Factors associated with urban and sub-urban communities in implementing urban agriculture: a case study in Central Java

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Abstract. The development of the agricultural sector often faced with various problems, one of which is the widespread land conversion that occurs in urban and suburban areas. One way to overcome the problem of decreasing land area is to develop urban agriculture. This study aims to assess the adoption of urban agriculture practices in urban and suburban communities, analyze their interest in implementing these practices, and identify the factors that influence this interest. Utilizing descriptive the research reveals that suburban communities exhibit a higher interest in urban agriculture compared to urban communities. An ordinal logistic regression model was used to to analyze the factors that influence interest in implementing urban agriculture. Key factors influencing this interest include education level, which has a negative impact; income level and land area, both of which positively influence interest. Interestingly, age does not significantly affect the willingness to adopt urban agriculture. By enhancing community awareness and improving accessibility could further promote urban agriculture adoption, particularly in suburban areas.

1 Introduction

The agricultural sector plays a significant role in developing the Indonesian economy. Its strategic importance includes providing food, especially for the Indonesian population, supplying raw materials for industry, and driving growth in other economic sectors [1]. The development of the agricultural sector often encounters various problems, one of which is the widespread conversion of land. Continuous conversion of agricultural land has a negative impact on food security, which, if not addressed immediately, could lead to a food crisis [2].

Agricultural Statistics Data for 2017-2021 shows that the trend of agricultural land area in Indonesia is decreasing from year to year. In 2012, Indonesia had an agricultural land area of 39,587,740 ha. However, in 2019, the agricultural land area in Indonesia was reduced to only 36,817,086 ha. One of the impacts of land conversion is a decrease in rice production in Central Java Province. This is due to the reduced rice harvest area from 1,696,712.36 ha in 2021 to 1,688,670 ha in 2022.

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Land conversion often occurs due to dense population, particularly in urban areas. According to the Central Statistics Agency (BPS), in 2020, 56.7% of Indonesia's population lived in urban areas, projected to rise to 66.6% by 2035 [3]. The characteristics of an area can be observed through its land use. When agricultural land use exceeds 75%, it indicates rural characteristics. If agricultural land use ranges from 25% to 75%, it reflects a blend of urban and rural influences (sub-urban). If agricultural land use is less than 25%, it signifies urban characteristics [4]. According to data from the Environmental Service, rice fields in Surakarta have been removed due to low productivity and converted for various purposes, clearly categorizing Surakarta as an urban area. Conversely, in 2022, rice fields in Sukoharjo Regency covered 20,514 hectares (43.96% of the area of Sukoharjo Regency), indicating characteristics of a sub-urban area.

Surakarta has evolved into a dynamic city dominated by residential areas, with minimal remaining agricultural land, thereby classified as urban [5]. The declining agricultural land in Surakarta suggests that the city's food supply increasingly relies on surrounding buffer areas, including Sukoharjo Regency. Situated on the outskirts of Surakarta, Sukoharjo Regency is intertwined with urbanization activities in the city. Given the region's transitional phase, the ongoing trend of land conversion in Sukoharjo Regency underscores the need for proactive measures. The diminishing agricultural land in Sukoharjo Regency challenges sustaining food production and meeting the population's needs [6].

Addressing the issue of diminishing land area, one viable solution is to promote urban agriculture. Utilizing limited urban land, such as yards and rooftops, urban agriculture can mitigate the negative impacts of land conversion. It provides city residents with direct access to fresh produce while reducing carbon emissions and improving air quality. Moreover, urban agriculture raises awareness about the importance of preserving agricultural land amidst rapid urbanization. By encouraging community engagement in these practices, we can uphold agrarian values and foster more sustainable communities. Research on community-led urban agriculture initiatives has been conducted by Challa & Mansingh, 2015 [7]; Ngahdiman *et al*., 2017 [8]; Nguyen *et al*., 2020 [9] and Aningtyaz *et al*., 2020 [10]. Studies analyzing factors influencing public interest in agriculture include research by Muhammad *et al*., 2016 [11]; Marza *et al*., 2020 [12]; and Dewi *et al*., 2021 [13]. However, research on factors influencing interest in implementing urban agriculture still needs to be available. This study aims to analyze urban agriculture practices and identify factors influencing public interest in implementing urban agriculture in urban and sub-urban settings.

