Does Internet Use Lead to an Increase in Farmers' Income? : Evidence From East Java

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Abstract: The agricultural sector is one of the dominant sectors in East Java's economic dynamics. Nevertheless, the per capita income of farmers in East Java is still relatively low. Promoting the adoption of digital technology for farmers is thought to be an effective way to improve farmers' welfare. Therefore, there are two objectives of this research. First, this study analyzes the determinants of internet use in farmer households. Second, this study analyzes the impact of internet use on farmer household income. The approach used in this study is a quantitative approach with cross-sectional data estimated using the Treatment Effect method. The data used comes from the 2021 National Socioeconomic Survey (Susenas). The results show that using the internet can increase farmers' income in East Java, and the impact is bigger when it is used for productive purposes. This study shows that the socialization of the use of digital technology (internet) in the agricultural sector is a strategic policy, especially to increase farmers' income. In addition, there are three main challenges in accelerating the use of digital technology: i) increasing the participation of the younger generation in the agricultural sector; ii) providing financial assistance for access to digital technology; and iii) increasing digital literacy for productive activities.

Keywords: Farmers' Household, Treatment Effect, Susenas, Internet Use, Income.

1. INTRODUCTION

Due to the development of technology, people increasingly rely on digital technology to support various activities, both in the context of individuals and broader community groups (UN. High-Level Panel on Digital Cooperation, 2019). Digital technology connects individuals through social media, big data, the Internet of Things, and cloud computing, which significantly impacts the set of processes, products, services, and business models, allowing new innovations to be generated (Legner et al., 2017). As a result of digital technology, people can communicate through the internet so that they are not isolated and can socialize without limits to the global scope (Castells, 2014).

Global internet usage continues to increase, as in 2021, more than 60 percent or 2 out of 3 of the global population has used the internet, especially internet users in developed countries, reaching an average of 90 percent of the total population (ITU, 2022a). These conditions are supported by adequate infrastructure. In contrast, universal connectivity is still a challenge in developing and least-developed countries, as the percentage of internet users still needs to be higher (ITU, 2022b).

One of the countries with the highest internet penetration is Taiwan, which is 94.8 percent of Taiwan's population, totaling around 23 million people (Internet World Stats, 2022). The technological advancement in Taiwan is inseparable from the Taiwanese Government's commitment to make Taiwan a global manufacturing hub for the smart machine industry, strengthening Taiwan's position as one of the world's largest suppliers of semiconductors, computers, cellphones, and computer (Yuan, 2022; Ferry, 2015; Siacor, 2022). In contrast, as one of the most populous countries in the world, technology utilization in Indonesia still lags behind Taiwan (Hardyanthi et al., 2019). The development of internet penetration in Indonesia is around 77 percent in 2022, showing a positive trend over the past five years (APJII, 2022). In Indonesia, internet users are dominated by the people of Java Island, one of which is East Java Province, which reaches 72.9 percent (APJII, 2022).

The use of Internet technology has been proven to contribute to the economy, including the agricultural sector (Aker, 2011; Aker et al., 2016; Bahrini & Qaffas, 2019; de Silva & Ratnadiwakara, 2008; Ma & Wang, 2020; Soma & Nuckchady, 2021; Sridhar & Sridhar, 2004). Industrial transformation in Taiwan aims to increase competitiveness not only in manufacturing but also in the service and agricultural sectors by utilizing IoT, Big Data, and automated system (Hardyanthi et al., 2019). The development of information and communication technology in Taiwan is optimized to provide efficient and effective agricultural solutions, as evidenced by the inauguration of the Agriculture 4.0 project or what has developed into Smart Agriculture (SA) by the Taiwanese Government (Leu et al., 2021; Maetzener, 2021; Yang et al., 2016). The advanced technologies developed in

