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Factor Determinant Climate Change Adaptation: Evidence from Household Farmers in Sumenep Regency, East Java

Mardiyah Hayati[1*], Mohammad Wahyu Firdaus[2], Taufik Rizal Dwi Adi Nugroho[1], Desi Ramadhani[2], Risma Nabila[2], Moh. Rizal[3], Syauqi Agung Firmanda[2]

[1]Agribusiness Department, Faculty of Agriculture, Universitas Trunodjoyo Madura, Bangkalan
[2]Agriculture Socio-Economic Department, Faculty of Agriculture, Universitas Brawijaya, Malang, Indonesia
[3]Department Agronomy, Faculty of Agriculture, Universitas Brawijaya, Malang, Indonesia

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ABSTRACT

Climate change poses serious challenges to agricultural production, particularly for smallholder farmers who depend on climate-sensitive farming systems. Increasing climate variability, irregular rainfall patterns, and prolonged dry seasons have heightened the vulnerability of agricultural activities, especially in dryland areas. This study aims to identify climate change adaptation strategies adopted by household farmers and analyze the factors influencing their adoption in Sumenep Regency, East Java. Primary data were collected from 120 farmers using a multistage sampling technique through structured interviews covering farmers' socio-economic characteristics and adaptation practices. Descriptive statistical analysis was used to identify the types of adaptation strategies implemented by farmers, while a Multivariate Probit model was applied to examine the determinants of farmers' adoption decisions. The results show that farmers implement several adaptation strategies with different adoption levels. Crop rotation is the most widely adopted strategy, followed by adjusting planting times and using climate-resistant crop varieties. In contrast, water-saving irrigation is the least adopted strategy due to limited irrigation infrastructure. The econometric results indicate that farming experience, participation in farmer groups, and access to mobile banking significantly influence farmers' decisions to adopt climate adaptation strategies. Strengthening farmer institutions, improving financial inclusion, and enhancing agricultural extension services are therefore crucial to improve farmers' adaptive capacity and promote more resilient agricultural systems in climate-vulnerable regions.

Keywords**:** Adaptation strategies; Climate change; Multivariate probit; Smallholder farmers

INTRODUCTION

Climate change has become one of the most pressing global challenges affecting agricultural production and rural livelihoods (Maharjan & Joshi, 2012). Increasing climate variability, rising temperatures, and the growing frequency of extreme weather events such as droughts, floods, and irregular rainfall patterns have significantly disrupted agricultural systems

*Corresponding author:
Email: mardiyah@trunojoyo.ac.id

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worldwide (Thornton et al., 2014; Kumar et al., 2018). These impacts are particularly severe in developing countries where agricultural production is highly dependent on natural climatic conditions (Praveen & Sharma, 2019). Smallholder farmers are among the most vulnerable groups to climate change because they often rely on rain-fed agriculture and have limited access to financial resources (Mbuli et al., 2021), modern technologies (Ozor et al., 2012), and climate information (Kalungu & Harris, 2013) . As a result, climate change not only threatens agricultural productivity but also poses serious risks to household income, food security, and the sustainability of rural livelihoods.

Agriculture is inherently sensitive to climate conditions because crop growth and productivity depend heavily on rainfall, temperature, and other environmental factors (Hatfield et al., 2011). Variability in climate conditions may lead to crop failure, declining yields, pest and disease outbreaks, and soil degradation (Liliane & Charles, 2020). In response to these challenges, farmers often adopt various adaptation strategies to reduce the adverse impacts of climate change on agricultural production. Climate change adaptation refers to the adjustments made by farmers in agricultural practices, technologies, and management strategies in response to actual or expected climate variability (Crane et al., 2011). Common adaptation strategies include crop diversification, adjusting planting dates, adopting drought-resistant crop varieties, improving irrigation systems, and implementing soil and water conservation practices. These strategies play a crucial role in enhancing the resilience of farming systems and sustaining agricultural productivity under changing climatic conditions.

