ORIGINAL RESEARCH ARTICLE

Urban agriculture and its determinants in Kidfarmaco estate, Kikuyu Town

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ABSTRACT

Urban agriculture is an important multifunctional aspect of the urban ecosystem that contributes to the sustainability and resilience of urban areas. The unplanned transition from the traditional spatial character of agriculture to that of urban agriculture presents a challenge in the residential areas of Kidfarmaco Estate, Kikuyu Town. To understand the character of urban agriculture, the paper sought to describe urban agriculture and its determinants. The study took a quantitative research approach and a survey design. Snowballing was identified as the best sampling method for the study. Data was collected from a total of 93 resident farmers. The sample size was determined during data collection upon data saturation. Questionnaires with statements describing urban agriculture and its determinants were rated on a 7-point Likert scale by resident farmers. The data was analyzed using multiple linear regression to establish whether these determinants explain urban agriculture within the Estate. Economic and social factors were found to be significant in explaining the likelihood of a resident of Kidfarmaco Estate, Kikuyu Town practicing urban agriculture at a significance of 0.000 and 0.026 respectively. Independent variables accounted for 30.7% of the variance of urban agriculture. The regression line predicted by the independent variables explains a significant amount of the variance in urban agriculture ($F(6,86) = 6.339$, $P<0.05$). Economic factors included; employment creation, land productivity, and improved economy. Social factors included; food and health literacy, health and well-being, and recreational opportunities. Economic and social factors of urban agriculture should therefore be capitalized on to facilitate sustainable urban agriculture in Kikuyu Town. For ease of implementation, these strategies should conform to the legal framework (the constitution of Kenya, the Urban Areas and Cities Act, and the Agricultural Act); and be in line with the municipal, county, and national spatial plans.

Keywords: Urban agriculture, economic factors, social factors

1.0 Introduction

The dynamic nature of urban and peri-urban areas, shaped by competition over space, has necessitated an interrogation on whether or not to retain agriculture as an urban land use.

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Competition over space is exacerbated by rapid urban growth due to natural population increase and rural-to-urban migration (Willkomm et al., 2021). The food needs of this expanding population must however be addressed (Gicheha et al., 2022). By the year 2050, food production will need to be increased by seventy percent to accommodate the needs of the growing population. Today, nearly 690 million people suffer from hunger. Food production accounts for only one-fifth of all energy consumed by urban food systems, while processing and transportation account for four-fifths (Yang, 2020). An estimated 800 million people worldwide practice urban agriculture, with developing countries showing a higher adoption rate than developed countries (Davies et al., 2021).

Urban agriculture is agriculture within an urban context, integrated spatially and functionally into urban systems (Specht et al., 2021; Tóth & Timpe, 2017). The United Nations identified the need for sustainable urban development; the Brundtland Report mentions urban agriculture as one of the strategies for sustainable development (Dobele & Zvirbule, 2020). Urban agriculture, due to its proximity to consumers, is seen as a potential strategy to achieve the sustainability goals of cities by ensuring sustainable food production systems that implement resilient agricultural practices. As cities strive to become more sustainable, they again become places for growing food (Skar et al.,2020). Technological and social initiatives have also set the stage for the renaissance of urban agriculture (Dobele & zvirbule 2020). As well as providing the urban poor with nutritious food and extra income, urban agriculture has become an important strategy for reducing cities' ecological footprint, recycling urban wastes, containing urban sprawl, protecting biodiversity, building resilience to climate change, stimulating regional economies, and reducing dependency on global food markets (Davies et al., 2021).

Increased urbanization in Africa has led to increased pressure on food resources. Sub-Saharan Africa will have nearly 670 million people living in urban areas by 2030 (de Oliveira et al., 2021), a rate of 3.5% population growth per annum, the highest in the world (Langemeyer et al., 2015). Despite this growing need, a clear planning framework for urban agriculture in African cities is still lacking. According to Steenkamp et al., (2021), a lack of connection between food and the built environment, and the perception of modernization; which aimed to remove agriculture as a land use in cities by establishing agriculture in rural areas and keeping urban areas exclusively for economic growth and development, has resulted in the exclusion of urban agriculture in the planning of African cities.