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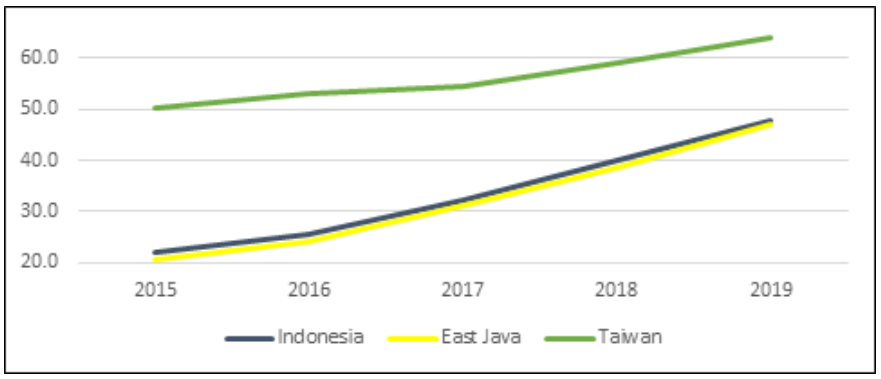

Fig. (1). Individual Using Internet (% of Population).
Source: World Bank, 2020.

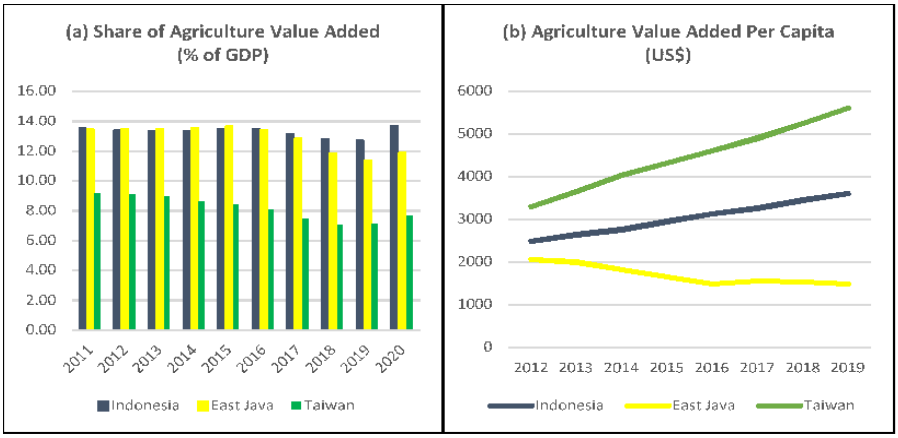

Fig. (2). Comparison of Agriculture Value Added.
Source: World Bank, 2021.

agriculture emphasize innovation, mechanization, and digital farming systems such as smart devices, sensing techniques, cloud computing, robots, IoT, LEDs, artificial intelligence, and extensive data analysis (Demiryurek et al., 2021; Yang et al., 2016). The SA project can be an alternative solution for Taiwan to overcome limited natural resources and increase agricultural productivity with production facilities for digital marketing of agricultural businesses (Chuang et al., 2020; Maetzener, 2021; Yang et al., 2016). Therefore, internet usage is suspected to be one of the reasons for the difference in per capita income in the agricultural sector in Taiwan and Indonesia, especially East Java.

In contrast to Taiwan, Indonesia's economic structure is still more dominated by agriculture than industry. Therefore, the agricultural sector's contribution in Indonesia is still more significant than in Taiwan. As illustrated in Fig. (**1a**). Since 2011, the average contribution of the agricultural sector in Taiwan has been below the average of Indonesia and East Java. However, at the same time, the per capita income generated from the agricultural sector in Taiwan is greater than that of Indonesia and East Java (See Fig. **1b**). It means that agriculture in Taiwan can generate more added value with the industrialization of the agricultural sector, so the welfare of farmers in Taiwan is higher than in Indonesia and East Java. This condition then explains the need to improve the agricultural sector's performance to improve farmers' welfare in Indonesia and East Java. In addition, given that the agricultural sector is also a source of employment, especially in rural areas, agricultural development, and growth should be prioritized, especially in developing countries (Chhachhar & Hassan, 2012; Khan, 2021).

