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The Effect of Community Participation, Knowledge Transfer, Technology Adoption on Community Food Security and Agricultural Sustainability in Farm Entrepreneurs in Indonesia

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ABSTRACT

In the context of agricultural entrepreneurship in Indonesia, this quantitative study explores the intricate relationships that exist between community engagement, knowledge transfer, technology adoption, community food security, and agricultural sustainability. To look into the connections between these crucial factors, the study included 350 agricultural entrepreneurs from various parts of Indonesia in a representative sample. Structural equation modeling using partial least squares (SEM-PLS) was used to gather and analyze data. The findings provided insights into the significance of community engagement, knowledge sharing, and technological advancement in guaranteeing food security. They also confirmed the significant positive direct effects of community participation, knowledge transfer, and technology adoption on community food security. Furthermore, the research findings indicate that the relationship between agricultural sustainability and community engagement is mediated by knowledge transfer and technological adoption, underscoring their crucial function in advancing sustainable agricultural practices. These results add to our knowledge of the dynamics of agricultural entrepreneurship in Indonesia and have important ramifications for stakeholders and policymakers who want to enhance the region's agricultural sustainability and food security.

Keywords: *Community Participation, Knowledge Transfer, Technology Adoption, Community Food Security, Agricultural Sustainability, Farm Entrepreneurs, Indonesia*

1. INTRODUCTION

Indonesia grows a wide variety of crops all around the nation. The primary fruit and vegetable crops farmed in Indonesia are shallots, cabbage, tomato, cucumber, rambutan, pineapple, banana, chile, yard-long beans, mango, papaya, and shallots, according study [1]. According to the same study, Indonesia's fruit production increased by almost 17% in 2011, but its vegetable production increased by less than 1%. It is crucial to remember that the study only looks at the output of fruits and vegetables; other crops that are cultivated in Indonesia might not be included in this analysis.

Crop diversity, agroclimatic zones, and farming practices define Indonesia's agricultural landscape. Agricultural productivity has increased significantly over the years, but problems still exist. These include regional disparities in food security, varying crop yields, and unequal access to contemporary agricultural techniques [2], [3]. The effects of climate change, shifting weather patterns, and natural calamities also highlight the necessity of resilient communities and sustainable farming methods [4]–[6].

The agricultural entrepreneurs, who frequently operate at the center of rural communities, are at the center of addressing these issues. In addition to producing food, they are crucial conduits for the transfer of information and technology within their communities [7]–[9]. Their engagement,

learning, and technology adoption can have a big impact on the community's general well-being, especially when it comes to food security and sustainable agriculture.

In this study, "community participation" refers to farm entrepreneurs' active involvement and engagement in cooperatives, community-based agricultural initiatives, and decision-making processes [10], [11]. Technology adoption is the process of integrating contemporary agricultural technologies and practices into conventional farming systems [12]–[14], whereas knowledge transfer is the exchange and acquisition of agricultural know-how and practices. Our research focuses on how these factors interact with one another [15], [16].

With its enormous and varied agricultural area, Indonesia is essential to maintaining food security and advancing agricultural sustainability in Southeast Asia [17]–[19]. The country's agriculture industry not only supports its quickly expanding population but also makes a substantial economic contribution [20], [21]. A increasing global population and global challenges like climate change make it critical to ensure food security and sustainable agriculture methods [20]–[22]. A crucial element in accomplishing this objective is the proactive engagement of agricultural entrepreneurs in nearby communities [23], [24]. The sustainability of agricultural practices and community food security can be greatly impacted by their involvement, knowledge access, and use of contemporary agricultural technologies.

The objective of this study is to examine the complex interplay among Indonesian farm entrepreneurs regarding community involvement, technology adoption, and knowledge transfer, and how these factors affect agricultural sustainability and community food security. Comprehending this complex interaction is essential for molding policies, advocating for eco-friendly behaviors, and augmenting the general welfare of rural areas and the country in general. In Indonesia, where the agricultural sector is essential to a large share of the population's livelihood and nutrition, the research tackles the urgent concerns of food security and agricultural sustainability. Finding long-term solutions to Indonesia's food security issues is crucial, especially in light of the rising demand for agricultural products and the ways that global developments are affecting the country's agricultural environment.

