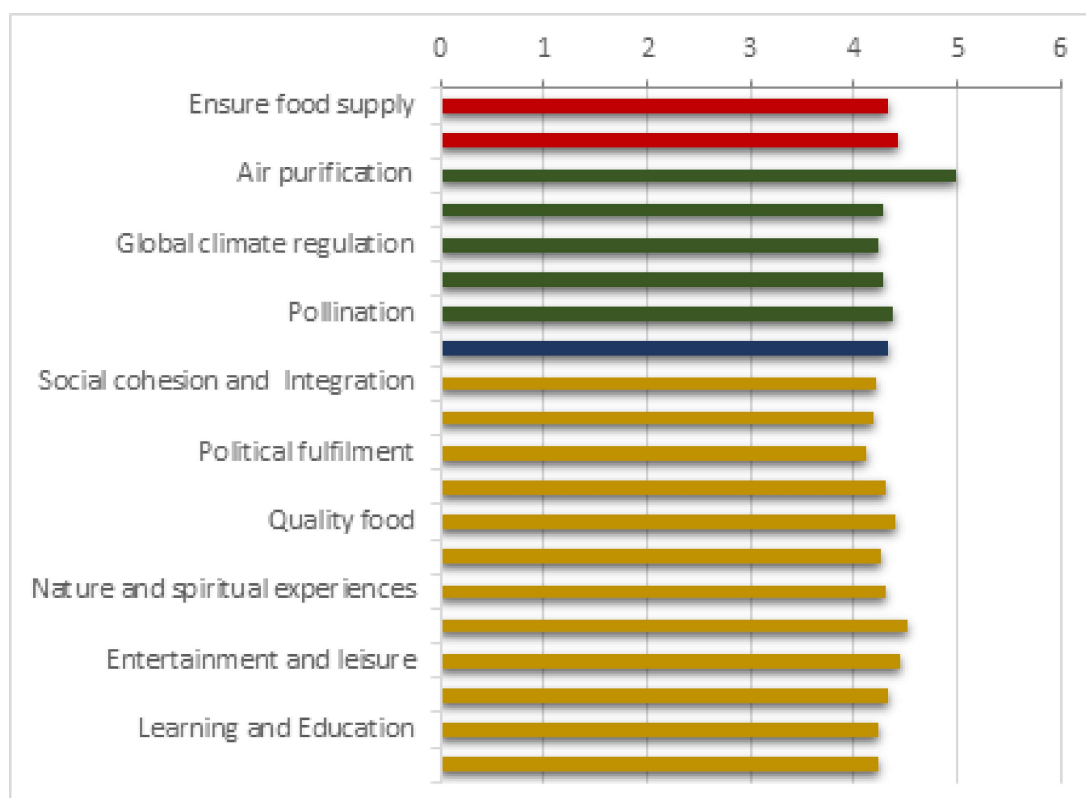
The 14 ecosystem services were categorised into four, i.e. provisional services, regulating services, habitat services and cultural services. The level of agreement on the ecosystem benefits of respondents was measured using a five-point continuum and the Mean Score (MS) of each ecosystem was calculated and shown in Table-1.

The two provisioning services identified were ensuring food supply 4.32 and ensuring therapeutic services through medicinal and aromatic plants 4.43. The regulating services include air purification 4.99, local climate regulation 4.29, global climate regulation (4.24), maintenance of soil fertility (4.29) and pollination (4.38). The overall mean score for regulating services was 4.43. Regarding habitat service which solely included the maintenance of biodiversity, the mean

score was 4.33. The twelve cultural services were learning & education (4.24), social cohesion & integration (4.22), entertainment & leisure (4.44), maintenance of cultural heritage (4.24), aesthetic information (4.25), relaxation and stress reduction (4.52), quality of food (4.4), place-making (4.2), biophilia (4.31), exercise & physical recreation (4.32), nature & spiritual experiences (4.31) and political fulfilment (4.13). The total mean score of cultural services was 4.29.

Table 1: Ecosystem services of Urban Agriculture

Sl. No	Categories	Mean Score	Overall Mean Score
I.	Provisional Services		
1.	Ensure food supply	4.32	4.37
2.	Ensure therapeutic services through Medicinal and aromatic plants	4.43	
II	Regulating service		
3.	Air purification	4.99	4.43
4.	Micro climate regulation	4.29	
5.	Global climate regulation	4.24	
6.	Maintenance of soil fertility	4.29	
7.	Pollination	4.38	
III.	Habitat services		
8.	Biodiversity	4.33	4.33
IV.	Cultural services		
9.	Social cohesion and integration	4.22	4.29
10	Place-making	4.2	
11	Political fulfilment	4.13	
12	Biophilia	4.31	
13	Quality food	4.4	
14	Aesthetic information	4.25	



The analysis result indicated the most felt benefit from the ecosystem service of urban agriculture was regulating services, which has a mean score of 4.43. The mean score for air purification was the highest and it was the most agreed ecosystem benefit. Therefore, it can be concluded that the most important ecosystem service from urban gardens according to the respondents was air purification followed by relaxation and stress reduction benefits.

Discussion

1. Ecosystem Services

Ecosystem services from urban gardens can be crucial in resolving several urban policy issues in cities, including encouraging the stewardship of urban ecosystems, generating opportunities for recreation and healthy living, and fostering social cohesion (Camps-Clavet et al, 2016). Among the ecosystem services, highest mean score was observed in the case of regulating services, which included the air pollution and climate regulation benefits of urban green spaces. Green spaces aid in building an efficient and highly localized stable food system that can support the development of sustainable urban environments by reducing food miles and carbon emissions. It can also increase carbon sequestration, and lower greenhouse gas emissions (McDougall et al., 2019).