Therefore, this research investigated the factors influencing interest in urban agriculture among Surakarta City and Sukoharjo Regency communities. The objectives of this study are: 1) to assess the adoption of urban agriculture practices by urban and sub-urban communities, 2) to analyze the level of interest among urban and sub-urban communities in implementing urban agriculture, and 3) to identify the factors that influence this interest.

2 Methods

2.1 Location Determination Method

The research locations were purposively selected. According to Igga *et al*., 2019 [14], determining the location deliberately is determining the sample area taken deliberately based on specific considerations by the research objectives. Surakarta and Sukoharjo Regency were chosen as research locations because Surakarta City is an urban area that functions as a growth center for its supporting area, namely Sukoharjo Regency. Sukoharjo Regency is a peri-urban/sub-urban area affected by the external development of Surakarta City [15].

2.2 Sampling Technique

The sampling method in this research uses a purposive sampling method. The sample comprised Surakarta City and Sukoharjo Regency residents engaged in urban agriculture. 100 respondents were surveyed, evenly distributed with 50 respondents from each location. The sampling process involves identifying key informants who provide information related to urban farming communities in Surakarta City and Sukoharjo Regency. Primary data, collected through questionnaires, included respondents' demographic information and details on urban agriculture practices. Secondary data encompassed general descriptions of urban agriculture in both areas.

2.3 Data Analysis Method

Descriptive analysis was used to evaluate the application of urban agriculture and interest levels. The factors influencing urban and sub-urban communities' interest in implementing urban agriculture were analyzed using ordinal logistic regression. Ordinal logistic regression analysis is a statistical method that describes the relationship between a response variable (Y) and several predictor variables (X) where the response variable has more than two categories and the measurement scale is level [16]. The research's response variable (Y) is public interest, which is one of the psychological aspects characterized by a feeling of liking or being attracted to the implementation of urban agriculture, analyzed using ordinal logistic regression with three level response categories: less interested, quite interested and very interested. The predictor variables (X) in this research are age (X1), education level (X2), income level (X3), and land area (X4). Educational level refers to the formal learning process that an individual undergoes, expressed in years. Income level refers to the total monthly household income derived from both primary and secondary jobs expressed in IDR/month. Land area refers to the size of vacant land or yard used for implementing urban agriculture expressed in m². Specifically, the ordinal logistic model can be stated as below :

$$P(Y \leq j|X) = \theta_j + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + e$$

2.3.1 Assumptions of Ordinal Logistic Regression

Ordinal logistic regression has one crucial assumption, that there are no cases of multicollinearity. Multicollinearity can be assessed using the Variance Inflation Factor (VIF). A VIF value greater than 10 indicates multicollinearity, whereas values below 10 indicate its absence.

2.3.2 Goodness of Fit

The goodness of fit test is a feasibility test of a model to find out whether the model formed is correct or not. This test used the Deviance test statistic by looking at the Chi-Square value. The logit model is appropriate if the significance value is less than 0.05 ($\alpha < 0.05$).

2.3.3 Parameter Significance Test

The significance test consists of two stages, namely joint and partial. The likelihood ratio test (G test) is a significance test to see the influence of the independent variable on the dependent variable together/simultaneously in the logistic regression model. The criteria for concluding the G test are carried out by comparing the significance value (p-value) with the actual level

(α). If the p-value ≤ α (0.05), then H0 is rejected, meaning there is at least one significant parameter, so a partial test is carried out.

The Wald test is a test of the parameters of a logistic regression model which aims to determine the magnitude of the influence of predictor variables and response variables partially/individually. The criteria for concluding the Wald test are carried out by comparing the significance value (p-value) with the actual level (α). If the p-value ≤ α (0.05) then H0 is rejected, where the predictor variable has a significant effect on the response variable partially.

2.3.4 Model Interpretation

Model interpretation can be done by looking at the odds ratio value. Odds represent the ratio of the probability of success to the probability of failure [17]. This value is used to explain the ordinal logistic regression coefficient, which compare the trend levels of two or more categories of an independent variable against a reference category.

3 Result and Discussion

3.1 Demographic Characteristics of the Respondents

Most respondents in both regions belong to the 45-59 age group (pre-elderly), with an average age of 56 years in Surakarta City and 53 years in Sukoharjo Regency. Most respondents in both locations were female. Research participants in Surakarta City and Sukoharjo Regency demonstrated awareness of the importance of education, as evidenced by a majority having completed education up to high school/equivalent or tertiary levels. In Surakarta City, most respondents work as entrepreneurs, whereas in Sukoharjo Regency, they are predominantly housewives. The average monthly household income is IDR 4,028,000 in Surakarta City and IDR 4,825,200 in Sukoharjo Regency.