2. LITERATURE REVIEW

2.1 Community Participation in Agriculture

Numerous studies have been conducted on community involvement in agricultural efforts, both in Indonesia and beyond. It has been demonstrated that farmer participation in community-based initiatives, such as agricultural cooperatives and group decision-making, improves resource management, information exchange, and local food production [6]. According to a [25], [26], cooperative farming increases food production and improves community well-being. It implies that increased productivity and better resource availability can result from cooperative efforts in agriculture.

A community's ability to build social capital and trust is essential for successful involvement in agricultural operations. [27]–[29] emphasizes the importance of social capital in promoting mutual trust and collaboration, two things that are necessary for community involvement in agriculture. According to study by [30], [31], trust and social capital are important components of cooperative farming in Indonesia and can affect the effectiveness of team efforts to increase food security and sustainability.

2.2 Knowledge Transfer in Agriculture

Agricultural knowledge transfer, especially from specialists to farmers, is essential for the adoption of contemporary farming techniques. Extension services—which include education and training initiatives—play a crucial role in this process of knowledge transmission. According to research by [12]–[14] extension services are crucial for improving the knowledge and abilities of Indonesian farm entrepreneurs, which improves crop management and productivity.

In Indonesia, contemporary agriculture methods have coexisted with indigenous and traditional knowledge systems. The potential for this range of knowledge resources to support sustainable agricultural development exists. Research conducted by [32]–[34] investigate how incorporating traditional knowledge into contemporary agricultural methods enhances crop diversity and sustainability.

2.3 Technology Adoption in Agriculture

Enhanced agricultural productivity is intimately associated with the implementation of contemporary agricultural technologies, including precision agriculture, mechanization, and better seeds. Research by [12], [13], [35] emphasizes how crucial technological adoption is to solving issues with food security in poor nations. It suggests that crop yields and food availability may be greatly increased by having access to improved agricultural technologies [36].

Adoption of technology is crucial, but there are a number of obstacles in the way. Infrastructure, financing availability, and farmers' low level of technology awareness are some of the obstacles. The necessity of policies and interventions that address these obstacles to encourage technology adoption in the agriculture industry is highlighted by research conducted in [32]–[34].

2.4 Community Food Security and Agricultural Sustainability

The availability, accessibility, consumption, and stability of food within communities are all included in community food security. A number of studies highlight the connection between agricultural methods, food production, and community food security, including the work of [8], [9], [37]. According to the research, varied and sustainable agriculture practices can increase food supply and lessen the likelihood of food insecurity.

The idea of agricultural sustainability is complex, with aspects related to the environment, economy, and society. [7], [38] conducted research that emphasizes the significance of sustainable agriculture techniques in mitigating environmental issues and advancing economic feasibility. Sustainable agricultural methods preserve natural resources while simultaneously improving long-term food production.

2.5 Research Gap and Theoretical Framework

The assessment of the literature reveals a close relationship between technological adoption, knowledge transfer, and community participation in agriculture. Effective knowledge transfer and technology adoption can be facilitated by farm entrepreneurs' active participation in community efforts that cultivate social capital and trust. Consequently, there's a chance that this will improve agricultural sustainability and community food security.

Although the body of research on each of the following topics—community involvement, knowledge transfer, technology adoption, food security, and sustainability—is quite helpful, there is a clear deficiency in studies that look at these elements' combined effects in their whole. By using a theoretical framework that unifies these ideas and enables a quantitative examination of their interactions and impacts on community well-being, this study aims to close this gap.

3. METHODS

The relationship between community involvement, knowledge transfer, technology adoption, and their combined effects on agricultural sustainability and community food security among Indonesian agricultural entrepreneurs was examined in this study using a quantitative research methodology. With the help of the quantitative approach, we can test certain hypotheses and derive statistical conclusions by methodically gathering and analyzing numerical data. Data was gathered using a cross-sectional research approach at one particular moment in time. This design works well for painting a picture of the interaction between variables, giving a foundation for comprehending the sample's current state in terms of food security, agricultural sustainability, knowledge transfer, and community involvement.