The availability of agricultural land in Indonesia, which reaches 33.8 percent of the total land (World Bank, 2022), also indicates the dominant contribution of the agricultural sector in Indonesia. In contrast, in Taiwan only 25 percent of agricultural land is available from total state-owned land (Demiryurek et al., 2021). This condition also shows that the agricultural sector in Taiwan has implemented digital agriculture by utilizing technological developments (Leu et al., 2021), while the application of digital technology in agriculture in Indonesia is still not optimal (Rozaki, 2021).

Adopting digital technologies such as the Internet in agriculture can increase efficiency in the trade process, thereby improving the competitiveness and welfare of farmers, as successfully implemented in Taiwan (Chang & Just, 2009). With IoT, AI, and big data, agricultural technology innovations can empower Taiwanese farmers to do more work with less labor and time and reduce pesticide costs and environmental impact, ensuring healthier food quality (VIR, 2022). Using internet technology can also help reduce information asymmetry by disseminating information quickly at a low cost. Therefore, in the industrial era 4.0, digitalization in the agricultural sector can be a game changer in increasing productivity, profitability, and resilience to climate change (FAO, 2021).

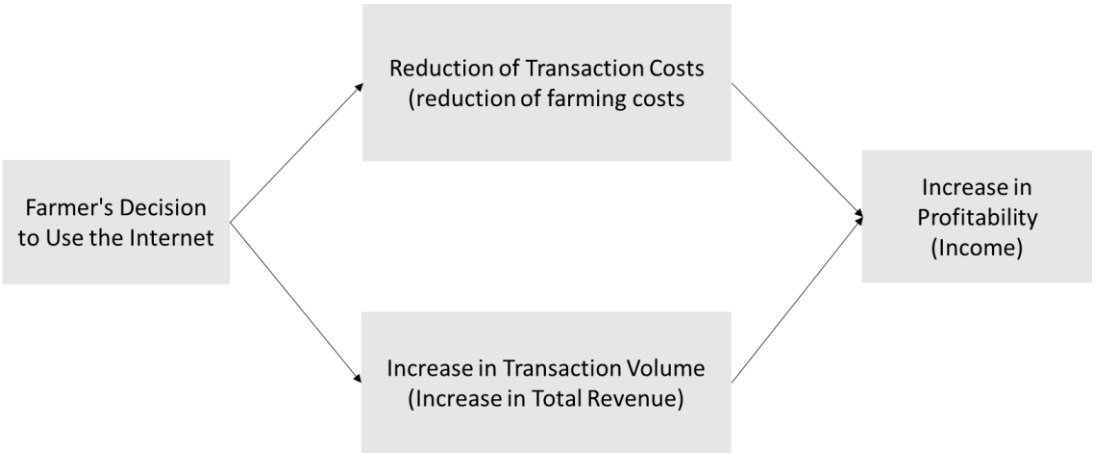

Fig. (3). Linkage Between Internet Use and Income.
Source: Adapted from various sources.

Several previous studies have also proven that the use of internet technology can increase the accessibility of financial and agricultural services for smallholder farmers (Trendov, 2019), the availability of input and output markets (Xydis et al., 2020), and increased income (Chen et al., 2022; Gao et al., 2018; Khan et al., 2022; Zheng et al., 2021). Based on this background, there are two main objectives in this study. First, this study will identify the factors influencing farmers' internet usage. Second, this study will identify the magnitude of the effect of internet usage on farmers' income.