Table 1. The demographic characteristics of the respondent.

Variables	Category	Frequency	
		Surakarta	Sukoharjo
Age	25-44	7	11
	45-59	22	23
	60-64	8	8
	≥65	13	8
	Average	56	53
Gender	Male	7	4
	Female	43	46
Education	Primary school	5	6
	Junior high school	10	9
	Senior high school	17	18
	Bachelor	18	17
Occupation	Housewife	15	23
	Civil Servant	0	1
	Teacher	3	2
	Private employee	5	5
	Self-employed	19	13
	Labor	2	2
	Pensionary	6	4

Income	≤ 2.000.000	10	10
	2.000.001-5.000.000	31	22
	5.000.001-10.000.000	6	16
	10.000.001-15.000.000	1	1
	15.000.001-20.000.000	2	1
	Average	Rp4,028,000	Rp4,825,200

Sources: Primary data

3.2 Urban Agriculture in The Study Area

The agricultural conditions in Surakarta City and Sukoharjo Regency are quite different, despite their proximity. Surakarta, an urban area, lacks agricultural land and relies on Sukoharjo for food. Sukoharjo, known as the "national rice barn," primarily produces food crops like rice. However, the area dedicated to rice cultivation is decreasing due to ongoing land conversions. The different background conditions of urban and suburban communities also influence the implementation of urban agriculture in Surakarta City and Sukoharjo Regency. The differences in implementing urban agriculture can be seen in the objectives, institutions involved, techniques employed, cultivated commodities, and the benefits obtained. The institutional aspect is the most visible difference in urban and suburban communities' implementation of urban agriculture. The urban agricultural institution refers to the organizational patterns of the surrounding population, where there are rules of behavior and social relationships among the community in implementing urban agriculture. These institutions aim to facilitate the necessary activities for urban agriculture.

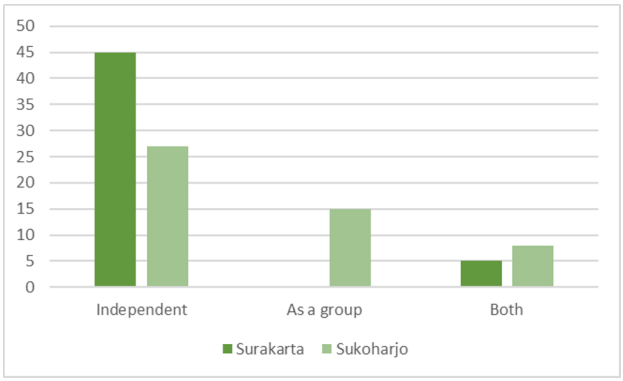

Fig. 1. Agricultural implementation in Surakarta City and Sukoharjo Regency.

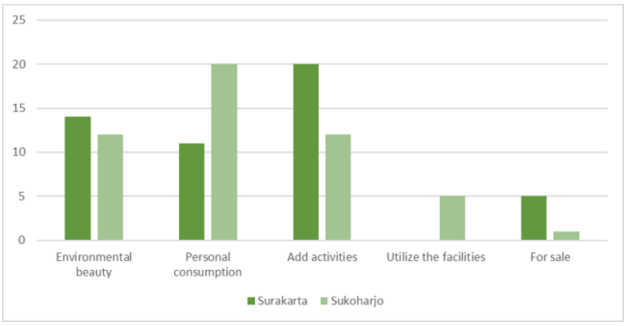

Fig. 2. The objectives of implementing urban agriculture in Surakarta City and Sukoharjo Regency.

Based on Fig. 1, urban communities in Surakarta City implement urban agriculture independently in private yard areas, whereas in Sukoharjo Regency, it is done individually and in groups on shared land. Each community naturally has different goals in implementing urban agriculture. These goals vary for urban and suburban communities, including preserving the environment, personal consumption, engaging in activities, utilizing facilities, and selling produce. Fig. 2 indicates that the goals of implementing urban agriculture for environmental health in Surakarta are higher than in Sukoharjo. This is because urban areas are more vulnerable to air pollution due to high population mobility, making the planting of crops important for reducing carbon emissions in the surrounding environment. Most urban communities in Surakarta City undertake urban agriculture to engage in activities during their free time, which includes not only cultivation but also socialization and training within the local community. In contrast, suburban communities in Sukoharjo Regency primarily aim for personal consumption to save on food expenses. The aim of utilizing facilities such as communal land is more commonly found in Sukoharjo because there is limited communal agricultural land in Surakarta. Furthermore, residents in Surakarta are more focused on selling their harvests, as urban populations tend to have less free time to manage their produce due to their busy schedules compared to those in Sukoharjo.