Indonesian agricultural entrepreneurs make up the study's population. Owing to the population's wide distribution, a stratified random sampling approach was employed to guarantee representation from various geographic areas and demographic categories. 400 questionnaires were issued, however only 350 were fully returned. Power analysis was used to estimate the sample size, resulting in a representative and statistically significant sample that permits robust statistical analysis.

3.1 Data Collection Instruments

The primary tool for gathering data was an organized questionnaire. The purpose of the questionnaire was to gather data on community involvement, knowledge sharing, technology adoption, food security in the community, and sustainable agriculture. The Likerth Scale, a proven and approved tool from earlier study, served as the foundation for the measurement scale included in this questionnaire.

3.2 Data Collection Procedure

A survey that was given to agricultural entrepreneurs in various parts of Indonesia was used to gather data. All participants gave their informed agreement in order to guarantee that their participation in the study was voluntary. To reduce language barriers, surveys were carried out in the native tongues, and data collectors received training to ensure consistency in the data collection procedure.

3.3 Data Analysis

SEM-PLS, or structural equation modeling, was chosen as the main method of data analysis for this investigation. Because SEM-PLS can model intricate relationships between numerous variables, it is a good choice for examining how community engagement, knowledge transfer, technology adoption, community food security, and agricultural sustainability interact.

The following steps were engaged in the analysis process:

In order to define the connections between latent constructs and observable variables, a structural model was created. In this model, the observable variables are agricultural sustainability and community food security, whereas the latent variables are community participation, knowledge transfer, and technological uptake.

In order to determine the validity and reliability of the measuring scales that were employed to identify the latent components, the measurement model was examined. In order to verify that the observed variables accurately reflect the corresponding latent components, confirmatory factor analysis is used.

To investigate the connection between latent constructs and observable variables, path models are constructed. The approach specifically examines the relationship between community involvement, technology uptake, and knowledge transfer and how it affects agricultural sustainability and community food security.

The SEM-PLS model was used to evaluate hypotheses on the relationship between agricultural sustainability, community participation, knowledge transfer, and technology adoption as well as community food security. Testing the latent constructs' direct and indirect impacts on the observed variables was made possible as a result.

4. RESULTS AND DISCUSSION

4.1 Respondent Demographics

The wide range of ages among the participants emphasizes how inclusive our study is. The majority, or 35%, were in the 31–40 age range, which makes up a substantial portion of the sample. The proportion of younger agricultural entrepreneurs who are actively involved in agricultural activities is most evident in the 18–30 age group, which makes up 23% of the total. However, 26% fall into the 41–50 age group, suggesting that a significant percentage of people are mature.

Fascinatingly, we saw that there were people with more experience present—12% of them were in the 51–60 age range. The fact that 4% of participants were over 60 demonstrates the persistent commitment of seasoned business owners. It's important to note that, in terms of gender distribution, 63% of participants were men, suggesting that they were heavily involved in the agricultural entrepreneurial scene. The fact that 37% of participants were female is indicative of a growing trend of gender inclusivity in the agriculture industry.

There was a noticeable difference in the educational backgrounds of the study participants. Thirty percent of them had completed high school, indicating that secondary education had shaped their views on agriculture. Additionally, 20% of participants held a bachelor's degree, showing a high proportion of those with advanced degrees. A further 7% of respondents held a master's degree or above, highlighting the existence of people with highly educated backgrounds. Our members bring a wide range of knowledge and capacities that contribute to the vitality and flexibility of Indonesia's agricultural sector, as seen by the vast range of education levels they possess, from basic to advanced.

Participants in our study came from a variety of Indonesian locations, which gave us important insights into the spatial diversity of the agricultural environment. Java was the most represented region among the participants, accounting for 43% of them, indicating its importance to Indonesian agriculture. Sumatra demonstrated a significant presence with 21%, adding to the

regional diversity. Sulawesi's 14% presence highlights how significant eastern Indonesia is. With 11% each, Bali and Nusa Tenggara provide information about agriculture in the archipelago.

With 8% of the total, Kalimantan indicates the involvement of businesspeople from Western Indonesia. The geographic coverage of the study is further enhanced by the remaining 3%, who are from different regions. Our research may take into consideration regional differences in community participation, knowledge transfer, technology adoption, and their effects on food security and agricultural sustainability because of this broad geographical distribution.

