



Adaptation Responses to Climate Variability among Rainfed Farmers in Bengkulu Province, Indonesia

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Abstract. Climate variability adaptation is crucial to sustaining rainfed farmers' livelihood and well-being in developing countries like Indonesia, where rainfed agriculture is one of the major economic sectors. We aimed to answer the following questions: (i) What responses have farmers implemented to respond to climate variability? (ii) what factors influence farmers' adaptation responses? We interviewed 213 rainfed farmers in Bengkulu Tengah Regency and Seluma Regency, Bengkulu Province, Indonesia. We find support for all questions using a multiple-weighted score analysis and logistic regression model. Shifting the planting season and implementing an intercropping system is an adaptation response priority for farmers. Only 42% of farmers adapt to climate variability. Farmers' participation in farmer groups and farmers' perceptions of climate variability influence adaptation responses. Overall, our results recommend strengthening farmer groups as a forum for discussion for farmers in dealing with various problems they face, especially climate variability-related ones.

Keywords: Climate Variability, Adaptation, Rainfed Farmer.

1 Introduction

El Nino and La Nina climate variability, as well as climate change (a rise in sea surface temperature by several degrees in the last 10 years) due to carbon emissions that cause global warming, poses a threat to economic resilience and also economic vulnerability through disruption of the planting season and decreased productivity of agricultural land. According to Cruz et al [1], the water and agriculture sectors are the most sensitive to the impacts of climate change in Asia. Agricultural productivity in Asia will likely suffer severe losses due to high temperatures, severe droughts, flood conditions, and soil degradation. There is a trend of decreasing average annual rainfall, including in Indonesia. The negative impacts of climate change are increasingly evident and have been proven to hit Indonesia through various environmental disasters such as floods, landslides, and droughts [2,3]. These impacts pose challenges to sustainable development regarding the social and economic environment and attaining Indonesia's development goals [3].

Farmers are not only synonymous with poverty but also because of the great uncertainty about the impact and the magnitude of climate variability. Research conducted

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Y. K. Dewi et al. (eds.), *Proceedings of the International Agriculture Meeting (IAM 2023)*,

Advances in Biological Sciences Research 42

https://doi.org/10.2991/978-94-6463-510-2_6

by Krishnamurthy et al [4] shows a high correlation between hunger and climate risk, especially for areas most affected by food insecurity. The analysis describes the impact of climate on crop yields, provides a multidimensional analysis of vulnerability, and shows the vital role of adaptive capacities of farming households in reducing vulnerability. Exposure to climate variability and increasing the intensity of extreme weather events such as droughts and frequent floods will accentuate many of the challenges farmers experience. Exposure to climate variability and extremes, especially drought and floods, poses a risk to people living in areas of marginal land quality. Some interventions on land use, livelihoods, and environmental management systems have been developed to enable households to build resilience to stress from drought, flooding, and other climate variations [5].

Changes in rain patterns are the biggest threat to farmers in Indonesia because so many farmers rely on rain for their agricultural activities and livelihoods; any change in rainfall poses a significant risk. Plants are susceptible to high temperatures during critical stages such as flowering and seed development. Often combined with drought, high temperatures can cause disaster for agricultural land [6]. Drought usually occurs in the second growing season, which causes changes in cropping patterns from rice-paddy to paddy-non-rice. The change in the cropping pattern led to a decrease in rice production, which would disrupt national food stocks. The continuity of rice production in recent years has often been disrupted due to reduced rice planting area [7].

Climate variability and its side effects can cause stress (small-scale disturbances to livelihoods), shock, or crises (large-scale, rare, unpredictable disturbances with direct impacts on livelihoods) [8]. Human resources play an essential role in adapting to climate variability because they relate to the strategy or adaptability that farming households will carry out. Adaptation efforts in the agricultural sector are critical factors in the success of national development, given the large number of people working in the agricultural industry, both as farmers and farm laborers. The focus on agricultural growth is expected to contribute to food availability and the availability of the energy sector, especially for renewable energy. Based on this background, the aims of this study were 1) to analyze adaptation responses in dealing with climate variability carried out by rain-fed farmers and 2) to analyze the factors that influence farmers' adaptation responses to climate variability.