2. LITERATURE REVIEW

The use of digital technology through the Internet can expand access, making it easier for people to connect and exchange information for knowledge, social, and commercial purposes (UN. High-Level Panel on Digital Cooperation, 2019). Internet utilization has been shown to positively influence farmers' income in Taiwan (Chang & Just, 2009). In general, the impact of internet usage on income can be explained through two main mechanisms, reducing transaction costs and increasing transaction volume. First, using Internet technology (IT) can help farmers obtain information quickly and cheaply, thus helping to reduce information asymmetry and production cost efficiency. This argument has been explained empirically in many previous studies. A study conducted by Goyal (2010) in India revealed that increasing internet access in rural areas can help farmers obtain market information and increase production and farmers' income. The results of Chen et al., (2022) also show that the Internet has become an important channel that helps farmers improve their production efficiency.

Meanwhile, a study conducted by Silva & Ratnadiwakara (2008) found a reduction in transaction costs, specifically reducing information search costs due to internet use by farmers encouraging farmer participation in commercial agriculture compared to subsistence farming which is still widely practiced in developing countries. Using the Internet can reduce farmers' search costs, obtain price information in more markets, and sell in markets with the highest prices after considering transportation costs (Tack & Aker, 2014; Khan et al., 2022). Internet usage also allows farmers to reduce the uncertainty associated with selling in remote markets (Zanello, 2014).

In addition to reducing transaction costs, Internet usage is also related to increasing the volume of agricultural transactions. Internet usage can increase the bargaining power of smallholder farmers, expand agricultural sales markets, and improve agricultural production performance, increasing the volume of farmer transactions and income. In this regard, a study conducted by Kaila & Tarp (2019) showed that internet access increased agricultural yields by 6.8 percent. The study of Oyelami et al., (2022) reinforces these findings that internet use positively affects agricultural yields in the long run. Similar things are also found in several studies which add that the use of the Internet can reach a broader market, so it will be able to increase income because farmers can access other markets that have higher prices (Baumuller, 2018; Larsen and Gilliand, 2009; Setiadi et al, 2020).

3. RESEARCH METHODS

This study uses data from the 2021 national socio-economic survey (Susenas). Susenas is a collection of data from individuals on several indicators such as demography, education, social, and economics. This survey is conducted annually by the Central Statistics Agency (BPS) and is often the main medium that can be used to monitor the socio-economic dynamics of the population. The number of observations was 20169 respondents taken from the agricultural sector. There are two groups that are the focus of the research, namely: (i) farmers who use the internet and (ii) farmers who do not use the internet. The TEM (Treatment Effect Model) method used in this study is good for explaining the factors that influence respondents' interest in digitalization and its impact on income. If there are two equations that must be estimated simultaneously, where one of the models is treated as a treatment variable, then the Treatment Effect Model is used to estimate the model (Greene, 2012).

In general, there are two models to be estimated in this study. The first model is used to identify the factors that influence internet use by farmers, while the second model is used to determine the impact of internet usage on farmers' income. The model specifications are as follows:

Table 1. Determinants of Internet Use by Function.

Variables	Model 1 (Business)	Model 2 (Finance)	Model 3 (Entertainment)	Model 4 (Social Media)	Model 5 (other)
	Dependent Variable: Internet (1: use; 0=not use)				
Age	-0.060***	-0.029***	-0.058***	-0.057***	-0.050***
Wealth	0.234***	0.365***	0.204***	0.274***	0.273***
Grad. from university	0.016	0.647***	0.005	-0.061*	-0.011
Grad. from highschool	0.356***	0.341***	0.330***	0.543***	0.507***
Grad. From Junior high	0.382***	0.211*	0.372***	0.486***	0.415***
Male =1, female = 0	-0.436***	-0.141*	-0.455***	-0.353***	-0.407***
Constant	1.382***	-2.517***	1.394***	1.623***	0.955***

Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

$$Internet_i = \gamma_0 + \gamma_1 Age + \gamma_2 Education + \gamma_3 Wealth + \gamma_4 Gender_i + \varepsilon_i \quad \text{(eq. 1)}$$

$$Income_i = \delta_0 + \delta_1 Internet_i + \delta_2 Age_i + \delta_3 Education_i \, \delta_4 Wealth_i + \mu_i \quad \text{(eq. 2)}$$

Internet variable is a dummy variable of internet use by farmers where the value is 1 if farmers use the internet and 0 if they don't. Internet variables will also be divided based on their function which consists of 5 main categories, namely the use of the internet to find information, business activities (buying and selling), social media, financial needs and entertainment needs. The factors that influence interest in using the internet are divided into 4 variables including age, education, wealth and gender. In the second model, farmer income is influenced by internet usage, age, education and wealth.