The sample's variation in farm size and ownership structure demonstrates the complexity of Indonesian agricultural operations. The importance of medium-sized farms in Indonesia's agricultural landscape is highlighted by the fact that 49% of participants oversee farms with a total size of 1 to 5 hectares. With 68% of participants owning the farms they oversee, the ownership distribution highlights the variety of farming practices even more. This highlights the bulk of participants' independence and spirit of entrepreneurship.

The strength of community-based and cooperative farming approaches in the area is evidenced by the 10% of farms that are owned collectively. This distribution is in line with Indonesian agricultural reality, where farms of all sizes and ownership arrangements coexist and support the food security and sustainability of the country.

The participants' diverse range of years of farming experience shows how broad this survey is. 42% of the participants had been in the agricultural industry for 11–20 years, which suggests that a significant number of them were seasoned business owners. The proportion of persons with over 20 years of farming experience (27%), highlights the long-term commitment of those with a strong background in agriculture.

The diversity persists as 23% of the participants had a work experience of 5-10 years, suggesting that they are relatively new to the area. The survey covers the perspective of newcomers entering the agriculture sector, even among those with less than five years of experience, which represents 8% of the total. This variety of years of farming experience is evidence of the knowledge, creativity, and fresh viewpoints that combine to create Indonesia's dynamic agricultural environment.

4.2 Assessment of Measurement Models

As part of the SEM-PLS investigation, confirmatory factor analysis (CFA) was carried out to guarantee the validity and reliability of the measurement scale [39]. The following are the outcomes of the measurement model assessment:

Tabel 1. Research Validity and Reliability

Variable	Code	Loading Factors	Cronbach's Alpha	AVE
Community Participation	CP.1	0.723	0.762	0.621
	CP.2	0.843		
	CP.3	0.893		
Knowledge Transfer	KT.1	0.725	0.863	0.721
	KT.2	0.852		
	KT.3	0.868		
Technology Adoption	TA.1	0.744	0.833	0.698
	TA.2	0.755		
	TA.3	0.921		

Community Food Security	CFS.1	0.822	0.924	0.782
	CFS.2	0.854		
	CFS.3	0.716		
	CFS.4	0.912		
	CFS.5	0.812		
Agricultural Sustainability	AS.1	0.882	0.886	0.752
	AS.2	0.852		
	AS.3	0.875		
	AS.4	0.877		
	AS.5	0.927		

Source: The Results of The Author's Data Analysis (2023)

The validity and reliability of the measurement scales utilized in this study are well supported by the findings of the confirmatory factor analysis. With factor loadings that regularly surpass the advised cutoff of0.7, all latent variables—including community participation, knowledge transfer, adoption of technology, community food security, and agricultural sustainability—are well-represented by the corresponding observable variables.

The observed variables' ability to measure each latent construct is demonstrated by these high factor loadings. Put practically, this indicates that the underlying ideas of interest are accurately captured by the measuring scales employed in our investigation. The measurement instruments employed in this work are reliable for use by scholars and decision-makers.

In order to guarantee that the interactions between latent constructs and related routes are founded on trustworthy and legitimate measurement scales, a strong measurement model serves as a solid foundation for ensuing structural equation modeling (SEM-PLS) analysis. Thus, in the context of agricultural entrepreneurship in Indonesia, the study's findings can be regarded as trustworthy and relevant since they offer insightful information about the intricate relationships between community involvement, knowledge transfer, technology adoption, food security, and agricultural sustainability.

4.3 Pathway Modeling and Hypothesis Testing

Path models were developed to examine the relationships between agricultural sustainability (AS), community food security (CFS), technology adoption (TA), knowledge transfer (KT), and community engagement (CP). Within the SEM-PLS framework, hypotheses relating to these correlations were examined.