2 Methods

This research was conducted in Bengkulu Tengah and Seluma Regencies, Bengkulu Province, Indonesia (Figure 1). In this research, the analysis unit is rainfed farmers who have their land as key informants to make decisions related to climate variability adaptation. The method used in determining the respondents is purposive random sampling, with 213 farmers selected. The questionnaire was carefully designed to get information on socio-economic characteristics and adaptation responses to climate variability selected by farmers based on their knowledge, understanding, and experience.

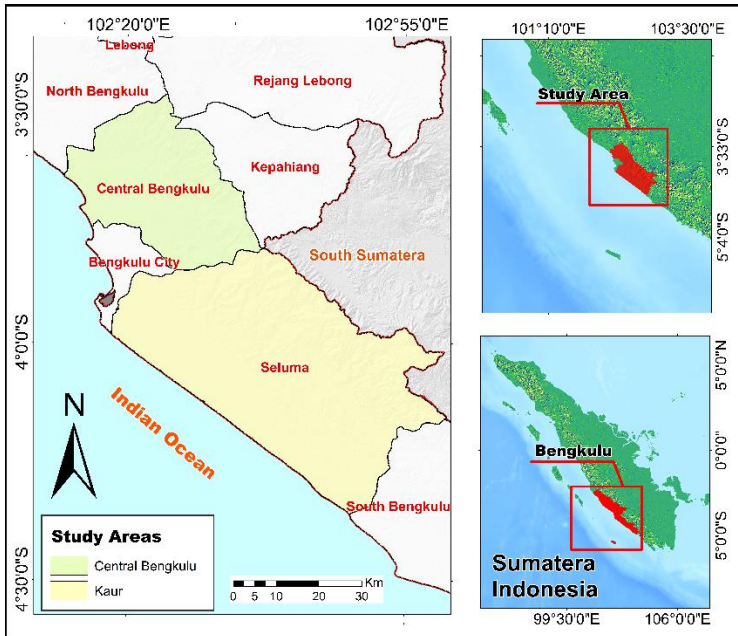


Fig. 1. Research area.

The adaptation response to climate variability in this study was studied from adaptations that can be made and those that have been carried out by rainfed farmers in the context of adjustments to climate variability in their farming [9]. Binary logistic regression has been used to identify factors determining farmers' responses to climate variability effects. The response of farmers is a discrete value (1, 0). One (1) denotes farmers who implement more than 50% of the adaptation in this study to climate variability. In comparison, zero (0) denotes farmers who adapt to climate variability with less than 50% of the adaptation in this study. Important determinants that affect farmers' adaptation response were selected based on previous studies, such as age [10], formal education [11], farming experience [11], membership organization [12], and perception of climate variability impacts, such as higher risks of crop failure, increasing post-harvest and marketing cost per unit product, the extremely long dry or wet season that causes yield decrease, etc [13].

3 Results and Discussion

3.1 Socio-economic characteristics of rainfed farmers

Socio-economic characteristics indicate that a farmer has resources to adapt to climate variability. Characteristics include age, formal education, farming experience, and organizational participation. The study's results (Table 1) show that most of the farmers are in the age range of 40 – 58. Age is related to the experience and maturity of farmers

in doing farming. Age will also affect physical ability and response to new things in agriculture. There is a tendency for young farmers to adopt an innovation related to climate variability adaptation more quickly because they are passionate about knowing and discovering what they don't know.

Education dramatically determines farmers' competence level in agricultural activities [14]. Most farmers are educated at the high school level, but some still need formal education (4.22%). Education will influence the mindset of farmers when dealing with a problem, especially climate variability. Farming experience, namely the time the respondent farmers have been doing rainfed lowland rice farming. The research results (Table 1) show that most farmers have experience ranging from 3 – 20 years. This indicates that the respondents had reasonably good experience farming rainfed lowland rice, so they could gain knowledge not learned at school. The study's results (Table 1) also show that most farmers participate in farmer groups. A farmer group is an organization consisting of farmers whose function is to accommodate aspirations, collaboration, and participation to achieve common goals, as well as being a forum for farmers to find solutions to various problems faced by farmers, especially those related to the impact of climate variability on rice farming rainfed [15].