In Kenya, urban residents have embraced urban agriculture to supplement their dietary needs and income. This is attributed to rising income levels, changing diets, persistent constraints for long-distance food distribution attributed to rising income levels (Ng'ang'a et al., 2023; Follmann et al., 2021), and the need to increase urban food security. However, poor management of land use change from agricultural to residential use in Kenya's urban fringes has caused land use conflict, hindering the sustainable practice of urban agriculture. The Urban Areas and Cities Act of 2011,

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clause 36(f), requires that all cities and municipalities provide a framework for regulating urban agriculture. However, this is still lacking in Kikuyu Town, with urban agriculture not included as a land use in the Kikuyu Municipality Spatial Plan of 2018.

Common planning strategies have included adopting supportive policies, removing regulatory barriers, and incentivizing urban agriculture (Horst, 2017). '…Despite the growing significance of smaller urban areas, the majority of the existing research on urban agriculture and urban food security has focused on large metropolitan areas. A bias toward primary cities overlooks the significant challenges faced in secondary and tertiary urban areas, where poverty rates are typically higher relative to larger cities due to fewer employment opportunities…' (Davies et al., 2021). In this regard, there is a need to develop strategies to guide planning decisions regarding urban agriculture, to appropriately respond to the specific needs of smaller towns in the African context, whilst enabling their sustainable development.

An analysis of the literature on urban agriculture from 2001 to 2021 shows that related research has focused primarily on urban food production and urban green space. It highlights the need to provide insight into the economic, environmental, and social functions of urban agriculture (Yan et al., 2022). An analysis to investigate the association between urban agriculture and household food security, and assess which types of households are engaged in urban agriculture was conducted in Kenya and Zambia. Results showed that 33% of households engaged in urban agriculture and there was limited statistical significance in terms of the relationship between urban agriculture and household food security. The study emphasizes the need to study smaller tertiary towns (Davies et al., 2021). There is increased interest in connecting urban agriculture, which had been pushed to the peri-urban areas, to cities (Philips & April, 2013).

This paper describes urban agriculture and its determinants in Kikuyu Town. More broadly, it has contributed to the development of the concept of Continuous Productive landscapes, a novel concept in planning urban green spaces. While previous studies have focused on larger metropolitan areas, they have overlooked smaller tertiary towns (Davies et al., 2021). In Kenya, these smaller towns offer a greater spatial opportunity for urban agriculture compared to major cities (Follman et al., 2021), as they continue to grow. It is limited to the theory and concept of continuous productive landscapes and the theory of sustainable cities. These theories have social, environmental, and economic factors as their main constructs. Availability of resources, spatial, technological, and institutional factors have also been investigated in the paper.

Kikuyu town is part of the Nairobi metropolitan region and one of the most favored residential destinations by the Nairobi working population. This has made it the fastest-growing part of Kiambu County, with an annual growth rate of 4.13%. The community vision for Kikuyu Sub-County is making it a sustainable agro-based industrial and residential Sub-County, by ensuring the preservation of agricultural land by promoting compact mixed-land use development within the

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built-up areas (County Government of Kiambu, 2020). With an increasing urban population and loss of agricultural land to development, urban agriculture could contribute to food security, environmental sustainability, and strengthen the economic sustainability of the residents.

2.0 Materials and Methodology

The research took a quantitative research approach; hence, data was collected from a sample of the population in quantitative form. The data then underwent qualitative analysis and the findings were used to infer that the population has the same characteristics.

A survey design was adopted. Surveys are useful in understanding the nature of variables rather than manipulating them. Surveys done in descriptive studies are useful in understanding phenomena dispersed over a geographical region or community.

