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ASSOCIATIONS OF URBAN FARMING PRACTICE CHARACTERISTICS AND SOCIOECONOMIC FACTORS WITH HOUSEHOLD FOOD SECURITY STATUS AMONG URBAN FARMING PRACTITIONERS IN PEKANBARU, INDONESIA

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Abstract

Urban farming practices in Pekanbaru City vary in land area, cultivation technology, crop diversity, and production output. Their relationship with household food security needs to be examined alongside socioeconomic conditions. This study aimed to describe urban farming practice characteristics, household socioeconomic conditions, and food security status based on food access, as well as to analyze the associations among these variables. A cross-sectional survey was conducted among 97 urban farming households selected from the 2024 sampling frame of 2,486 registered urban farming practitioners, with proportional allocation across 14 districts. Data were collected from July to mid-August 2026. Urban farming characteristics included land area, cultivation technology, number of crop types, harvest frequency, and average production, while household income and household size were included as socioeconomic factors, with income entered as a five-category ordinal variable. Food security status was assessed using an adapted Household Food Insecurity Access Scale (HFIAS) referring to experiences during the previous 30 days. Operationally, scores of 0–1 were classified as food secure, while scores of 2–27 were classified as food insecure. Data were analyzed using descriptive statistics and hierarchical binary logistic regression, supported by diagnostic and sensitivity analyses. Most respondents primarily engaged in urban farming for commercial purposes, with 84 respondents (86.6%) identifying sales as their main objective and 90 respondents (92.8%) primarily selling their harvest. Semi-modern cultivation technology was used by 51 respondents (52.6%). Based on the operational classification, 59 households (60.8%) were food secure, while 38 (39.2%) were food insecure. The full regression model was statistically significant compared with the intercept-only model ($\chi^2 = 29.207$; df = 8; $p < 0.001$), with a Nagelkerke R^2 of 0.352, an area under the curve (AUC) of 0.802, and a classification accuracy of 69.1%. Household income was the only statistically significant predictor in the main model (OR = 0.230; 95% CI: 0.098–0.541; $p < 0.001$). Adding urban farming practice indicators after accounting for income and household size did not significantly improve model fit ($\Delta\chi^2 = 8.174$; df = 6; $p = 0.226$). These findings indicate that household income had a clearer association with food access experiences than the additional technical practice indicators in the model. However, the cross-sectional design and adapted measurement instrument limit causal interpretation and comparability with standard HFIAP prevalence estimates. The findings suggest the importance of tailoring urban farming support to farmers' business orientations, strengthening economic record-keeping, and improving food access measurement.

Keywords: Food access, HFIAS, logistic regression, Pekanbaru, socioeconomic factors, urban farming.

INTRODUCTION

Urban farming is the cultivation of food crops and horticultural plants in urban areas, using yards, vacant land, and other available spaces. Urban farming practices vary in land area, cultivation technology, crop types, harvest frequency, and production volume. Besides being a productive activity, urban farming can benefit households economically through the sale of crops and can support household food needs through the consumption of self-grown products. Household food security depends on a household's ability to obtain enough food to meet its needs. In urban settings, access to food is determined not only by food availability but also by households' economic capacity to meet their consumption needs. Household income and household size are relevant factors because they relate to purchasing power and the quantity of food required. Urban farming therefore does not necessarily benefit all households equally, given differences in business objectives, production capacity, sales orientation, and the socioeconomic conditions of each practitioner (Huq and Deacon 2025). Urban farming can affect food security

through several pathways. Households that consume their own crops may reduce part of their food expenditure, while households that sell their produce can earn income to purchase food. These benefits, however, depend on cultivation practices and household economic conditions. In commercially oriented operations, higher production does not automatically mean that household food needs are met, especially when most of the harvest is sold and the income earned is insufficient to cover household needs.

Pekanbaru is a relevant setting for examining this relationship because urban farming is practiced by households with diverse characteristics and goals. Some practitioners farm to earn income, while others farm to meet family needs or for other purposes. This diversity shows the importance of assessing urban farming practices together with socioeconomic factors when describing household food security status. Assessments that focus only on whether households cultivate risk overlooking differences in their ability to access food (FAO 2008; Payen et al. 2022).