4. RESULTS AND DISCUSSION

4.1. Estimation Result

The results of estimating the determinants of internet usage among farmers can be observed in Table 1. There are six types of internet usage that have been estimated, namely buying and selling, entertainment, social media, information seeking, and financial needs. The findings indicate that age has a negative and significant impact on internet usage across all types. This means that older farmers are less likely to use the internet. Additionally, education is a significant factor influencing internet usage among farmers across all internet functions. Therefore, farmers with higher education have a greater likelihood of using the internet. Educated farmers also find it easier to acquire new knowledge, including advancements in internet technology, compared to their uneducated counterparts. Moreover, educated workers tend to be more receptive to technological advancements that can be utilized in their farming businesses.

The wealth or number of assets owned by farmers also influences their inclination to use the internet.. The results in Table **1** indicate that wealth has a positive and significant impact on internet usage across all categories. These findings highlight the disparity in internet usage between affluent and economically disadvantaged households. Wealthier households, with more assets, have better access compared to poorer households. This finding also suggests that internet usage entails relatively high costs, making it more challenging for small-scale farmers with limited wealth to adopt internet technology. Gender is another significant factor influencing internet usage. The results reveal that female farmers utilize the internet more than male farmers across all categories of internet usage.

Table **2** presents the impact of internet usage on farmers' income in East Java. The findings demonstrate that farmers who utilize the internet have higher incomes compared to those who do not. The use of the internet among farmers is expected to minimize information asymmetry and transaction costs, leading to improved farming efficiency and increased income. By accessing essential information on agricultural operations such as market demand trends, raw material sales, and crop prices, farmers can make more informed decisions, thereby enhancing their income. Moreover, internet usage enables farmers to access goods and services, engage in digital marketing, sales, and payments, ultimately improving their overall quality of life.

Furthermore, in another model, by considering several different uses of the internet, this study looks at whether there are differences in the impact on income. The results show that the use of the internet for financial needs has the greatest influence on increasing farmer income. While the use of the internet for entertainment has the smallest effect. Differences in the effect on each of these functions can occur because not all internet functions are used for productive activities that can support business activities.

Table 2. Impact of Internet Use on Income.

Variables	Model 1 (Business)	Model 2 (Finance)	Model 3 (Entertainment)	Model 4 (Social Media)	Model 5 (other)
	Dependent Variable: Farmers' Income				
Age	-0.004***	-0.003***	-0.005***	-0.002	-0.002
Wealth	0.894***	0.769***	0.898***	0.883***	0.875***
Grad. from university	-0.03	-0.155***	-0.028	-0.023	-0.033
Grad. from highschool	0.057	0.047	0.065	0.014	-0.008
Grad. From Junior high	-0.015	0.045	-0.008	-0.049	-0.055
Internet	0.362***	10.699***	0.316***	0.418***	0.627***
Constant	0.788***	1.052***	0.815***	0.675***	0.679***

Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

4.2. Discussion

A unique finding of this study is that female farmers in East Java exhibit a higher likelihood of utilizing the internet compared to male farmers. This finding diverges from some previous research, which suggests that women tend to have lower internet usage rates (Hilbert, 2011; Antonio & Tuffley, 2014; Joshi et al., 2020). The internet can serve as a crucial tool for promoting gender equality and empowering women (FAO, 2018; Hafkin & Huyer, 2008). In countries like America, women dominate internet usage due to advancements in gender parity and educational attainment (FAO, 2018). Women's empowerment, indicated by education and income levels, can both hinder and drive their decision to use the internet since internet usage requires skills and incurs costs (Braimok, 2017; Isaya et al., 2018; Sharma & Maheshwari, 2015). Additionally, research reveals that women predominantly use the internet for various personal activities such as social interaction, directions, spirituality, and health (Fallows, 2005; Hafkin & Huyer, 2008; Warner & Procaccino, 2007). In Indonesia, women predominantly utilize the internet for business purposes, including product promotion, communication, and transactions with consumers (Suwadji, 2020). Furthermore, Suwadji (2020) notes that technological advancements have provided opportunities for Indonesian women to enter the entrepreneurial world, as it allows them to earn additional income while managing household responsibilities.

This situation is also influenced by the characteristics of farmers in East Java, where most farmers are older and predominantly male. Consistent with previous findings, older individuals are less inclined to use the internet. The results of the initial analysis indicate that younger farmers have a greater awareness of the importance of internet usage, which aligns with research conducted by Iskandar et al. (2020) and Leng et al. (2020), which also highlights lower internet usage among older farmers. In East Java, the agricultural sector is primarily comprised of older farmers, with 50 percent of farmers falling within the age range of 45-64 years. For some elderly individuals, the opportunity to secure decent or formal employment diminishes due to a positive correlation between productivity and age. As individuals age, their productivity decreases, reducing their employment prospects (Deelen et al., 2018; Poletaev & Robinson, 2008). Consequently, the agricultural sector serves as an alternative employment opportunity and a form of social security for older individuals who are no longer able to compete in the job market.

According to FAO (2018), older farmers tend to have lower digital skills, making it challenging for them to adopt internet technology. Conversely, younger individuals tend to be more adaptable to technological advancements. This is evidenced by the higher percentage of young people utilizing the internet in more advanced countries (94 percent of young people aged 15-24 use the internet in developed countries, 67 percent in developing countries, and only 30 percent in underdeveloped countries). The limited experience of young farmers compared to their older counterparts in the agricultural sector motivates them to rely on the internet as an additional source of knowledge, making them more inclined to utilize internet technology (Kabir, 2015; Khan, Ray, Kassem, & Zhang, 2022).

The estimation results from the second equation align with numerous previous studies that emphasize the crucial role of the internet in boosting farmers' income (Navarro, 2010; Goyal, 2010; Michailidis et al., 2011; Dimitri et al., 2015; Siaw et al., 2020). There are two logical reasons for the positive correlation between internet usage and income. Firstly, the internet facilitates an increase in agricultural productivity by expediting the adoption of agricultural technology (Leng et al., 2020). Secondly, the internet enables farmers to access valuable information related to the adoption of agricultural technologies, financial resources, and fluctuating conditions in agricultural markets, thereby enhancing their decision-making process (Leng et al., 2020).

5. CONCLUSION

Based on the analysis conducted using data from the 2021 National Socio-Economic Survey (Susenas), this study re-

veals that the utilization of the internet has the potential to enhance the income of farmers in East Java, with varying impacts depending on its specific functions. Particularly, the use of the internet for financial purposes emerges as the most influential factor in augmenting farmer income. Furthermore, it is evident that internet usage is primarily concentrated among young individuals, those with higher wealth, and those with advanced education levels within the farming community. These findings underscore the significance of implementing strategic policies that promote the widespread adoption of digital technology in the agricultural sector, specifically aimed at elevating farmers' income.

Nevertheless, the dissemination of digital technology faces three significant challenges. Firstly, there is a need to enhance the engagement of young people and stimulate their interest in agricultural activities. Secondly, it is important to address the financial aspect of internet usage, as the acquisition of digital technology infrastructure entails costs that may exceed the financial capacities of most farmers. Finally, efforts must be made to educate farmers on effectively utilizing digital technology in productive activities, thereby enabling them to increase productivity and reduce transaction costs.

Overall, addressing these challenges is crucial in order to foster the successful integration of digital technology within the agricultural sector, ultimately facilitating income growth for farmers.

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