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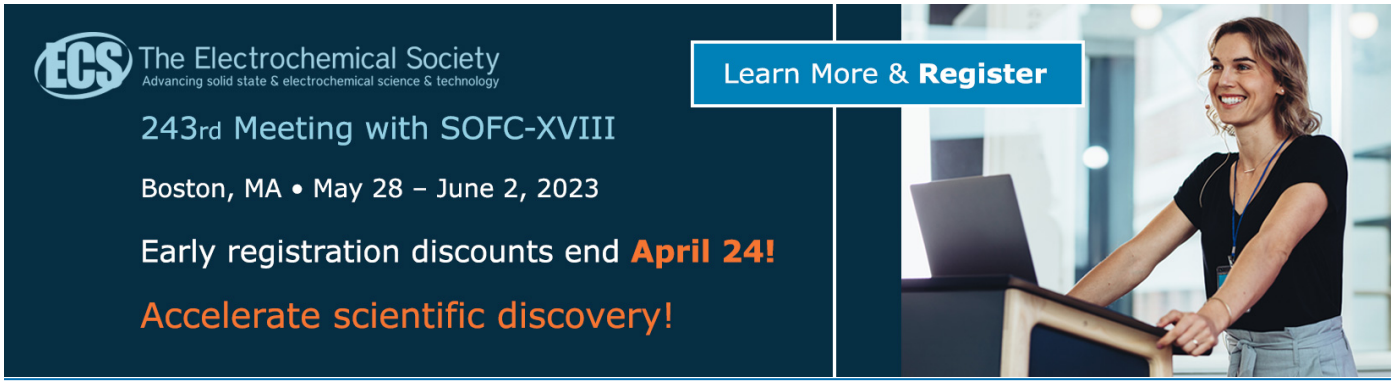

Urban Forestry in Kota Kinabalu: Home Garden practices by urban villages for biodiversity, socio-economic and environmental services

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Abstract. The growing urbanization has greatly reduced biodiversity. Home gardening is a crucial approach for biodiversity preservation, particularly in metropolitan settings with a dearth of green spaces. The goal of this study is to determine the types of trees and crops growing in urban villages in Kota Kinabalu, as well as the socioeconomic and environmental benefits that urban residents receive from their home gardens, which serve as urban forests. In four urban villages, the data were gathered through observation and household questionnaires. Interviews have been conducted with 217 respondents in total. The results showed that the respondents planted a total of 14 different crop and tree types, with Misai Kucing (*Orthosiphon stamineus*) and mango tree (*Mangifera spp*.), Pandan (*Pandanus sp*.) and Red Onion (*Allium ascalonicum*) being the most popular trees and crops. The garden's key contributions were lowering the temperature in the residential areas and as a leisure activity area. There was little correlation between the social benefit of urban forestry and the function of home gardens such as for food supply, medicinal use and hobby. Due to the small-scale home gardens, the economic contribution was little but complemented domestic requirements. The promotion of agroforestry systems in urban areas needs to be stepped up to preserve biodiversity, meet the demand for food and medicine, and provide environmental benefits.

Keywords: Home Garden; agroforestry; biodiversity; socioeconomic; environmental services; urban forestry

1. Introduction

Recently, the concern of global warming has become worse in, particularly in urban areas. There are now much fewer trees and forest areas due to rapid urban expansion. Urbanization has been shown to be one of the most risks in terms of the number of species lost or in danger, even though there are many reasons of deforestation. According to [1], urbanization significantly contributes to an increase in CO^2 emissions. To address this issue and maintain sustainable development, it is strongly advised to improve forest management. Urban forestry is one approach, which is the conservation of trees and forest resources within and surrounding urban community ecosystems for the physiological, sociological, economic, and aesthetic benefits trees provide society [2]. In order to handle environmental issues like

erosion control and enhancing water quality, shade, and other ecosystem services, urban forests are essential. In terms of environmental, social, and economic factors, urban woods generally have a favourable influence on cities and in particular, their inhabitants. In accordance with Sustainable Development Goal 11, which strives to create sustainable cities and communities, the government therefore encourages the development of green spaces around urban areas [3].

Urban greenery is crucial to raising the standard of living in cities. One of the agroforestry practices that is widely used for urban forestry development is the home garden. It is described as a land use system involving intentional management of multipurpose plants and trees as well as stable animals within the compounds of individual dwellings, which is being extensively managed by family labour [4]. According to [5], small-scale home gardening techniques are appropriate for urban or semi-urban regions with limited land. Home gardens offer direct access to nature, and gardening activities assist lower stress, rage, despair, and anxiety, according to a study by [6]. When properly managed, urban agriculture practices in home gardens serve to promote food security, resilience, ecological advantages, and economic benefits. A home garden is a potential strategy to improve household food security and wellbeing [7].