However, the adoption of climate change adaptation strategies varies widely across farming communities and regions (Hanani et al., 2024). Differences in socio-economic characteristics, resource availability, institutional support, and access to information often influence farmers' decisions to adopt specific adaptation practices (Mugi-Ngenga et al., 2016). Previous studies have highlighted that farmers' adaptation behavior is influenced by various factors such as age, education level, farming experience, farm size, household income, access to credit, and participation in farmer organizations (Ndamani & Watanabe, 2016; Uddin et al., 2014; Belay et al., 2022). Institutional factors such as agricultural extension services, climate information access, and government support programs also play an important role in shaping farmers' adaptive capacity (Jha & Gupta, 2021). Understanding these determinants is essential for developing effective policies and programs that support farmers in adapting to climate change.

In Indonesia, agriculture remains a key sector supporting rural livelihoods and national food security (Purnawan et al., 2021). However, the sector is increasingly exposed to the negative impacts of climate change (Praveen & Sharma, 2019). Changes in rainfall patterns, prolonged dry seasons, and unpredictable weather conditions have begun to affect agricultural productivity in many regions (Lal, 2011). These impacts are particularly significant in areas where farmers depend heavily on rain-fed agriculture and have limited irrigation infrastructure. East Java Province, one of Indonesia's major agricultural production centers, has experienced increasing climate variability over the past decades (Amien et al., 1996). Farmers in this region frequently face

uncertainties related to the onset of the rainy season, irregular rainfall distribution, and extended drought periods, which create significant challenges for agricultural planning and crop management.

Sumenep Regency, located in the eastern part of East Java, represents a region where agricultural activities are highly vulnerable to climate variability (Danugroho et al., 2025). The majority of farmers in this area operate small-scale farming systems that rely heavily on rainfall and traditional farming practices (Ramadhani et al., 2024). Limited water resources, seasonal drought, and unpredictable weather conditions frequently affect agricultural production in this region (Danugroho et al., 2025). To cope with these challenges, farmers often implement various adaptation strategies such as adjusting planting schedules, adopting drought-tolerant crop varieties, diversifying crops, and improving soil and water management practices (Abebaw, 2025). These adaptive actions reflect farmers' efforts to reduce production risks and maintain the sustainability of their farming systems under changing environmental conditions.

Despite the increasing importance of climate change adaptation in agricultural development, empirical evidence regarding the types of adaptation strategies adopted by farmers and the factors determining these decisions remains limited, particularly in the context of smallholder farmers in eastern Indonesia. Moreover, farmers often adopt multiple adaptation strategies simultaneously, and these decisions may be interrelated (van Zonneveld et al., 2020). Conventional analytical approaches that analyze each adaptation strategy independently may fail to capture the interdependence among farmers' adaptation choices. Therefore, this study aims to examine climate change adaptation strategies among household farmers in Sumenep Regency, East Java. Specifically, the objectives of this study are (1) to identify the types of climate change adaptation strategies implemented by farmers using descriptive analysis and (2) to analyze the determinants influencing farmers' decisions to adopt these strategies using a Multivariate Probit model. The findings of this study are expected to provide valuable insights for policymakers and agricultural stakeholders in designing effective climate adaptation policies and strengthening the resilience of smallholder farmers to climate change.

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RESEARCH METHOD

This study was conducted in Sumenep Regency, East Java, Indonesia, which represents one of the dryland agricultural areas in the province that is highly vulnerable to climate change. The region is characterized by limited water availability, seasonal drought, and high dependence on rainfall for agricultural production, making farming systems in this area particularly sensitive to climate variability. The research was carried out in Lenteng Subdistrict, one of the main agricultural areas in Sumenep dominated by dryland farming systems. Within this subdistrict, two villages Lenteng Village and Ellak Daya Village were purposively selected as the study locations based on recommendations from the Agricultural Extension Office (Balai Penyuluhan Pertanian). These villages were considered representative locations where farmers frequently experience climate variability and implement various strategies to cope with climate change in their farming activities.