The study targeted resident farmers of Kidfarmaco Estate, Kikuyu Town. Records of farmers in Kidfarmaco Estate do not exist. Farmers within the Estate were difficult to identify since most of the farming is done within their gated compounds, out of view. Due to the time constraint of the research, a sample frame was not developed. Snowballing was therefore identified as the best method of sampling for the study. Data was collected from a total of 93 resident farmers. The sample size was determined during data collection upon data saturation. All the different types of farmers (mixed farmers, animal husbandry, and vegetable farmers) responded to the given questionnaires. Sampling locations are shown in Figure 1.

Field research was conducted. It was conducted with the use of questionnaires as a data collection method. Respondents were required to rate aspects of urban agriculture, The study developed questions based on research variables related to urban agriculture. Respondents rated statements covering various aspects such as food supply, cost, access, and affordability. Economic factors' impact on urban agriculture was assessed through inquiries about income generated from urban agriculture and related costs along its value chain. Additionally, the study analyzed social factors' significance by gathering data on their contribution to community and family well-being, urban agriculture as a leisure activity, and the relationship between stress levels and urban agriculture. A cross-sectional data collection technique was used to describe urban agriculture and its determinants. The survey instrument adopted for this study included a standardized questionnaire. Participants were asked to rate 80 statement items on the same 7-point Likert scale to identify factors that significantly inform the likelihood of a resident practicing urban agriculture and the resident's understanding of urban agriculture. The 7-point Likert scale was selected for a greater differentiation of responses.

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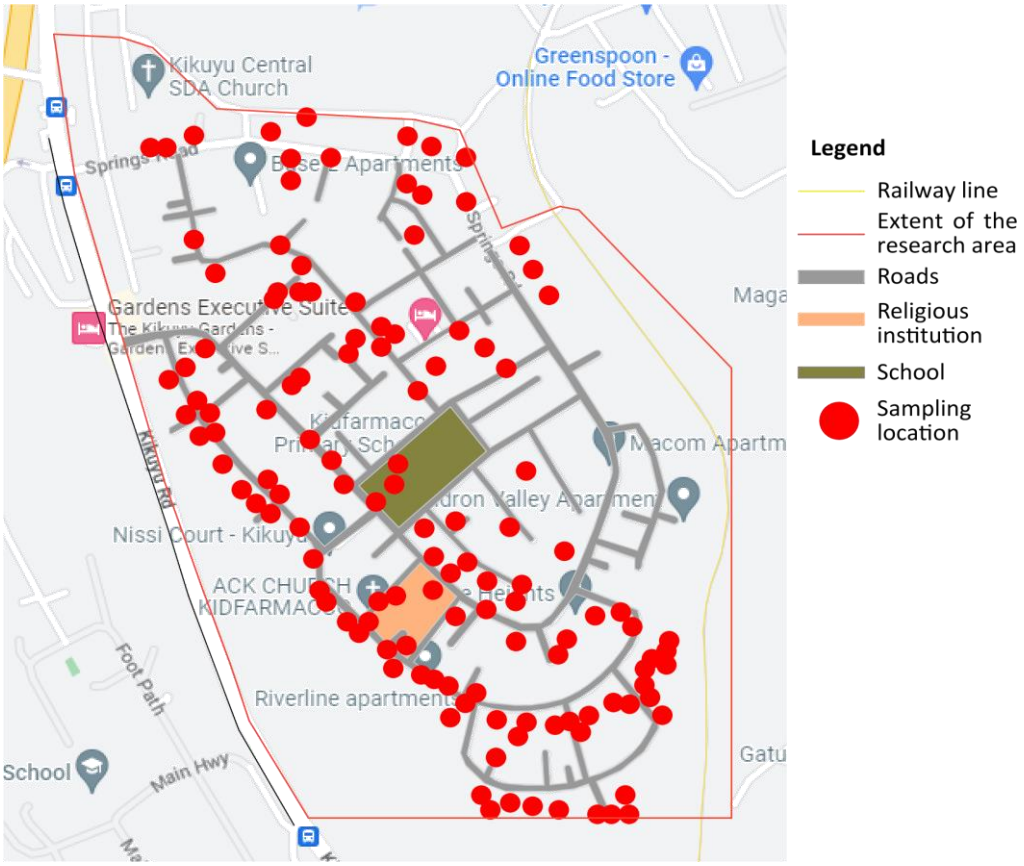

