Can Smart Farming Become a Food Security Solution in Urban Areas?

Lilis S. Badriah[1*], Wiwiek R. Adawiyah[1], Zainal Abidin[2], Bambang A. Pramuka[1], & Istiqomah[1]

[1]Faculty of Economics and Business Universitas Jenderal Soedirman, Purwokerto, Central Java, Indonesia
[2]Department of Management, STEI Indonesia Jakarta, Jakarta Timur, Indonesia

Abstract

Ensuring adequate food security and managing limited urban land is essential due to the large population living in indigenous and migratory urban areas. In limited land, urban Farming has the potential to be a solution through the application of smart farming techniques. However, many people still need to be more hesitant to assess the potential of Smart Farming. Therefore, this study aims to assess the feasibility of the Smart Farming business and its impact on the economic welfare of farmer households. This study uses primary data from 9 Smart Farming farmers in Jakarta and its surroundings. The analysis methodology used includes Break Even Point Analysis for Production and Price, R/C ratio analysis, and proportion analysis. The study's findings show that Smart Farming activities in urban environments have a decent development opportunity. However, the contribution of Smart Farming to the family economy is still relatively low. However, good prospects for the development of smart farming businesses can motivate farmers to continue to improve their business performance so that the contribution of the business to the income of farmers' families will also increase. The findings of this study show that using smart farming techniques in urban environments can serve as a viable solution to improve food security in the community. In addition, Smart Farming activities can potentially encourage the improvement of the welfare of farmer families. Therefore, Triple Helix support is essential for smart agriculture's long-term success and sustainability in urban areas.

Keywords: Smart Farming, Urban Farming, Food Security, Business Feasibility, Family Economy.

1.0 Introduction

According to FAO, the global population is projected to reach 9.6 billion by the year 2050. Hence, there is a requirement for a 70% increase in agricultural productivity to adequately cater to the demands of a population of that magnitude (Budiharto, 2019). By 2030, over 5 billion individuals are projected to reside in urban areas (Avgoustaki & Xydis, 2020). Urban areas are regions that entice individuals to undergo urbanization. Urbanization leads to a change in the demand for food in cities, thus necessitating attention to the issue of food security in urban settings.

Urban Farming can be employed to establish food security in urban areas. Urban Farming can enhance food security, including availability, access to food, and quality (Bareja, B., 2010; Dubbeling, M. et al., 2010; Mougeot, 2010; Specht et al., 2014). This improvement aligns with the Neo-Malthusian Theory, which examines food security from a food production standpoint

* Corresponding author. E-mail address: lilis.badriah@unsoed.ac.id

[7][8]. Relocating food production to metropolitan areas with a high demand for food can effectively decrease greenhouse gas emissions and serve as a method of mitigating climate change. It is crucial to note that agriculture accounts for 20-30% of greenhouse gas emissions (Eigenbrod & Gruda, 2015). The economic impact of Urban Farming should be considered (Mok, H.F. et al., 2014). Urban Agriculture, also known as Urban Farming, can enhance food availability, health conditions, local economy, social integration, and environmental sustainability(Orsini et al., 2013). Urban Farming can be categorized as either subsistence or commercial, depending on the production scale (Sitawati. et al., 2019).

Smart Farming is a viable method for implementing Urban Farming. Nevertheless, the implementation of Smart Farming in Indonesia faces various challenges, including restricted technology accessibility, inadequate infrastructure, insufficient knowledge and skills among farmers to adopt Smart Farming technology, high costs associated with advanced technology, lack of government support for the development of Smart Farming technology, including training assistance, adequate funding, and infrastructure. Hence, in order to execute Smart Farming, it is imperative to establish a collaborative partnership among the government, academia, and the business sector, known as the Triple Helix. In addition, it is imperative to offer education and training to farmers, enhance their access to technology, and augment government assistance through policies and programs that promote the advancement of Smart Farming technology in Indonesia (Sari, A.M., 2023). Smart Farming can potentially engage the younger generation in agricultural operations (Nugroho et al., 2018).