The data used in this study consist of primary data collected through field surveys involving 120 household farmers selected using a multistage sampling technique. In the first stage, Lenteng Subdistrict was selected due to its vulnerability to climate change and its dominance of dryland farming systems. In the second stage, Lenteng and Ellak Daya villages were selected purposively based on recommendations from agricultural extension officers. In the final stage, respondents were selected from farmer populations in the two villages. Data collection was conducted through direct face-to-face interviews using structured questionnaires, which gathered information on farmers' socio-economic and demographic characteristics as well as their climate change adaptation strategies. The collected information includes variables such as age, education level, farming experience, farm size, household income, access to credit, participation in farmer groups, and various adaptation strategies implemented by farmers in response to climate variability.

In this study, climate change adaptation strategies adopted by farmers are represented by several key variables that capture the major practices implemented to cope with climate variability. These adaptation strategies are modeled as binary dependent variables, indicating whether a farmer adopts a particular strategy or not. Farmers often implement more than one adaptation strategy simultaneously as part of their risk management practices to reduce the negative impacts of climate change on agricultural production. Therefore, four main adaptation strategies were identified based on field observations and previous literature on climate change adaptation in agriculture. These strategies include crop rotation, climate-resistant varieties, adjusting planting times, and water-saving irrigation (Muzammal et al., 2024). Each variable is measured using a dummy variable, where a value of 1 indicates that the farmer adopts the strategy, and 0 indicates that the farmer does not adopt the strategy. These variables are used as dependent variables in the Multivariate Probit model to analyze the determinants influencing farmers' adaptation decisions.

Table 1.
Description Climate Change Adptation Strategy

Variable	Description	Measurement
Crop Rotation	Farmers change crop patterns or rotate crops across planting seasons to maintain soil fertility and reduce climate-related production risks.	Dummy (1 = adopt, 0 = not adopt)
Climate-Resistant Varieties	Farmers use crop varieties that are more tolerant to drought, pests, or climate variability.	Dummy (1 = adopt, 0 = not adopt)
Adjusting Planting Times	Farmers modify planting schedules based on rainfall patterns or seasonal climate changes.	Dummy (1 = adopt, 0 = not adopt)
Water-Saving Irrigation	Farmers implement irrigation practices that reduce water use, such as efficient irrigation methods or water management techniques.	Dummy (1 = adopt, 0 = not adopt)

To achieve the first objective, this study employs descriptive statistical analysis to identify and describe the types of climate change adaptation strategies implemented by farmers in the study area. Descriptive analysis is used to present the distribution and frequency of adaptation practices adopted by farmers, including crop rotation, the use of climate-resistant varieties, adjusting planting times, and water-saving irrigation practices (Msweli et al., 2025). The results are presented in the form of percentages and frequency distributions to provide an overview of farmers' responses to climate variability. This approach allows the study to illustrate the patterns of adaptation strategies adopted by farmers and to understand how widely each strategy is practiced within the farming community.

To address the second objective, this study applies the Multivariate Probit (MVP) model to analyze the determinants influencing farmers' decisions to adopt different climate change adaptation strategies. The MVP model is appropriate because farmers may adopt multiple adaptation strategies simultaneously, and these decisions may be correlated. The model allows the estimation of several binary adoption decisions jointly while accounting for potential correlations among the error terms across equations. The general form of the Multivariate Probit model used in this study is expressed as follows:

$$Y_{ij}^{*} = X_i \beta_j + \varepsilon_{ij} \quad (1)$$

where Y_{ij}^{*}represents the latent variable indicating the propensity of farmer $i$to adopt adaptation strategy j; $X_i$is a vector of explanatory variables representing the socio-economic characteristics of farmer i; $\beta_j$is a vector of parameters to be estimated for strategy j; and $\varepsilon_{ij}$is the error term. The observed adoption decision is defined as:

$$Y_{ij} = \begin{cases} 1 & \text{if } Y_{ij}^{*} > 0 \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

The error terms $\varepsilon_{ij}$are assumed to follow a multivariate normal distribution with zero mean and a variance-covariance matrix that allows correlations among the error terms across different adaptation strategies. This approach enables the analysis to capture the interdependence among farmers' adaptation decisions and to identify the socio-economic factors influencing the adoption of climate change adaptation strategies.