Figure 1: Sampling locations (Source: adapted from Google Maps)

To describe urban agriculture and its determinants, urban agriculture (measured as availability of food, access to food, and food adequacy) is the dependent variable. Availability of resources (year-round water supply, space availability), social factors (food and health literacy, health and well-being, and recreational opportunities, economic factors (employment creation, and land productivity), environmental factors (improved micro-climate, reduced food miles, waste recycling, ecosystem resilience, and improved biodiversity) institutional factors (local government support, farmer's associations, access to services, and access to information), technological factors (access to Building Integrated Agriculture technology) is the independent variables.

To describe urban agriculture and its determinants, a multiple linear regression model for six dependent variables was generated:

$$y = a + \sum \beta_n X_n \pm c$$

where;

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y = urban agriculture measured as; fresh food supply, constant food supply, stable food source during uncertain times, stability of food prices, affordable food supply, affordable food production, access to food by all, healthy food variety, and sufficient household food supply.

X_1 = availability of resources measured as; Availability of water, fertilizer, and financing.

X_2 = Social factors measured as; food and health literacy, health and well-being, and recreational opportunities.

X_3 = Economic factors measured as, employment creation, productivity, and improved economy.

X_4 = Environmental factors measured as; improved micro-climate, reduced food miles, waste recycling, ecosystem resilience, and improved biodiversity.

X_5= Spatial factors measured as space availability, size, and relationship with other land uses

X_6 = Institutional factors measured as; local government support, NGOs, financial institutions, and farmer's associations.

X_7 = Technological factors measured as access Building Integrated Agriculture technology.

Results were presented in tables and graphs. Measures of central tendency including the mean and standard deviation are presented in graphs. Correlations explaining the relationship between the dependent and independent variables were presented in tables.

3.0 Results

To describe urban agriculture in Kidfarmaco estate, respondents were required to describe their understanding of urban agriculture. Eleven descriptors of urban agriculture were ranked on a 7-degree Likert scale. The results (in Figure 2) show a mean of 3.15 implying 'agree' on the 7-degree Likert Scale. The respondents associate urban agriculture with these descriptors. Of the descriptors, the standard deviation is very low, at 1.31, an indication that the resident's opinion on urban agriculture varies slightly.

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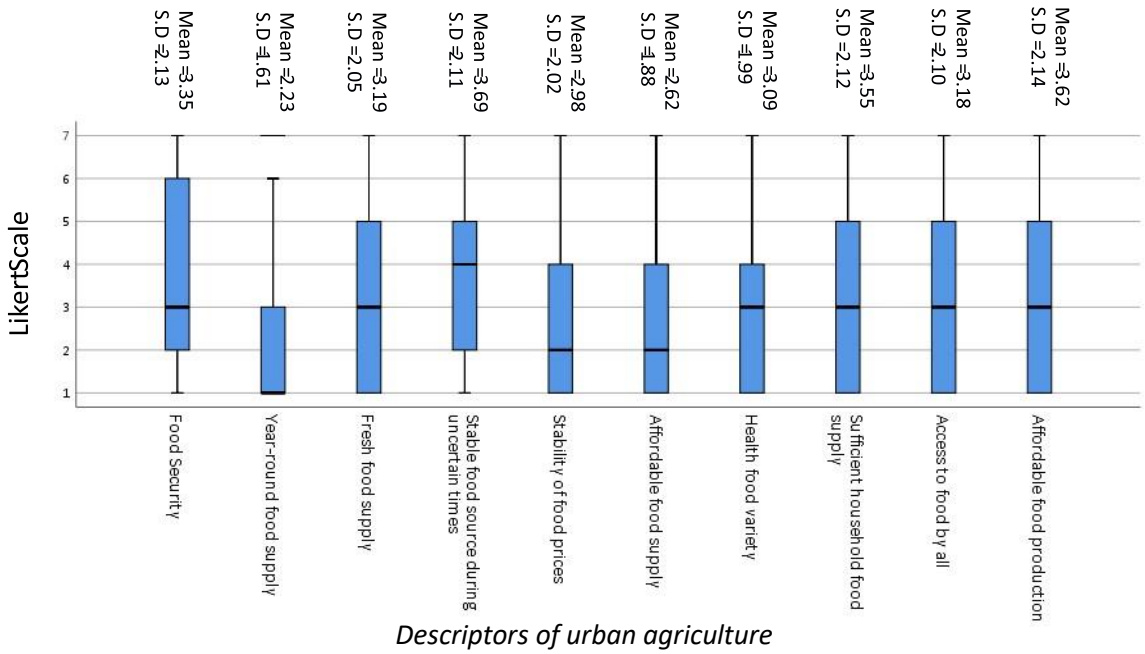