In Surakarta City, institutional conditions could be more optimal due to the busyness of urban community members with work. This results in neglect of shared land designated for urban agricultural cultivation. According to Fig. 3, the land is often overgrown with weeds and wild plants, leading to minimal harvests. Conversely, institutions in Sukoharjo Regency operate effectively, with community members working together to maintain cultivated plants according to their scheduled tasks.

Fig. 3. Condition of urban agriculture in Surakarta City.

Fig. 4. Condition of urban agriculture in Sukoharjo Regency.

The presence of urban agricultural institutions in Sukoharjo Regency has several positive impacts, including the maintenance of shared agricultural land (Fig. 4), abundant harvests that can be sold, and faster dissemination of information within the community. Moreover, technologies supporting urban agriculture, such as automated irrigation systems for chili plants (as shown in Fig. 5), can be quickly adopted. The most commonly cultivated plants in both locations are vegetables like chilies, eggplants, tomatoes, and catfish farming (as depicted in Fig. 6).

Fig. 5. Cultivation of chili plants in urban agriculture.

Fig. 6. Catfish cultivation in urban agriculture.

3.3 Communities Interest in Implementing Urban Agriculture

The level of interest of urban and suburban communities will affect how urban agriculture is technically implemented. Interest in implementing urban agriculture in this study is divided into three levels: very interested, quite interested and less interested. The level of interest in this study refers to the extent to which respondents have implemented urban agriculture in their environment, assessed through their level of interest and involvement in environmental initiatives related to urban agriculture.

Table 2. Interest in implementing urban agriculture in Surakarta City and Sukoharjo Regency.

Category	Interval	Frequency	
		Surakarta	Sukoharjo
Less interested	2.00 – 3.33	8	7
Quite interested	3.33 – 4.66	12	5
Very interested	4.66 – 6.00	30	38
Total		50	50

Sources: Primary data

Respondents in both locations were mainly very interested in implementing urban agriculture, with 30 respondents in Surakarta City and 38 in Sukoharjo City based on Table 2. More research respondents who were less interested in implementing urban agriculture were found in Surakarta City compared to Sukoharjo Regency. This is because most of the time respondents in Surakarta City spend on work while most respondents in Sukoharjo Regency are housewives who have a lot of free time to implement urban agriculture in their environment.

3.4 Factors Affecting Urban and Suburban Communities' Interest in Implementing Urban Agriculture

The research variables have been tested for conditions, namely the multicollinearity test. The results obtained were that there were no cases of multicollinearity so that the analysis could be continued. The results of ordinal logit model are presented in Table 3.

Table 3. Results of the analysis of the influence of independent variables on the interest of urban and sub-urban communities in implementing urban agriculture.

Variable	Estimasi	Std. Error	Wald	df	Sig.	Odds Ratio
Y1	10.158	6.530	2.420	1	0.120	25796.65
Y2	11.387	6.551	3.022	1	0.082	88168.06
X1	0.715 ns	0.956	0.559	1	0.455	2.044
X2	-2.073**	0.969	4.577	1	0.032	0.126
X3	0.839**	0.383	4.805	1	0.028	2.314
X4	0.913***	0.226	16.361	1	0.000	2.492
Likelihood- ratio					0.000	
Deviance					0.997	
Pseudo R-Square:						
Nagelkerke	0.275					
Total Observations	100					

Sources : Primary data

Where,

*** : significant at α = 99% (0.01)

** : significant at α = 95% (0.05)

ns : not significant

3.4.1 Model Feasibility Test

Table 3 shows that the significance value is 0.996, which means it is more significant than α (0.05). Therefore, it can be concluded that the logit model obtained is suitable for use.

3.4.2 Likelihood Ratio Test

The results of the likelihood ratio test (G test) in Table 3 show that the significance value obtained is 0.000 which is smaller than α (0.05). Therefore, it can be concluded that the variables of age (X1), education level (X2), income level (X3) and land area (X4) affect the interest of urban and suburban communities in implementing urban agriculture (Y) simultaneously.