RESULTS AND DISCUSSION

Table 2 presents the descriptive statistics of the main variables used in this study. The results show that the average age of the household head is 54.47 years, indicating that most farmers in the study area belong to the older age group. This suggests that farming activities in the region are still dominated by older farmers who possess long-term farming experience. On average, farmers have 7.23 years of formal education, which is equivalent to completing primary school. Meanwhile, the average farming experience reaches 30.48 years, reflecting that most respondents have been involved in agricultural activities for a considerable period. The average household size is 2.81 persons, suggesting relatively small household structures. In terms of farm resources, the average cultivated land area owned by farmers is 1.16 hectares, indicating that farming in the study area is primarily characterized by smallholder agricultural systems.

Table 2.
Statistics Descriptive

Variable	Measurement	Mean	Std.
Age	Age of household head (years)	54.475	10.846
Education	Years of formal education (years)	7.233	2.347
Experience	Farming experience (years)	30.483	14.082
Family Size	Number of household members (persons)	2.808	1.132
Land Area	Total cultivated land area (hectares)	1.163	0.841
Household Income	Annual household income (IDR/Month)	39200000	42100000
Livestock Ownership	Number of livestock owned (head)	3.100	3.460
Group Farm	Participation in farmer group (1 = yes, 0 = no)	0.600	0.492
Off Farm	Engagement in off-farm activities (1 = yes, 0 = no)	0.850	0.359
Mobile Bangking	Access to mobile banking services (1 = yes, 0 = no)	0.892	0.312
Internet	Access to internet (1 = yes, 0 = no)	0.950	0.219

Regarding economic characteristics, the average household income of farmers is approximately IDR 39,200,000 per month, although the relatively high standard deviation indicates considerable variation in income levels among respondents. Farmers also own an average of 3.1 livestock units, which can serve as an additional source of income and a form of household asset. Institutional and technological access among farmers appears relatively high. Around 60% of farmers participate in farmer groups, which may facilitate knowledge sharing and access to agricultural information. Additionally, 85% of farmers are involved in off-farm activities, indicating that rural households often diversify their income sources to reduce agricultural risks. Access to digital and financial services is also relatively widespread, with 89.2% of farmers having access to mobile banking services and 95% having access to the internet. These findings suggest that farmers in the study area are increasingly connected to digital information and financial systems, which may potentially support their capacity to adopt climate change adaptation strategies.

Table 3 presents the distribution of climate change adaptation strategies adopted by farmers in the study area. The results indicate that several adaptation practices have been implemented by farmers to cope with climate variability, although the adoption rates vary across strategies. Among the observed practices, crop rotation is the most commonly adopted adaptation strategy, with 41 farmers (34.17%) implementing this practice, while 79 farmers (65.83%) do not adopt it. Crop rotation is commonly used by farmers to maintain soil fertility, reduce pest and disease pressure, and manage production risks associated with climate variability. Another frequently adopted strategy is adjusting planting times, practiced by

37 farmers (30.83%), while 69.17% of farmers do not adopt this strategy. Adjusting planting schedules allows farmers to better align crop growth cycles with rainfall patterns and seasonal climate conditions.

Table 3.
Distribution Climate Change Adaptation Strategy

Climate Change Adaptation	Quantity			
	1 = Adaptor	%	0 = Non Adaptor	%
Crop Rotation	41	34.17%	79	65.83%
Climate-Resistant Varieties	36	30.00%	84	70.00%
Adjusting Planting Times	37	30.83%	83	69.17%
Water-Saving Irrigation	14	11.67%	106	88.33%
Observation	120			

Similarly, climate-resistant varieties are adopted by 36 farmers (30.00%), while 70.00% of farmers have not adopted such varieties. The use of climate-resilient crop varieties can help farmers reduce production losses caused by drought or climate-related stresses. However, the adoption rate remains relatively moderate, possibly due to limited access to improved seed varieties or information regarding their benefits. In contrast, water-saving irrigation is the least adopted adaptation strategy, with only 14 farmers (11.67%) implementing this practice, while the majority of farmers (88.33%) do not adopt it. The low adoption rate may be associated with limited irrigation infrastructure, financial constraints, or the predominance of rain-fed farming systems in the study area. Overall, these findings suggest that although farmers have begun to adopt several adaptation strategies, the overall adoption level remains relatively limited, indicating the need for improved access to technology, information, and institutional support to strengthen farmers' adaptive capacity to climate change.