Despite the potential advantages, local development organisations pay less attention to and encourage these approaches [8]. Moreover, [9] shows that although house gardens are a type of agroforestry system that are frequently used in urban agriculture, they are consistently underappreciated and unresearched. In order to determine how the community in Kota Kinabalu uses their home gardens, this study was carried out. Identification of the tree, crop, and livestock species raised by the community is the study's initial goal. This study will also ascertain the contribution of home gardens to the growth of urban forestry in terms of economic, social, environmental, and aesthetic value aspects.

2. Methodology

The Sabah state capital, Kota Kinabalu, has a population of 580,000 [10]. Four villages around Kota Kinabalu are the sites of this study. The study locations include Kampung Cenderamata (6º0'11"N and 116º7'3"E), Kampung Likas Lama (5º59'37"N and 116º6'43"E), Kampung Inanam (5º59'47"N and 116º7'58"E), and Taman Kemajuan (6º0'7"N and 116º7'3"E). All these villages are located within 7km from Kota Kinabalu city. Questionnaires and direct observation are used to gather the study's main data. The questionnaire is divided into three sections: Section A covers sociodemographic data on the respondents; Section B covers the status of the land, the types of crops, trees, and livestock; and Section C addresses the purpose of the home garden. Using the random sampling approach, this questionnaire was given out to houses, with a 50% sample taken from all the households in the four villages.

In addition, some information was gathered through conducting field surveys and actual observations, such as the species of flora and animals. The observation was conducted to determine which aspect of agroforestry the respondents practised. The types of trees, crops, and livestock that can be found close to the respondents' dwellings also need to be identified using this method. The survey's legitimate data was entered into Microsoft Excel for analysis at the conclusion. In this study, descriptive and statistical analysis were both used. Means, percentages, and frequencies were used to present the descriptive analysis results. The association between the purpose of the home garden and the growth of urban forestry was investigated using correlation analysis.

3. Results and Discussion

3.1 Socio-demographic Information

A total of 217 household surveys in all have been gathered. The socio-demographic characteristic of respondents is important to categorize and to better understand the sample population. Table 1 reveals that women made up the bulk of respondents (66.4%), with men making up just 33.9%. The age group of 31 to 40 years old accounts for most respondents (34.1%), followed by that of 41 to 50 years old

(25.3%). A total of 213 respondents (98.2%) identifies as Muslim and only 1.8% are Christian. About 82.5% of the respondents have a secondary school education. Only 1.8% of the total respondents have no formal education. The findings also showed that most respondents (59.4%) work in the private sector, followed by the self-employed (18.4%). According to this study, most respondents earn between RM1500 and RM2000 each year. The study's findings might be utilised to ascertain the respondent's familiarity with and participation in a home garden agroforestry system.

Table 1. Socio-demographic Characteristic of the Respondents

Demographic information		Frequency	Percentage (%)
Gender	Male	73	33.9
	Female	144	66.4
Age	<21 years	17	7.8
	21-30	44	20.3
	31-40	74	34.1
	41-50	55	25.3
	>51 years	27	12.4
Marriage status	Single	44	20.3
	Married	163	75.1
	Other	10	4.6
Religion	Muslim	213	98.2
	Christian	4	1.8
Education level	No formal education	4	1.8
	Primary school	17	7.8
	Secondary school	179	82.5
	Higher education	17	7.8
Job	Public sector	21	9.7
	Private sector	129	59.4
	Self-employed	40	18.4
	Unemployed	27	12.4
Income level	<RM500	28	12.9
	RM501-RM1000	23	10.6
	RM1001-RM1500	52	24.0
	RM1500-RM2000	92	42.4
	>RM2000	22	10.1

3.2 Home Garden practices among respondents

A total of 208 of the 217 respondents, participate in home gardening activities, while 9 do not. Approximately 72.4% of respondents, as shown in Table 2, have only been practising home gardening for less than five years, followed by those who have been doing so for six to ten years. However, very few respondents have been cultivating a home garden for more than 16 years. This is because most respondents only recently learnt about home gardening techniques and their advantages. According to [11], home gardening activities are becoming more popular, especially among women, due to their many advantages, which include generating revenue and ensuring access to food and healthcare as well as the environment.

Table 2. Period involved in home garden practices

Years	Frequency	Percentage (%)
<5 years	157	72.4
6-10 years	36	16.6
11-15 years	17	7.8
16-20 years	5	2.3
>20 years	2	0.9

Table 3. Land use status

Land Area	Area (m^2)	
	Minimum	Maximum
Area of Land Around House	12.55	40.47
Average land area that had been planted	9.71	
Average land area that had not been planted	24.69	

The land area surrounding the respondents' home ranges from 12.55m^2 to 40.47m^2, as shown in Table 3. This demonstrates that the space available for gardening in the gardens of urban residents is limited. However, with good land use planning, urban populations might also make use of their limited space for a little garden. There are currently 24.69m^2 of average unutilized land, compared to 9.71m^2 of average land used for home gardening. This demonstrates that there are greater land areas that have not been used for agroforestry systems in household gardens.