Despite the existing challenges, implementing Smart Farming in Indonesia can address the food requirements of urban areas. This condition is due to the escalating urbanization phenomena in Indonesia. From 2011 to 2021, the urban population in Indonesia has consistently grown, accounting for an average of 50.44% of the total population each year. The burgeoning urban population necessitates a corresponding increase in food demand, requiring metropolitan regions to allocate more land for food production. Hence, updating and modernizing agricultural practices in urban regions is imperative. Smart Farming presents a promising potential for urban inhabitants to pursue as their primary source of income or as an additional source of revenue. This circumstance is consistent with Slabinski's assertion that urban agriculture offers economic, social, and environmental advantages (Slabinski, 2013).

Urban communities in the Jakarta area and its environs have implemented Smart Farming techniques in horticulture cultivation, namely for melons. They have engaged in Smart Farming practices for a year and have successfully harvested their crops. Nevertheless, there is still room for improvement in the enthusiasm among urban people to engage in Smart Farming. This is primarily due to their uncertainties over the potential outcomes of this practice and its influence on their household finances. Hence, this study was done to assess the commercial viability of Smart Farming practices in the City of Jakarta and its environs and to evaluate the impact of these practices on the household economy.

2.0 Research Methods

This study employed descriptive quantitative methodologies and was conducted in Jakarta and Depok regions, known for their significant engagement in smart farming practices, specifically in melon horticulture. The research sample consisted of nine melon growers who participated in Smart Farming as part of a cooperation with PT Alif Tekno Farm (ATF). This study includes all individuals in the population as research participants. Data collection at the horticulture

Smart Farming area involves the utilization of survey methodologies, recordkeeping, questionnaires for interviews, and direct observation.

An assessment of business viability can be conducted by examining various factors, such as production breakeven points (BEP), price breakeven points (BEP), return on investment (ROI), and business efficiency. Revenue-cost ratio computation can be employed to assess business effectiveness (Permana & Fauzy, 2017; Soekartawi, 2006). The efficiency of Smart Farming may be determined based on the R/C ratio. The activity is considered efficient if the R/C ratio is greater than 0. If the R/C ratio equals 0, the activity is in a breakeven point (BEP) condition. The activity is considered inefficient if the R/C ratio is less than 0.

The percentage formula is employed to assess the impact of Smart Farming on the household economy by determining the ratio of overall business income to the combined total of family income and spending. The contribution conditions are as follows: (a). The small percentage range is between 1% and 20% (b). The low percentage range is between 21% and 40% (c). The percentage is medium range, specifically between 41% and 60%; (d) The percentage range is high, specifically between 61% and 80%; (e). The percentage range is very high, between 81% and 100% (Sumantri. & Ansori, 2004).

3.0 Results and Discussion

3.1 Description of Smart Farming Business

Respondents in this study consisted of nine Smart Farming melon farmers. They are domiciled in Jakarta and surrounding areas, such as Kebon Baru, Kampung Melayu, Parung, Depok, Pasar Minggu, and Jagakarsa. They are male, married, and in the productive age category with a range of 30 years – 42 years. Their lowest education is high school, and the highest is a bachelor's degree. All respondents do the melon Smart Farming business as a side job, while the main jobs were relatively varied, such as market laborers, city transport drivers, school office assistants, teachers, traders, and online drivers. Respondents' time in the Smart Farming business varies between 4 and 12 months.

Innovative Farming farmers engage in their activities thrice daily, each lasting approximately 30 to 40 minutes. The tasks undertaken during the melon plant's growth include seed sowing, transplanting seedlings into polybags, monitoring fertilizer and water levels, pollination, and harvesting.

The typical duration from seed sowing to harvest is around three months. Therefore, the length of one production cycle is three months. The mean melon yield for each harvest is 50. Nevertheless, a single farmer has been attempting for 12 months. During the first three harvests, he achieved a yield of 50 melons per harvest. However, his yield increases to 100 melons in the fourth harvest period. This condition is due to the availability of extra funds, which allows for expanding the business size.