The results of the Multivariate Probit (MVP) model estimating the determinants of climate change adaptation strategies among household farmers are presented in Table 4. In general, the findings indicate that several socio-economic and institutional variables significantly influence farmers' decisions to adopt climate change adaptation strategies. The results show that farming experience, participation in farmer groups, access to mobile banking services, family size, and internet access are significant determinants of adaptation behavior, although their effects vary across different adaptation strategies. Meanwhile, variables such as age, education, land area, household income, livestock ownership, and off-farm activities do not show statistically significant effects on most adaptation strategies. The significant variables reveal both positive and negative relationships with farmers' adoption decisions, suggesting that adaptation behavior is shaped by complex interactions between farmers' experience, institutional participation, and access to financial and digital services.

Among the explanatory variables, farming experience appears to be one of the most consistent determinants influencing farmers' adaptation behavior. The coefficient of farming experience is negative and

statistically significant at the 1% level for crop rotation (coef. = -0.044; p < 0.01), climate-resistant varieties (coef. = -0.051; p < 0.01), and adjusting planting times (coef. = -0.049; p < 0.01). This result indicates that farmers with longer farming experience tend to be less likely to adopt certain climate adaptation strategies (Hayati et al., 2024).

Table 4.
Factor Determinant Climate Change Adaptation using Multivariate Probit

Variable	Crop Rotation		Climate-Resistant Varieties		Adjusting Planting Times		Water-Saving Irrigation	
	Coefficient	Sig	Coefficient	Sig	Coefficient	Sig	Coefficient	Sig
Age	0.016	0.403	0.014	0.476	0.017	0.360	-0.015	0.500
Education	0.075	0.255	0.087	0.206	0.034	0.609	-0.040	0.579
Experience	-0.044	0.004 ***	-0.051	0.001 ***	-0.049	0.001 ***	-0.009	0.570
Family Size	-0.140	0.315	-0.279	0.061 *	-0.183	0.192	0.208	0.194
Land Area	-0.114	0.501	-0.079	0.654	-0.178	0.322	-0.143	0.477
Household Income	0.000	0.944	0.000	0.829	0.000	0.647	0.000	0.869
Livestock Ownership	0.012	0.791	-0.026	0.554	-0.031	0.482	0.060	0.234
Group Farm	1.258	0.000 ***	1.158	0.001 ***	1.124	0.001 ***	0.340	0.370
Off Farm	0.574	0.225	0.479	0.315	0.709	0.132	0.171	0.771
Mobile Bangking	1.120	0.049 **	1.869	0.025 **	1.325	0.032 **	-0.046	0.929
Internet	-1.079	0.08*	-1.211	0.054 *	-0.679	0.269	-1.257	0.051 *
_cons	-1.410	0.311	-1.357	0.362	1.325	0.348	0.301	0.842

Note : ***,**,* significant at 1%, 5% and 1%

One possible explanation is that more experienced farmers may rely more heavily on traditional farming practices and accumulated local knowledge rather than adopting new adaptation strategies. Experienced farmers often develop habitual farming routines that are perceived as effective based on past experiences, making them relatively less responsive to new technological or management innovations. This finding is consistent with several previous studies that suggest experienced farmers may demonstrate lower adoption rates for new agricultural practices due to risk aversion and preference for familiar production systems (Ward & Singh, 2015). For example, studies on climate change adaptation in smallholder agriculture have found that younger or less experienced farmers are often more willing to experiment with new technologies and management

practices, while older and more experienced farmers tend to maintain traditional approaches (Tessema et al., 2018).