Table 1. Summary of Research Findings

Variable	Coefficient (β)	p-value
Community Participation ➔ Community Food Security	0.483	0.000
Knowledge Transfer ➔ Agricultural Sustainability	0.628	0.000
Technology Adoption ➔ Community Food Security	0.394	0.000
Mediating Role of Knowledge Transfer	0.302	0.000
Mediating Role of Technology Adoption	0.229	0.000

Source: The Results of The Author's Data Analysis (2023)

To examine the connections between agricultural sustainability (AS), community food security (CFS), technology adoption (TA), knowledge transfer (KT), and community involvement (CP), path models were constructed. Within the SEM-PLS framework, hypotheses pertaining to these correlations were examined.

Hypothesis H1: There is a direct and positive correlation between community engagement and community food security. There is statistical significance in the path coefficient ($\beta = 0.483$, $p < 0.001$) between community food security (CFS) and community participation (CP). Consequently, hypothesis H1 is validated. Hypothesis H2: The direct impact of knowledge transfer on agricultural sustainability is good. A statistically significant path coefficient ($\beta = 0.628$, $p < 0.001$) was found between agricultural sustainability (AS) and knowledge transfer (KT). Consequently, hypothesis H2 is validated. Hypothesis H3: Adoption of technology directly and favorably affects community food security. There is statistical significance in the path coefficient ($\beta = 0.394$, $p < 0.001$) between community food security (CFS) and technology adoption (TA). Support exists for hypothesis H3.

4.4 Transfer of Knowledge's Mediating Role

A mediation analysis was carried out to look at the knowledge transfer's (KT) mediating function between agricultural sustainability (AS) and community involvement (CP). The findings corroborated hypothesis H4 by showing a substantial indirect effect ($\beta = 0.302$, $p < 0.001$) of community involvement on agricultural sustainability through knowledge transfer.

4.5 Technology Adoption's Mediating Function

In a similar vein, mediation analysis was used to evaluate how technology adoption (TA) mediated the relationship between community food security (CFS) and community involvement (CP). The findings corroborated hypothesis H5, showing a substantial indirect impact of community participation on food security through technology adoption ($\beta = 0.229$, $p < 0.001$).

Discussion

The study's findings support the beneficial relationship between community involvement and local food security. The results highlight how crucial it is to include agricultural entrepreneurs in community-based agriculture projects because doing so improves the food security of the community. Active involvement in cooperatives, decision-making procedures, and group initiatives has a good impact on the community's access to and availability of food [40]–[42].

Significantly beneficial direct effects on agricultural sustainability are demonstrated by knowledge transmission. This emphasizes how crucial it is to share agricultural practices and expertise among Indonesian agricultural entrepreneurs. The study's findings are consistent with other research emphasizing the value of training initiatives and extension services in enhancing agricultural sustainability [15], [16].

Adoption of technology directly improves communal food security. The results highlight how crucial it is to provide agricultural entrepreneurs with cutting-edge agricultural technologies in order to increase the quantity and quality of food available. The issues surrounding food security can be greatly helped by laws and initiatives that promote the use of technology [12], [13], [43].

The association between community engagement and agricultural sustainability is mediated by knowledge transmission, but the relationship between community participation and community food security is mediated by technological adoption, according to mediation analysis. The

aforementioned results emphasize the interconnectedness of the aforementioned components and stress the significance of taking into account technological adoption and knowledge transfer when attempting to enhance agricultural sustainability and food security.

Policy Implications and Recommendations

1. The study's conclusions have important ramifications for Indonesia's rural communities, farmers, and policymakers. In order to enhance agricultural sustainability and community food security, policies ought to promote community involvement in cooperatives and agricultural programs.
2. Enhancing agricultural sustainability requires funding extension services and knowledge transfer initiatives.
3. Access to contemporary agricultural technologies and the promotion of their adoption have to be top priorities.
4. To create a complete strategy, policies and interventions should take into account how these aspects are interconnected.

5. CONCLUSION

In summary, this study clarifies the complex network of variables affecting food security and agricultural sustainability among Indonesian farm entrepreneurs. Our research demonstrates the mediating roles that technology adoption and knowledge transfer play in promoting agricultural sustainability in addition to confirming the strong direct benefits of these factors on community food security. These results highlight the value of community involvement, the exchange of agricultural knowledge, and the integration of contemporary technologies in guaranteeing the sustainability and resilience of Indonesia's agricultural industry.

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