Although urban farming may support food provision and income, quantitative evidence is still needed on how variations in urban farming practices and socioeconomic conditions are associated with access-based food security status among households of urban farming practitioners in Pekanbaru. This study examined land area, cultivation technology, number of crop types, harvest frequency, and average production, while accounting for household income and household size. Food security status was assessed using an adapted Household Food Insecurity Access Scale (HFIAS), based on food access experiences over the previous 30 days. The results therefore address the food access dimension and are not intended to represent all dimensions of food security (Anggrayni, Andrias, and Adriani 2015; Pradhan et al. 2024; Sekaran and Bougie 2016).

This study aims to describe the characteristics of urban farming practices, socioeconomic conditions, and access-based food security status among households of urban farming practitioners in Pekanbaru, and to analyze the associations of urban farming practice characteristics and socioeconomic factors with household food security status. The results are expected to provide empirical evidence on factors related to food insecurity and to inform local governments in designing cultivation support, economic assistance, and food interventions that better fit the conditions of urban farming households (Zezza and Tasciotti 2010).

LITERATURE REVIEW

Urban Farming and Household Food Security

Urban farming is food production carried out in or around urban areas using available resources and space. It ranges from household-scale cultivation for self-consumption to commercial production for sale. Differences in business scale, technology, crop types, and production goals lead to varied economic and food benefits for each household (Orsini et al. 2013; Rao et al. 2022).

In relation to food security, urban farming can contribute through direct consumption of the produce, reduced food expenditure, and income from crop sales. These contributions are not the same for every household. Households that prioritize consumption may gain direct benefits in the form of additional food, whereas market-oriented households depend more on the ability of their farming business to generate income that can be used to buy food.

Household food security has several dimensions: food availability, access, utilization, and stability. This study focuses on the access dimension, that is, households' experience of obtaining food with the resources they have. Participation in urban farming therefore cannot be interpreted directly as food security, because the ability to obtain food also depends on income, household needs, and how the produce is used.

Characteristics of Urban Farming Practices

The characteristics of urban farming practices describe the capacity and management of cultivation at the household level. In this study, they comprise land area, cultivation technology, number of crop types, harvest frequency, and average production. Each indicator may be related to food access status in a different way.

Land area determines the space available for cultivation and may affect production capacity. However, a larger area does not necessarily improve food access if productivity, business costs, or crop utilization differ. Cultivation technology may improve the efficiency of space use and plant management, but its adoption depends on investment capacity, skills, and operational needs (Septya et al. 2022).

The number of crop types reflects the diversity of cultivated commodities. Greater diversity may widen crop choices, although the benefit for food access depends on the type of crop and how it is used. Harvest frequency and average production indicate the continuity and volume of output. Higher production may support household consumption or increase sales revenue, but it does not automatically mean that household food needs are met.

The characteristics of urban farming practices therefore need to be analyzed together with socioeconomic conditions. This approach helps distinguish production capacity from a household's actual ability to obtain food.

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Socioeconomic Factors and Household Food Access

Socioeconomic factors play an important role in shaping a household's ability to obtain food. Household income is one of the main factors because it determines purchasing power in the food market. In sales-oriented urban farming, income can link business activity to the ability to meet food needs. However, income from cultivation does not always reflect a household's overall economic resources.

Household size is also relevant because it relates to the volume of consumption needs and the distribution of available resources. Larger households may face higher food needs, although this relationship is not uniform because of differences in household composition, income, and food sources.

Including income and household size in the analysis makes it possible to assess the association between urban farming practices and food access status while accounting for socioeconomic conditions. It also avoids attributing differences in food status solely to differences in cultivation techniques.

Measurement of Household Food Insecurity

Food security status can be assessed using various indicators, depending on the dimension of interest. One approach for measuring experiences of limited food access is the Household Food Insecurity Access Scale (HFIAS), which captures household experiences of anxiety about food supply, reduced quality of consumption, and reduced quantity of consumption due to limited resources (Coates, Swindale, and Bilinsky 2007).