3.4.3 Wald test

Based on the results of the Wald test in Table 3, it is known that not all independent variables affect the interest of urban and suburban communities in implementing urban agriculture. Variables that significantly affect the dependent variable are education level, income level and land area. The results of the Wald test form 2 logit models as follows:

$$\text{Logit (Y1)} = 10.158 - 2.073X2 + 0.839X3 + 0.913X4$$

$$\text{Logit (Y2)} = 11.387 - 2.073X2 + 0.839X3 + 0.913X4$$

The age variable (X1) has a sig value of 0.455 > α (0,05). This means that age partially does not have a significant effect on the interest of urban and suburban communities in implementing urban agriculture. These results are in accordance with research by Aningtyaz *et al*., 2020 [10] that the age factor does not affect interest. This is because the community's overall ability is almost the same in implementing urban agriculture and urban agricultural cultivation is a job that is not too complicated and does not require special skills.

The education level variable (X2) has a sig value of 0.032 <α (0.05), so it has a negative effect on the interest of urban and suburban communities in implementing urban agriculture. The regression coefficient of -2.073 can be interpreted that if community education increases by 1 unit, it will reduce the odds ratio of the opportunity for community interest in implementing urban agriculture by 207.63%. The odds ratio value for the education level variable (X2) is 0.126. This value shows that people with higher education tend to be interested in implementing urban agriculture 0.126 times lower than people with low education. This condition is in line with Yamin *et al*., 2023 [18] that formal education significantly influences interest in agriculture. Highly educated people tend to have little leisure time due to being busy with work. On the other hand, individuals with lower education levels tend to have more free time due to their limited skills for employment.

The income level variable (X3) has a sig value of 0.028 < α (0.05). It means that income level positively affects the interest of urban and suburban communities in implementing urban agriculture. The regression coefficient of the income level variable (X3) of 0.839 can be interpreted that if people's income increases by 1 unit, it will increase the odd ratio of the opportunity for people's interest in implementing urban agriculture by 83.9%. The odd ratio value of the income level variable (X3) is 2.314. This value means that people with higher incomes tend to be interested in implementing urban agriculture 2.314 times higher than people with lower incomes. The higher the income of the community, the more leisure time they have to engage in urban agriculture. This is consistent with Sahara *et al*., 2023 [19], who stated that higher income increases leisure time, whereas lower income reduces or eliminates leisure time and increases work activities.

The land area variable (X4) has a sig value of 0.000 <α (0.01) so that it affects the 99% confidence level where has a positive effect on the interest of urban and suburban communities in implementing urban agriculture. The regression coefficient of the land area variable (X4) of 0.913 can be interpreted that if the land area owned by the community increases by 1 unit, it will increase the odd ratio of the opportunity for community interest in implementing urban agriculture by 91.3%. The odd ratio value of the land area variable (X4) is 2.492, which means that people with more land tend to be interested in implementing urban agriculture 2.492 times higher than people with narrow land. These results are in accordance with Emilia *et al*., 2017 [20] which states that land area significantly affects community interest. The wider the land the community owns, the more it affects the interest in implementing urban agriculture.

3.4.4 Coefficient of Determination

Based on Table 3, it is known that the Nagelkerke determination coefficient value of 27.5% means that the independent variables of age, education level, income level, and land area influence public interest in the implementation of urban agriculture in general by 27.5% while 72.5% is influenced by other factors not included in the model.

4 Conclusion

This study indicates that there are differences in the implementation of urban agriculture by urban and suburban communities, both in terms of institutional implementation and the objectives of implementation. Suburban communities in Sukoharjo Regency are more interested in implementing urban agriculture than urban communities in Surakarta City. The variables of education level has a negative effect, income level and land area have a positive

effect. In contrast, age variables do not significantly affect the interest of urban and sub-urban communities in implementing urban agriculture. The Surakarta City government and Sukoharjo Regency need to utilize green open spaces as urban agriculture areas through technological innovations and actively hold competitions among farmer groups or urban agricultural communities to enhance public interest and awareness of urban agriculture. Additionally, urban and suburban communities should establish organizational structures for sustainability. Future research should consider additional internal factors that affect interest in urban agriculture.

We acknowledge special thanks to Universitas Sebelas Maret for supporting this research.

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