Smart Farming is implemented through a partnership with PT Alif Tekno Farm (ATF). This type of collaboration entails providing support for the Smart Farming approach. PT Alif Tekno Farm produces Smart Nutrition Valves (KNP) equipment that aids in implementing Smart Farming practices. Agricultural practitioners are provided with instructional resources to utilize the KNP application effectively.

According to the data provided by the respondents, it is evident that they require additional financial resources for their business. The capital needed to conduct a single production process is an average of IDR 900,000.00. Eight participants utilized their cash to meet these financial requirements, while one individual obtained capital through borrowing from their family. A respondent required capital of IDR 1,800,000.00 due to possessing a more significant amount of land than other farmers. The average land area of farmers is 20 square meters, with one farmer having 40 square meters. Regarding land ownership, eight farmers utilize their land, while one individual utilizes land that belongs to their family.

3.2 Smart Farming Business Analysis

3.2.1 Cost

Table 1 shows the average costs required in one production process. The data show that the most significant cost components are KNP equipment and labor depreciation. Other relatively large costs are land/ greenhouse rental and fertilizer.

Table 1: Average production costs in one production process (IDR)

No	Cost component	Total
1	Rent land/greenhouse	250,000
2	Depreciation of KNP equipment	500,000
3	Fertilizer	250,000
4	Water	50,000
5	Labor	500,000
6	Seed	90,000
	Total	1,640,000

3.2.2 Production

The Smart Farming melon production process takes an average of 90 days. Harvesting is done every 90 days (3 months). The duration of harvest time varies, from at least one harvest to a maximum of 4 harvests, depending on the time spent carrying out this business. The average number of melons obtained in one production process is 50 units.

3.2.3 Income

The results of the Smart Farming business produce melons, all of which are sold. Five people sell their products to collectors for IDR 50,000.00 per piece, and four sell them directly to consumers at IDR 60,000.00 per piece. The selling price to collectors is lower than the selling price to direct consumers. The average total income from the Smart Melon Farming business is IDR 2,750,000.00 for each production process. Income from the Smart Melon Farming business is a side income. Each respondent has income from their primary job. The amount of basic income varies relatively. Farmers' income based on their primary occupation can be seen in Table 2.

Based on the data in Table 2, the majority of Smart Farming farmers had a total income exceeding the Regional Minimum Wage (UMR) in 2023, both in DKI Jakarta (IDR.

4,901,798.00) and Depok City (IDR. 4,694,494.00). However, market workers and city transport drivers are still below the minimum wage.

Table 2: Farmer Income Based on Main Work (IDR/month)

No	Type of work	Main income	Average Smart Farming income	Total income
1	Market workers	1,800,000	2,750,000	4,550,000
2	Online motorcycle taxi	2,300,000	2,750,000	5,050,000
3	City transport driver	1,800,000	2,750,000	4,550,000
4	School Office Boy	3,000,000	2,750,000	5,750,000
5	Trader	5,000,000	2,750,000	7,750,000
6	Teacher	4,000,000	2,750,000	6,750,000

3.2.4 Feasibility

Table 3 shows the feasibility of a melon smart farming business with indicators of Production Breakeven Point (BEP), Price BEP, Return on Investment, and Business Efficiency.