Table 4. Types of plant and livestock

No.	Plant Species	Purpose		
		Own	Sell	Total
1.	Misai Kucing (*Orthosiphon stamineus*)	98	-	98
2.	Pandan (*Pandanus* sp.)	30	-	30
3.	Bougainvillea (*Bougainvillea* spp.)	26	-	26
4.	Mango tree (*Mangifera* spp.)	24	1	25
5.	Red Onion (*Allium ascalonicum*)	22	-	22
6.	Banana Tree (*Musa* spp.)	5	4	9
7.	Yam (*Caladium* spp.)	8	-	8
8.	Cermai tree (*Phyllanthus acidus*)	6	-	6
9.	Kedondong tree (*Canarium* spp.)	6	-	6
10.	Tapioca (*Manihot esculenta*)	3	2	5
11.	Pinang tree (*Areca catechu*)	5	-	5
12.	Coconut tree (*Cocos nucifera*)	2	2	4
13.	Jackfruit tree (*Artocarpus heterophyllus*)	1	2	3
14.	Sugarcane (*Saccharum officinarum*)	3	-	3
	Livestock	Own	Sell	Total
1.	Ayam kampung (*Gallus domesticus*)	78	-	78

Table 4 provides examples of the different plant and animal species that the respondents raised. In all, 14 plant species were found in the four communities. The most often planted species among the responders is the herb plant Misai Kucing (*Orthosiphon stamineus*). This is a result of Misai Kucing's multiple therapeutic uses as a treatment for diabetes and high blood pressure [12]. This suggests that the respondents desire easy access to medical supplies near their residences. Additionally, the respondents expressed a greater interest in cultivating edible plants that may be used as food reserves in emergencies.

Based on the results of this study, low-maintenance, care-free plant species that can be grown in pots or other containers are the most popular for use in home gardening. The locals typically grow Misai Kucing (*Orthosiphon stamineus*), pandan (*Pandanus sp*.), bougainvillaea (*Bougainvillea spp*.), mango trees (*Mangifera spp*.), and red onions (*Allium ascalonicum*). Due to the lack of space around the respondents' homes to plant large trees, less frequent tree species including jackfruit (*Artocarpus heterophyllus*) and coconut (*Cocos nucifera*) trees were only sparsely found in the four villages. Only 78 of the respondents keep animals in their backyard gardens. Only chicken, which are kept as a pastime rather than for food or sale, were found in the survey areas. This is also a result of the respondents' residences' proximity to little grazing land for raising animals. Most respondents engage in small-scale home gardening, mostly for self-sufficiency as most of the respondents' work. This shows that the neighbourhood around Kota Kinabalu City is still largely reliant on the grocery store for their daily needs.

3.3 Correlation between the function of home garden practices and urban forestry development

The development of urban forests can be evaluated from four perspectives: social, economic, environmental, and aesthetic value. Based on respondents' perception, there is little correlation between the social benefit of urban forestry and the function of home gardens (food supply, medicinal use, hobby). However, the role of a home garden as a leisure activity reveals a significant association with the social component of urban forestry. This study also demonstrates that there is currently no significant correlation between the functions of the home garden practise and the economic component. This is a result of the respondents only having small-scale home gardens that are used for domestic purposes. One home garden function demonstrates a significant connection between urban forestry development and the environmental element. By bringing down the temperature in the neighbourhood, the home garden exhibition significantly benefits the environment. Many of the respondents concur that using home gardens could improve the quality of the air in their neighbourhood. This result is consistent with the home garden agroforestry system's original goal, which is to improve the microenvironment nearby.

4. Conclusion

Urban green space preservation is essential. The findings of this study suggest that a reasonable diversity of crops, trees, and livestock are planted and raised by the locals in the vicinity of Kota Kinabalu City. As of right now, the responders only maintain a self-sufficient home garden, particularly for food and medicine. The urban population's awareness should be promoted through pertinent activities to encourage more active home gardening among the urban community. There must be an awareness campaign to encourage more urban residents to use their property for home gardening. This study also reveals the close ties between home gardens and urban forestry expansion, especially in terms of the environment that lowers the air temperature around residential areas and offers recreational opportunities for the urban community. According to this study, a sizable amount of land is still unutilized for urban forestry or home gardening. Therefore, Kota Kinabalu City Hall's role is vital in promoting local community engagement, together with that of the local government and NGO organisation.

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