Figure 2: Boxplot showing mean and Standard Deviation of Respondent's description of urban agriculture

To understand the relationship between urban agriculture and its determinants, multiple linear regression was selected as a method of analysis. The model works under the assumption that the data is normally distributed. One-Sample Kolmogorov-Smirnov test was conducted to test for the normality of the data distribution. The data was found to be normally distributed for the frequencies of urban agriculture, social factors, economic factors, spatial factors, resource availability, institutional factors, and technological factors respectively.

The means and standard deviations of each variable are described in Figure 3. The standard deviations for the variables range from 1.091 to 1.549 indicating a low spread in opinions by the participants.

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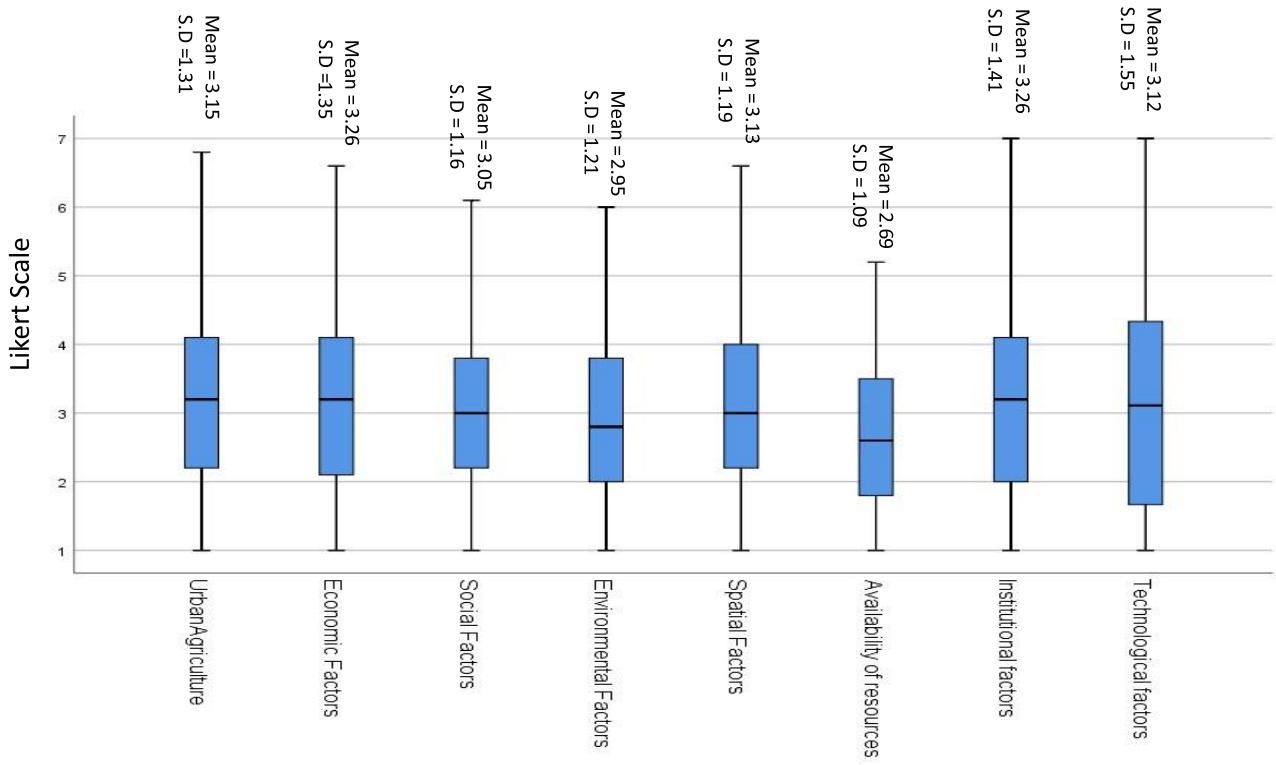