Another important determinant identified in this study is participation in farmer groups. The results show that farmer group participation has a positive and highly significant effect at the 1% level on the adoption of crop rotation (coef. = 1.258; $p < 0.01$), climate-resistant varieties (coef. = 1.158; $p < 0.01$), and adjusting planting times (coef. = 1.124; $p < 0.01$). These findings indicate that farmers who actively participate in farmer organizations are significantly more likely to adopt climate adaptation strategies compared to those who are not members of farmer groups. This result highlights the important role of social institutions and collective learning in facilitating farmers' adaptive capacity. Farmer groups often function as platforms for knowledge exchange, dissemination of agricultural innovations, and access to extension services (Izuchukwu et al., 2023). Through these groups, farmers can obtain information about climate risks, improved technologies, and best management practices that help them adjust their farming activities in response to climate variability (George et al., 2007 ; Cooper et al., 2008). This finding supports previous research emphasizing the importance of social networks and collective action in enhancing climate change adaptation (Rahman et al., 2024). Several studies in agricultural economics have shown that farmer organizations significantly improve farmers' access to information, technical assistance, and government programs, thereby increasing the likelihood of adopting climate-resilient farming practices.

The results also reveal that mobile banking access plays a significant role in influencing farmers' adaptation decisions. The coefficient of mobile banking is positive and statistically significant at the 5% level for crop rotation (coef. = 1.120; $p < 0.05$), climate-resistant varieties (coef. = 1.869; $p < 0.05$), and adjusting planting times (coef. = 1.325; $p < 0.05$). These findings suggest that farmers who have access to mobile banking services are more likely to adopt climate adaptation strategies compared to those who do not have such access. Access to mobile banking may facilitate farmers' financial transactions, savings, and access to credit, which are essential for investing in improved agricultural practices and technologies (Batista & Vicente, 2020; Mapanje et al., 2023). Financial inclusion through digital banking platforms can reduce transaction costs and improve farmers' ability to mobilize financial resources needed to adopt climate-resilient farming strategies (Negera et al., 2025). This finding aligns with recent literature emphasizing the growing importance of digital financial services in agricultural development. Studies have shown that financial inclusion can enhance farmers' adaptive capacity by improving their ability to manage risks, invest in productive assets, and adopt improved technologies that help mitigate the impacts of climate variability.

Another variable that shows a statistically significant effect is family size, particularly on the adoption of climate-resistant varieties. The results indicate that family size has a negative coefficient and is statistically significant at the 10% level (coef. = -0.279; $p < 0.10$). This suggests that households with larger family sizes are less likely to adopt climate-resistant crop varieties. One possible explanation is that larger households may face greater consumption needs and financial constraints, which limit their capacity to

invest in improved seeds or new technologies (Poulton et al., 2006). Larger families may allocate a greater share of household resources to basic consumption rather than agricultural investments, thereby reducing the likelihood of adopting climate-resilient varieties (Hertz, 2009; Doss & Quisumbing, 2020). This finding is consistent with some empirical studies suggesting that household dependency burdens can reduce farmers' capacity to invest in improved agricultural technologies due to limited financial flexibility.

The results further show that internet access has a statistically significant negative relationship with several adaptation strategies. The coefficient of internet access is negative and significant at the 10% level for crop rotation (coef. = -1.079; $p < 0.10$), climate-resistant varieties (coef. = -1.211; $p < 0.10$), and water-saving irrigation (coef. = -1.257; $p < 0.10$). This finding suggests that farmers with internet access are less likely to adopt certain adaptation strategies compared to those without internet access. At first glance, this result may appear counterintuitive, as internet access is generally expected to improve farmers' access to agricultural information and climate knowledge. However, this outcome may reflect differences in how farmers use digital technologies in rural areas. In many cases, internet access in rural communities is primarily used for social communication or non-agricultural purposes rather than for accessing agricultural information (Mapiye et al., 2023). Another possible explanation is that farmers with internet access may rely more on external income opportunities or alternative economic activities rather than intensifying agricultural adaptation strategies (Sassenrath et al., 2008). This finding highlights the need for improving the effectiveness of digital information dissemination systems to ensure that internet access translates into meaningful agricultural knowledge and climate adaptation practices.

Overall, the results of the Multivariate Probit model suggest that institutional participation and financial inclusion play a more important role than traditional socio-economic characteristics in shaping farmers' climate change adaptation behavior. While variables such as age, education, farm size, and household income are commonly considered important determinants of agricultural technology adoption, this study finds that they do not significantly influence most adaptation strategies in the study area. Instead, factors related to social networks, digital financial access, and farming experience appear to play more critical roles in influencing farmers' adaptive decisions. These findings highlight the importance of strengthening farmer institutions, improving access to financial services, and promoting effective knowledge dissemination systems to enhance farmers' adaptive capacity to climate change.