This study used an adapted HFIAS that refers to household experiences over the previous 30 days. Because the instrument is an adaptation, the results must be interpreted in light of the question items and the study's operational classification rules. The results represent food access status based on respondents' reported experiences, not a comprehensive measurement of all dimensions of food security.

Experience-based indicators help show that food production and food access are distinct. A household may actively cultivate crops yet still face limited food access if its economic resources are insufficient to meet its food needs.

Previous Studies and Research Gap

Previous research has discussed the relationship between urban farming and food consumption, household expenditure, and household food conditions among urban farming practitioners. Barokah, Rahayu, and Antriyandarti (2023) surveyed 60 households in Surakarta to examine the contribution of urban farming to food expenditure and energy consumption. Anggrayni, Andrias, and Adriani (2015) examined food security status and coping strategies among urban farming households engaged in agriculture and fisheries in Surabaya. Both studies provide an overview of variations in household food conditions, but they differ from the present study in context and indicators.

In Pekanbaru, Septya et al. (2022) documented community service activities such as Warung Hidup and Budikdamber. Wijaya, Baliwati, and Anggraini (2022) summarized the various pathways through which urban farming contributes to food security in a systematic review. Poulsen et al. (2015) likewise emphasized the need for caution in interpreting the benefits of urban farming, because the quality of research designs and the magnitude of reported outcomes vary across studies.

Based on this comparison, the research gap lies in the lack of quantitative evidence on the associations of five urban farming practice characteristics and socioeconomic factors with food access status, measured with an adapted HFIAS, among households of urban farming practitioners in Pekanbaru. This study does not assume that urban farming has never been studied in Pekanbaru; rather, it focuses on a specific combination of variables, production indicators, and a more specific population context.

Conceptual Framework

Conceptually, urban farming practices may be related to food access status through the consumption of own produce, reduced food expenditure, and income from sales. These relationships may differ by land area, cultivation technology, number of crop types, harvest frequency, and average production. At the same time, household income and household size may be related to a household's ability to meet its food needs.

Based on this framework, this study analyzes the associations of urban farming practice characteristics and socioeconomic factors with household food security status. Income and household size were included so that the statistical contribution of cultivation practices could be assessed while accounting for these factors. Because the design is cross-sectional, the relationships found are interpreted as associations and not as causal effects.

METHOD

Research Design and Location

This study used a quantitative approach with a cross-sectional survey design. It was conducted in Pekanbaru City, Riau Province, to describe urban farming practices, socioeconomic conditions, and household food security status, and to analyze the associations among these variables. Field data were collected from July to mid-August 2026.

Population and Sample

The study population consisted of 2,486 urban farming practitioners engaged in food crop cultivation and horticulture who were listed in the 2024 sampling frame of the Pekanbaru City Food Security Office. The unit of analysis was the household of each listed practitioner. The sample size was determined using the Slovin formula with a 10% margin of error (n = 96.13, rounded up to 97 households). The sample was allocated proportionally across the 14 districts represented in the sampling frame.

Respondents were selected based on the following inclusion criteria: the household was listed in the sampling frame, resided in Pekanbaru City, was still actively cultivating at the time of the survey, and had an adult member who knew the farming practices and the household's food conditions. Households that were no longer actively cultivating, were outside the administrative area of Pekanbaru City, or had incomplete core data were excluded.

Data Collection and Research Variables

Primary data were collected through interviews using a structured questionnaire. The independent variables were five characteristics of urban farming practices (land area, cultivation technology, number of crop types, harvest frequency, and average production) and two socioeconomic factors (household income and household size). The dependent variable was household food security status based on food access experience. Household income refers to total monthly household income, not net income from urban farming, and was reported in five groups (coded 1–5): <IDR 2,000,000; IDR 2,000,000–3,999,999; IDR 4,000,000–5,999,999; IDR 6,000,000–7,999,999; and ≥IDR 8,000,000.

Measurement of Food Security Status

Food security status was measured using an adapted Household Food Insecurity Access Scale (HFIAS), which describes households' experiences of accessing food over the previous 30 days. The measurement covers anxiety about food supply and limited quality and quantity of consumption due to limited resources.