Table 3: Results of Feasibility Analysis of Smart Farming Melon Fruit

Indicators	Formulas	Calculation	The calculation results	Real value	Information
Production BEP	The ratio of total costs to selling price	IDR 1.640.000/ IDR 55.000	30 melons	50 melons	Feasible
Price BEP	The ratio of total costs to the amount of production	IDR 1.640.000/ 50	IDR 32.800	IDR 55.000 per melon	Feasible
ROI	The ratio of total profit to total capital	(IDR 1.110.000 /IDR 900.000) x 100%	123,33%	> 100%	Feasible
Efisiensi Usaha	The ratio of total revenue to total costs	IDR 2.750.000/ IDR 1.640.000	1.68	>1	Efficient

Based on the calculation of business feasibility indicators, as shown in Table 3, it can be seen that the smart melon farming business is worth developing. The production's actual value and price are more significant than its BEP value. The same condition has been seen in ROI. The ROI figure is > 100%. It means that every Rp100.00 invested in Melon Smart Farming business activities will provide a profit of Rp123.33. It shows that the level of investment invested in the Melon Smart Farming business can provide more significant profits than its business capital. Judging from the business efficiency indicator, it can be seen that the value of the benefit-cost ratio is 1.68. It means that every expense of Rp1000.00 will provide an income of Rp1,680.00. This condition illustrates that the melon Smart Farming business is feasible to be developed**.**

The business feasibility indicators analysis results show that smart melon farming in the Jakarta area and its surroundings are worthy of cultivation and development. It is also related to the fact that most farmers have relatively high levels of education, so the technology transfer process used in their business can be faster. The ability of farmers to adapt to Smart Farming technology can encourage increased business productivity and efficiency. According to the New Growth Theory, technological advances can encourage increased productivity (Mankiw, 2016). This study's results align with the research (Shamshiri et al., 2018; Sitawati. et al., 2019).

3.3 Contribution of Smart Melon Farming Business Income to Family Incom and Meeting Family Needs

Smart Farming of melons is a side income for these farmers. This side income can help increase family income to meet family needs. Based on the data obtained, Table 4 shows the contribution of business income from Smart Melon Farming to family income and meeting family needs.

Table 4: Contribution of business income from Smart Farming to family needs

No	Income and expenses (per month)	Mark
1	Operating revenues	IDR 916,667.00
2	Family income	IDR 3,677,778.00
3	Family expenses	IDR 2,400,952.00
Contribution of business income to family income per month		24.92%
Contribution of business income to family expenses per month		38.18%

Family income is the sum of income from the main job and Smart Farming melons, while family expenditure is the total monthly costs incurred by the family to meet food and non-food consumption needs. Referring to the contribution criteria above, it can be seen that the data in Table 4 shows that the contribution of Smart Melon Farming business income, both to family income and family expenses, is in the low category. However, despite this, the business contribution can still increase in line with business development because the Smart Melon Farming business is efficient and worthy of development.

The results of this research align with past studies, which show that urban Farming has contributed to the income of farming families during the COVID-19 pandemic (Syah et al., 2022). The results also support previous works alleging that Urban Farming can create small businesses in the agricultural and informal sectors and increase the income of members of farmer groups to contribute to improving family welfare (Chairinisa, K. et al., 2022) (Alfariza et al., 2023) (Permana & Fauzy, 2017).

The results of the quantitative data analysis are in line with the perception of Smart Farming melon farmers. They think the Smart Farming business is beneficial because it can provide additional income and is worthy of development. To develop their business, farmers hope to obtain additional business capital to expand their production capacity, increase their land area to increase the scale of their business, hope that there will be other varieties of crops besides melons, and desire to form a business group so they can carry out production And marketing together.

4.0 Conclusion

The Smart Melon Farming business, developed by some residents in the Jakarta City area and its surroundings, has good prospects for development considering the business's efficient conditions. The Smart Farming business has been able to provide additional family income and can help meet family needs, although its contribution is still relatively low. However, the promising prospects for the development of intelligent farming businesses provide optimism for brilliant farming actors that, along with the development of their business, the contribution of their business to the family economy will also increase.

The results of this research imply that the development of Smart Farming in urban areas can be a solution for the community to fulfill food needs and boost the family economy. Therefore, synergistic collaborative support is needed between the Government, Universities, and Business/Industry actors (Triple Helix) to encourage and facilitate various necessary things, such as easy access to capital, technology, entrepreneurial education, sustainable business assistance, and convenience market access.

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