Figure 3: Boxplot showing mean and Standard Deviation of the determinants of urban agriculture

The correlation among explanatory variables was first tested using Pearson's correlation to check for multicollinearity. Environmental and social factors were found to be strongly correlated at 0.729 correlation. In the case of multi-collinearity, one of the variables should be eliminated or the two combined. Environmental factors were eliminated and social factors were retained.

The independent variables together account for 30.7 percent of the variance in urban agriculture as shown in Table 1. The multiple correlation coefficient value between all the factors and urban agriculture is 0.258 with a variance of 1.125.

Table 1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.554[a]	0.307	0.258	1.12483

a. Predictors: (Constant), Technological Factors, Economic Factors, Spatial Factors, Social Factors, Resource Availability, Institutional Factors

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The significance of the regression model was then tested by analysis of variance as shown in table 2. The significance (p-value) = 0.000. As $p < 0.05$, the regression line predicted by the independent variables explains a significant amount of the variance in urban agriculture ($F(6,86) = 6.339$, $P<0.05$). The significance of these findings lies in the validation of the regression model used to predict urban agriculture. The analysis of variance was employed to assess the significance of the regression model in predicting urban agriculture. The reported p-value of 0.000 indicated that there is a low chance of obtaining the observed results if the null hypothesis were true. In this context, the null hypothesis states that the independent variables have no significant effect on urban agriculture. The model's ability to explain a noteworthy portion of the variability in urban agriculture is further supported by the F-statistic ($F(6,86) = 6.339$), with a corresponding p-value below 0.05, indicating statistical significance. The model is considered statistically significant. The null hypothesis is therefore rejected.

Table 2: Analysis of variance of the regression model

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression Residual	48.121	6	8.020	6.339	.000[b]
Total	108.811	86	1.265		
	156.932	92			

a. Dependent Variable: urban agriculture

b. Predictors: (Constant), Technological Factors, Economic Factors, Spatial Factors, Social Factors, Resource Availability, Institutional Factors

Table 3 shows the correlation coefficient of the predictors of urban agriculture. Economic factors, social factors, and institutional factors are significant predictors of urban agriculture.