The adapted instrument was designed around nine food-access experience items, with a theoretical total score ranging from 0 to 27. The items were not identical to those in the standard HFIAS instrument. Scores were classified into two categories: households scoring 0–1 were categorized as food secure (code 0), and those scoring 2–27 as food insecure (code 1). This classification is an operational measure based on food access and does not cover all dimensions of food security. The thresholds of 0–1 versus 2–27 are the operational classification used in this study and have not been validated as standard HFIAP cut-offs; the results are therefore not presented as standard HFIAP prevalence estimates.

Data Analysis

Data were analyzed using descriptive statistics and hierarchical binary logistic regression. Descriptive statistics were used to describe respondent characteristics, urban farming practices, socioeconomic conditions, and the distribution of household food security status.

Binary logistic regression was used to analyze the associations of urban farming practices and socioeconomic factors with the likelihood of a household experiencing food insecurity. Model evaluation included the omnibus test, Nagelkerke R^2, the Hosmer–Lemeshow test, the classification table, the receiver operating characteristic (ROC) curve and area under the curve (AUC), the Wald test, and odds ratios with 95% confidence intervals. Additional checks covered linearity in the logit, outliers, inter-predictor correlation, the variance inflation factor (VIF), and tolerance.

Household income entered the main model as an ordinal variable with five ordered categories (coded 1–5), not as individual rupiah values. The odds ratio for income therefore represents the change in odds associated with a one-category increase, assuming a constant change in log-odds between adjacent categories; a dummy-variable specification was used as a sensitivity check. Sensitivity analyses compared the main model (Model A) with three

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alternative specifications: Model B, with income entered as dummy categories (reference: IDR 2,000,000–3,999,999); Model C, with a ln(1 + x) transformation of the highly skewed predictors (land area, harvest frequency, and production); and Model D, an ordinal logistic regression with three levels of severity (food secure, mildly food insecure, and moderately or severely food insecure combined). The significance level was set at 5% ($\alpha = 0.05$). Given the cross-sectional design, the results are interpreted as statistical associations rather than evidence of causal effects.

RESULTS AND DISCUSSION

Characteristics of Urban Farming Practices

This study involved 97 households of urban farming practitioners in Pekanbaru City. Cultivation practices were described by land area, cultivation technology, number of crop types, harvest frequency, and average production per harvest.

Table 1. Distribution of Characteristics of Urban Farming Practices

Indicator	Category	n	%
Land area	≤500 m²	15	15.46
	501–2,500 m²	28	28.87
	2,501–5,000 m²	20	20.62
	5,001–10,000 m²	15	15.46
	>10,000 m²	19	19.59
Cultivation technology	Traditional	32	32.99
	Semi-modern	51	52.58
	Modern	14	14.43
Number of crop types	1 crop type	55	56.70
	2–3 crop types	17	17.53
	4–5 crop types	9	9.28
	≥6 crop types	16	16.49
Harvest frequency	1–4 times/year	39	40.21
	5–12 times/year	24	24.74
	13–52 times/year	14	14.43
	>52 times/year	20	20.62
Average production	<100 kg/harvest	33	34.02
	100–499 kg/harvest	15	15.46
	500–1,999 kg/harvest	15	15.46
	2,000–9,999 kg/harvest	15	15.46
	≥10,000 kg/harvest	19	19.59

Source: Primary data processed, 2026.

As shown in Table 1, the most common land-area category was 501–2,500 m² (28 respondents; 28.87%). Most respondents used semi-modern technology (52.58%), and 55 respondents (56.70%) cultivated only one crop type. The most frequent harvest-frequency category was 1–4 times per year (40.21%), and 33 respondents (34.02%) had an average production of less than 100 kg per harvest.

The diversity in land area and production shows that the scale of respondents' farming is not uniform. The predominance of single-crop cultivation indicates that the range of commodities grown is relatively limited for most respondents. However, these characteristics alone cannot be used to infer household food security, because food access also depends on economic capacity and how the crops are used.

Household Food Security Status

Food security status was measured using an adapted HFIAS based on food access experiences over the previous 30 days. In this study, scores of 0–1 were categorized as food secure and scores of 2–27 as food insecure.

Table 2. Distribution of Household Food Security Status

Food security status	n	%
Food secure	59	60.82
Food insecure	38	39.18

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Total	**97**	**100.00**

Source: Primary data processed, 2026.