From a policy perspective, the results suggest that climate change adaptation programs should prioritize strengthening farmer groups and expanding access to digital financial services in rural areas. Supporting farmer organizations can improve knowledge sharing and collective learning, while financial inclusion through mobile banking platforms can facilitate farmers' investment in climate-resilient agricultural practices. Additionally, improving the quality of digital agricultural information systems is essential to ensure that internet access can effectively support farmers in accessing climate-related knowledge and technological innovations. Such integrated

approaches are crucial for enhancing the resilience of smallholder farming systems and ensuring sustainable agricultural production under changing climate conditions.

CONCLUSION

This study examined climate change adaptation strategies and their determinants among household farmers in Sumenep Regency, East Java, an area characterized by dryland agricultural systems that are highly vulnerable to climate variability. The research aimed to achieve two main objectives: first, to identify the types of climate change adaptation strategies adopted by farmers, and second, to analyze the socio-economic and institutional factors influencing farmers' decisions to adopt these strategies. To address these objectives, the study employed descriptive statistical analysis to describe the distribution of adaptation practices and applied a Multivariate Probit (MVP) model to examine the determinants of farmers' adaptation decisions. The empirical findings reveal that farmers in the study area have implemented several climate change adaptation strategies, although the adoption level varies across practices. Among the observed strategies, crop rotation, adjusting planting times, and the use of climate-resistant crop varieties were relatively more common, while water-saving irrigation remained the least adopted strategy due to limited irrigation infrastructure and the predominance of rain-fed agricultural systems. These findings indicate that farmers primarily rely on relatively low-cost and management-based adaptation strategies that do not require significant capital investment. The results of the Multivariate Probit model further show that climate change adaptation behavior is influenced by a combination of experience, institutional participation, and access to digital financial services. Farming experience was found to have a significant negative relationship with several adaptation strategies, suggesting that farmers with longer experience tend to rely on established traditional practices rather than adopting new adaptation innovations. In contrast, participation in farmer groups plays a significant positive role in encouraging the adoption of crop rotation, climate-resistant varieties, and adjusting planting times. This highlights the importance of social networks and collective institutions in facilitating knowledge exchange and promoting adaptive agricultural practices. Similarly, access to mobile banking services significantly increases the likelihood of adopting several adaptation strategies, indicating that financial inclusion through digital platforms can improve farmers' capacity to invest in climate-resilient practices. The results also show that family size negatively influences the adoption of climate-resistant varieties, while internet access has a negative relationship with several adaptation strategies, suggesting that digital connectivity alone does not automatically translate into improved agricultural adaptation unless it is effectively linked with agricultural information systems. Overall, the findings emphasize that institutional support and financial accessibility are more influential than traditional socio-economic characteristics in shaping farmers' climate adaptation behavior in the study area. From a practical perspective, the results highlight the importance of strengthening farmer organizations, improving access to financial services, and enhancing agricultural extension programs that focus on climate change adaptation. These interventions can help increase

farmers' adaptive capacity and promote the adoption of more effective climate-resilient agricultural practices. In terms of academic contribution, this study enriches the growing body of literature on climate change adaptation in smallholder agriculture by providing empirical evidence from dryland farming systems in eastern Indonesia, a context that remains relatively underexplored in existing studies. The use of the Multivariate Probit model also contributes methodologically by capturing the interdependence among multiple adaptation strategies adopted by farmers. Despite these contributions, this study acknowledges certain limitations, particularly the relatively limited sample size and the focus on a specific geographic area, which may affect the generalizability of the findings. Therefore, future research is recommended to expand the scope of analysis by incorporating larger datasets, multiple regions with different agro-ecological conditions, and additional variables such as climate perception, risk attitudes, and access to extension services. Such studies would provide deeper insights into farmers' adaptive behavior and contribute to the development of more effective climate adaptation policies for the agricultural sector.

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