Table 3: Correlation coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.355	0.438		3.092	0.003
Economic Factors	0.365	0.101	0.379	3.633	0.000
Social Factors	0.274	0.121	0.243	2.264	0.026
Spatial Factors	0.013	0.116	0.012	0.110	0.913
Resource Availability	0.187	0.137	0.157	1.367	0.175
Institutional Factors	-0.222	0.109	-0.239	-2.026	0.046
Technological Factors	-0.019	0.097	-0.023	-0.196	0.845

a. Dependent Variable: urban agriculture

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urban agriculture = 1.355 + 0.365 Economic Factors + 0.274 Social Factors + 0.013 Spatial Factors + 0.187 Resource Availability – 0.222 Institutional Factors – 0.019 Technological Factors

4.0 Discussion

From the findings, residents understand urban agriculture as a tool to promote the availability of food, access to food, and its adequacy. Achieving food availability by providing fresh food supply all year long, supply of food during uncertain times, and contribution to the stability of food prices. Promoting access to food by all through affordable food production and supply. Promotion of food adequacy by providing a healthy food variety and sufficient food to households. Urban agriculture should be described by its contribution to food availability, access, and adequacy in urban areas. Although other literature argues for urban agriculture's contribution to urban food availability, access, and adequacy (Davies et al., 2021; de Oliveira et al., 2021; Tapia, 2021; Smit, 2016), the findings show that these aspects are intrinsic to urban agriculture. Theory should therefore encapsulate the measure of urban agriculture beyond its onsite benefits to include its contribution to food availability, access, and adequacy.

Economic and social factors are significant in explaining the likelihood of residents of Kidfarmaco Estate practicing urban agriculture. Economic factors include; employment creation, land productivity, and improved economy. Social factors include; food and health literacy, health and well-being, and recreational opportunities. Adequate space is required in the integration of urban agriculture into the urban fabric also needs to be identified and included in spatial plans (Chen et al., 2019; Ayambirea, 2019; Tóth & Timpe, 2017; Viljeon et al., 2015; Lovell, 2010). With the growing density in the study area (County Government of Kiambu, 2020), urban agriculture spaces also need to be preserved.

The municipality should provide extension services to urban farmers, and facilitate the stability of food prices through urban agriculture as a way of ensuring food availability. The municipality should avail extension services for farmers from the agricultural department. This may serve to educate urban farmers on resilient farming practices to ensure year-round food production against all weather conditions. Incentives to both developers and farmers may be used to encourage the conservation of urban agriculture spaces. Developers should be allowed to develop an extra floor if they choose to for building integrated agriculture construction. This includes the construction of buildings that can integrate indoor farming on one floor, rooftop farming, or both. Financial incentives to developers may also include lower approval fees for building integrated farming spaces.

Access to food through urban agriculture includes; affordable food production and supply. The county government and farmers' associations are best placed to aid this. The local government should ensure access to markets by farmers. Urban agriculture spaces should also be planned to be in a multi-functional context (production, recreation, and residential) to improve land

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productivity. Farmers associations should also develop a pool of employees from low-income groups within the areas of residents. These employees may be trained, for employment by farmers, creating employment within the neighborhoods.

Urban agriculture provides a healthy food variety, sufficient for households. To facilitate this, the municipality may provide a wider variety of seedlings to farmers, which will ensure the produce will be able to meet the dietary needs of the resident population. Farmers associations may also monitor urban agriculture production by their farmers, to identify challenging and successful practices. Land productivity for urban agriculture should also be maximized by the practice of intense farming practices such as; vertical farming and hydroponics.

5.0 Conclusion

In conclusion, the study of urban agriculture and its determinants in Kidfarmaco estate, Kikuyu Town has shed light on the factors that affect the adoption of urban agriculture by residents. This study underscores residents' understanding of urban agriculture as being synonymous with food availability, access, and adequacy for residents. Economic, social, and institutional factors are the most significant in the likelihood that the residents would adopt the practice.

Planning strategies for urban agriculture should be done to attain food availability, access, and adequacy within the context of sustainable development. To ensure its success; the economic and social factors of urban agriculture must prevail. For ease of implementation, these strategies should conform to the legal framework; and be in line with the municipal, county, and national spatial plans. Further research needs to be carried out in other parts of Kikuyu Town to find out whether there is a relationship between the findings of this study and those of residential areas in other parts of Kikuyu Town.

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6.2 General acknowledgement

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6.3 Declaration of interest

None

6.4 Conflict of interest

None

7.0 References

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