The main ecosystem service of urban agriculture is the habitat service, which

solely includes biodiversity maintenance. The present scenario of forest land conversion for human inhabitation has resulted in the loss of habitat of many birds and animals. Urban gardening can be an effective way for increasing biodiversity in urban areas by enhancing the local flora and fauna. Ponds, moss, ground cover, and various vascular vegetative structures are examples of features in domestic gardens that may promote plant biodiversity (Smith et al., 2005). Urban agriculture systems can improve urban biodiversity and provide crucial ecosystem services like pollination, pest management, and climate resilience including diversified vegetative structure, increased native plant variety, and a decrease in urban impermeable surface (Lin et al, 2015). There is a direct correlation between the number of years of maintenance and the diversity of habitats and urban household vegetation. Diversity was also influenced by the quantity of land, the layout of the space, and economic concerns. For many years, the residences were kept with more vegetation and rich diversity. In most cases, lack of space is the main constraint in urban areas to maintain biodiversity. It can be reduced by a household level approach to biodiversity maintenance (Salini, 2023).

The primary reasons for participating in Urban Agriculture are food production for domestic consumption, income supplementation, and rising market food prices (Nugent, 2000). The provisional services of urban gardening are mainly the supply of fruits and vegetables and the therapeutically benefits of medicinal plants grown and it had the second highest mean score. Many people engage in urban farming because of their gardening interests, it gives them access to a garden, access to fresh food, and social contact (Corrigan, 2011). Urban agriculture in some cases was necessary for the subsistence of citizens it provided financial gain. In some contexts, it improves the food security of farming households (Poulsen et al., 2015).

The social and cultural services of urban gardens mainly emphasise citizen involvement through capacity building, participatory management, and multilevel governance (RUAF, 2003). Urban gardens can act as a space for knowledge sharing between generations and individuals. It can aid in capacity building required to provide citizens with knowledge and skills in a variety of urban agriculture-related areas. Numerous people regard urban gardening as a nice way to spend their free time which helps them to preserve the urban environment (Dieleman, 2017). It is crucial for food sovereignty because it is a region that contributes significant quantities of local products to the metropolis.

2. Profile characteristics of respondents

The profile characteristics like age, annual income, gender, time spent in urban farming, educational status and job status, and health consciousness were

measured using procedures developed by the researcher appropriate for the study. Environmental orientation was measured using the scale followed by Arathy (2022). It was observed that most of the respondents (44 %) were in the young age category (less than 32 years) followed by the middle-age category viz. 30 percent (32-46 years). Among the respondents, 62 percent were women. Most of the respondents (49 %) were graduates, 46 percent with a higher secondary level of education or diploma. Regarding job status, 34 percent were government employees, 21 percent were private employees, 16 percent were retired officials, 16 percent were self-employed individuals and 13 percent of respondents were homemakers. Regarding annual income, 25 percent belonged to Rs. 3-4 lakhs/ year, 24 percent to 1-2 lakhs/ year and 2-3 lakhs/ year categories. It was observed that 43 percent of respondents spent about 2-3 hours daily in urban agriculture activities or spent their time in urban gardens followed by 29 percent of respondents who spent 1-2 hours/per day in urban farming activities, and 17 percent belonged to 3-4 hours/day category. There were only 11 percent of respondents spent more than 4 hours daily in urban agriculture. It was observed that 67 percent of respondents belonged to the medium health consciousness category followed by 21 percent in the high health consciousness and 12 percent in the low health consciousness category. Most of the respondents (74% belonged to the medium environmental orientation category followed by 22 percent in the high environmental orientation category.

3. Relationship between ecosystem services and profile characteristics

The cause effect relationship between ecosystem services and profile characteristics was found using regression analysis. The ecosystem service score was positively and significantly associated with time spent in urban agriculture activities, health consciousness and environmental orientation. A negatively significant association was seen in the case with that of age and ecosystem service means score.

Table 2: Regression Analysis

Sl. No	Independent variables	Estimate	P value
1	Age	-0.007	0.000*
2	Gender	0.026	0.599
3	Annual income	-0.025	0.195
4	Job-status	-0.018	0.140
5	Time spent in urban agriculture activities	0.132	0.000*
6	Education	0.055	0.146
7	Health consciousness	0.070	0.000*
8	Environmental orientation	0.104	0.000*
	P values less than 0.05 are significant		

People who are highly health conscious in urban areas usually opt for growing their food, which is free of chemical use. They also agreed that urban agriculture ensures food supply and that the food produced without chemicals is tastier and healthier. This might be the reason they opined that urban agriculture provides ecosystem services in urban areas.

Respondents who had high environmental orientation were aware of the problems in their surroundings. They may have greater awareness about the issues related to rapid urbanization and the importance of urban agriculture in this scenario. Therefore they may have felt that urban agriculture greatly contributed to the ecosystem services, which reduces the problems of air pollution and climate change.

It was also observed that the individuals who spent more time in urban gardens/urban agriculture activities had a higher mean score for ecosystem services. They might have felt the various benefits of urban agriculture /urban gardens in maintaining biodiversity in urban areas for pollination of crops, providing aesthetics and pleasure, reducing depression and anxiety and increasing their food supply as they spent more time in the farm areas.

Conclusion

Urbanisation is happening all around the world. The current scenario of rapid urbanisation and decrease in land area as forest covers and cultivable farm land resulted in biodiversity loss. Urban greening is a cost-effective climate mitigation strategy that the policymakers can implement around the globe.

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