Table 2 shows that 59 households (60.82%) were classified as food secure and 38 households (39.18%) as food insecure. Thus, although food-secure households are the majority, more than one-third of the respondent households still experienced limited access to food under the study's operational classification.

This finding is important because urban farming does not automatically guarantee household food access. Most respondents farmed for sale, so the contribution of their farming to food access may depend on the income earned and on households' ability to buy food. The classification used here is an adaptation of the HFIAS and cannot be equated directly with the standard HFIAS/HFIAP classification.

Associations of Urban Farming Practices and Socioeconomic Factors with Food Security Status

Associations between variables were analyzed using binary logistic regression, with food insecurity as the modeled event. The model included the urban farming practice indicators, household income, and household size.

Table 3. Binary Logistic Regression Results

Variable	OR	95% CI	p-value
Land area	1.000	1.000–1.000	0.176
Modern vs. traditional technology	0.569	0.077–4.187	0.580
Semi-modern vs. traditional technology	2.391	0.681–8.393	0.174
Number of crop types	1.070	0.722–1.584	0.736
Frequency of harvest per year	0.996	0.967–1.026	0.795
Average production per harvest	1.000	1.000–1.000	0.173
Household income (ordinal code)	0.230	0.098–0.541	<0.001
Number of household members	0.919	0.606–1.395	0.692

Source: SPSS data processing results, 2026.

Note: OR = odds ratio; CI = confidence interval. Household income was entered as an ordinal code (1–5). The ORs for land area and average production are per-unit estimates (per m² and per kg per harvest) that are displayed as 1.000 (95% CI: 1.000–1.000) because of rounding to three decimals; very small per-unit changes in the odds are therefore not visible. This does not mean that the association is exactly zero.

Based on Table 3, household income is the only significant predictor in the main model. An OR of 0.230 indicates that a one-category increase in household income is associated with lower odds of food insecurity, holding the other predictors constant and assuming a constant change in log-odds between income categories. These results are consistent with the importance of economic capacity for household food access.

Meanwhile, land area ($p = 0.176$), cultivation technology (modern vs. traditional, $p = 0.580$; semi-modern vs. traditional, $p = 0.174$), number of crop types ($p = 0.736$), harvest frequency ($p = 0.795$), and average production ($p = 0.173$) were not significantly associated with food insecurity at the 5% level. Household size was also not significant ($p = 0.692$). These results do not mean that cultivation practices or household size are unimportant; they indicate only that the statistical evidence in this sample is insufficient to conclude that they are independently associated with food insecurity status.

Model Performance and Hierarchical Block Test of Urban Farming Practices

Table 4. Summary of Model Performance and Hierarchical Block Test

Indicator	Results
Full model Omnibus test	$\chi^2 = 29.207$; df = 8; $p < 0.001$
Nagelkerke R^2	0.352
Classification accuracy	69.1%
Sensitivity for food-insecure households	52.6%
Specificity for food-secure households	79.7%
AUC	0.802
Change in model fit after adding the practice indicator block	$\Delta\chi^2 = 8.174$; df = 6; $p = 0.226$

The omnibus test indicated that the full model fit significantly better than the intercept-only model. However, this does not mean that every predictor in the model is significant. The Nagelkerke R^2 of 0.352 is a pseudo-R^2 that indicates the model's relative explanatory strength; it is not interpreted in the same way as the coefficient of determination (R^2) in linear regression.

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The classification accuracy of 69.1% exceeded the baseline accuracy obtained by classifying all households into the majority category (60.8%). However, the sensitivity of 52.6% shows that the model correctly identified only about half of the food-insecure households. The AUC of 0.802 indicates good discrimination in the study data, but it is not evidence of performance in other populations because external validation was not carried out.

The hierarchical block test provided an important finding. The model containing only income and household size fit significantly better than the intercept-only model ($\chi^2 = 21.033$; df = 2; $p < 0.001$). However, adding the five urban farming practice indicators (six parameters) did not significantly improve model fit ($\Delta\chi^2 = 8.174$; df = 6; $p = 0.226$). Thus, there is insufficient statistical evidence that the practice indicators, as a group, contribute additional explanatory power for food insecurity status. Sensitivity analyses supported the same conclusions: income remained significantly associated with food insecurity in Model B (likelihood-ratio $\chi^2 = 22.042$; $p < 0.001$), Model C (OR = 0.240; $p < 0.001$), and Model D (proportional OR = 0.225; $p < 0.001$), while the practice indicator block remained non-significant ($p = 0.216$, 0.293, and 0.600, respectively). In Model B, the lowest income category (<IDR 2,000,000) contained only one household, so its coefficient could not be estimated stably.

Discussion

The main finding of this study is the association between household income category and food access status, whereas the urban farming practice indicators did not show a significant additional contribution once socioeconomic factors were taken into account. This finding can be explained by the economic access dimension of food security: households need not only food availability but also the ability to obtain food through purchase or other sources.

Most respondents farmed to sell their crops. Under these conditions, the benefit of farming for food access may depend more on business revenue and on the ability to use that income to buy food. However, this study did not measure net income from urban farming, production costs, sales value, or the proportion of the harvest consumed by the household. This mechanism is therefore a plausible explanation but was not tested directly.

The non-significance of land area, technology, number of crop types, harvest frequency, and average production does not mean that these indicators are unimportant for business sustainability. Physical production volume does not necessarily reflect net profit or direct contribution to household consumption: high production may entail high costs, and high harvest frequency may come from commodities with small yields per harvest. This is consistent with the correlations among predictors in the data: land area was positively correlated with production ($\rho = 0.705$), and harvest frequency was negatively correlated with production per harvest ($\rho = -0.706$).

In terms of policy, urban farming programs should emphasize not only increased production but also the economic viability of the business, cost and revenue recording, marketing, and the utilization of crops. Identifying low-income households may also help in setting priorities for economic assistance and food support. However, the model's sensitivity is not high enough for it to be used as the sole targeting tool.

This study has several limitations. First, the cross-sectional design cannot establish causal relationships. Second, food security was classified using an operational threshold based on an adapted HFIAS that has not been validated as a standard HFIAP cut-off, so the results are not comparable with standard HFIAP prevalence estimates; in addition, only total scores were available, so item-level responses and internal consistency could not be re-examined. Third, the sample was small relative to the number of model parameters: there were 38 food-insecure households for eight predictor parameters (about 4.75 events per parameter), which limits the stability of the coefficients and the precision of the confidence intervals (Riley et al. 2019). Fourth, household income was entered as five ordered categories and refers to total household income rather than net income from urban farming, so the pathway from sales to income to food access was not tested as a mediation; the lowest income category contained only one household. Fifth, the sampling frame consisted of urban farming practitioners registered with the Food Security Office in 2024, so the findings mainly represent the households of registered practitioners and may not describe unregistered practitioners or other cities. There was also no comparison group of households not engaged in urban farming. Future studies should measure net business income, production costs, food expenditure, and consumption of own crops, and consider longitudinal or comparison-group designs to assess the contribution of urban farming to food access more comprehensively.

CONCLUSION

This study found that household income was significantly associated with access-based food insecurity among urban farming households in Pekanbaru. Of the 97 surveyed households, 59 (60.82%) were classified as food secure and 38 (39.18%) as food insecure under the study's operational classification based on an adapted HFIAS instrument.

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In the main binary logistic regression model, household income was the only statistically significant predictor (OR = 0.230; 95% CI: 0.098–0.541; $p < 0.001$), whereas land area, cultivation technology, number of crop types, harvest frequency, average production, and household size were not independently associated with food insecurity at the 5% level. Adding the urban farming practice indicators after socioeconomic factors did not significantly improve model fit ($\Delta\chi^2 = 8.174$; df = 6; $p = 0.226$).

These findings are statistical associations rather than causal effects, given the cross-sectional design and the limitations of the adapted food-access measure. Urban farming support should therefore be accompanied by efforts to strengthen household economic capacity, including cost and revenue recording and improved marketing access. Future research should validate the operational classification and collect more detailed data on net farm income, production costs, food expenditure, and consumption of own crops, using longitudinal or comparison-group designs.

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