Table 1. Socio-economic characteristics of rainfed farmers.

Categories	Σ (person)	%
Age (year)		
21 – 39	48	22.53
40 – 58	132	61.98
59 – 76	33	15.49
Formal education (year)		
Don't have formal education	9	4.22
1 – 6	52	24.42
7 – 9	49	23.00
10 – 12	88	41.31
>12	15	7.05
Farming experience (year)		
3 – 20	106	49.76
21 – 38	87	40.85
39 – 55	20	9.39
Membership organization		
Yes	169	79.34
No	44	20.66

3.2 Adaptation responses to climate variability

Rainfed rice farming is very vulnerable to the effects of climate variability because the success of this staple food production business is very dependent on the carrying capacity of the previously considered average and stable climate. Food and Agriculture Organization [16] predicts climate variability will create an extreme human crisis as

farmers depend on sufficient rain for their crops. They rely on predictable weather patterns for crops when planting and harvesting. However, climate change has created unpredictable variability in climate. Irregular rains and rising temperatures make farming more challenging.

Natural climatic conditions emphasize the importance of adaptive capacity to climate variability for rainfed rice farmers. However, the reality shows that there are still various understandings or conceptualizations that are followed by different responses to the phenomenon of climate change/variability, as revealed by Asplund et al [17] that through their own experience, farmers understand climate change/variability as a natural process that humans do not influence. In addition, there are still conflicts between farmers and rural communities regarding climate variability, such as the use of the term climate variability for climate change as opposed to weather variations [18] and different representations of climate change as a gradual process as opposed to an unpredictable process [19].

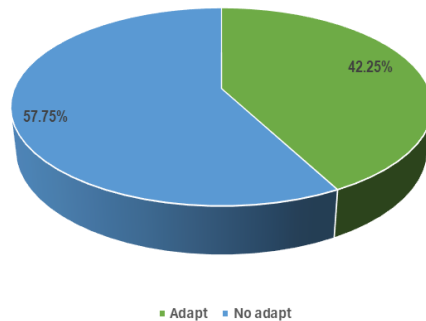


Fig. 2. Distribution of farmers adapting to climate variability.

Figure 2 shows that most farmers do not adapt to climate variability. Farmers adjust plant varieties depending on the season as one of the adaptation responses that is quite common. Based on the interviews, most of the farmers use the Ciherang and IR64 rice varieties, where the Ciherang rice variety is a subsidy from the government. However, the Ciherang rice variety, according to Pekik Nyaring Village farmers, does not increase production yields and increases pest attacks, especially during the dry season. Hence, farmers only use the IR64 variety.

Table 2. Adaptation responses of rainfed farmers (n = 213).

Adaptation	Yes	Rarely	No
Shifting the growing season	24.41	48.83	26.76
Carry out an intercropping system	2.82	15.96	81.22
Pumping water from irrigation canals	2.82	0.00	97.18
Adjust plant varieties depending on the season	47.42	1.88	50.70
Find detailed information about climate variability	26.29	34.27	39.44
Strengthening farmer group institutions for resilience to climate variability	17.37	31.46	51.17
Livelihood diversification outside of agriculture	14.08	0.00	85.92

Based on the research results, as many as 34.27% of farmers sometimes, 26.29% never, and 39.44% often adapt to seek complete information about climate variability. Based on the interview results, farmers said they did not know much about climate variability. In addition to not functioning farmer groups, mobile technology is challenging to use because of little knowledge. So, when looking at climatic conditions, farmers only rely on looking directly at the conditions in the field and the interactions of farmers with other farmers. Some farmers often see climate conditions through the weather news on TV. Kurniawati et al [20] farmers' adaptability to climate change can be increased by obtaining easy access to information. High knowledge, education, and skills will increase farmers' chances of successful adaptation. Farmers' adaptability will affect all practical actions in dealing with climate change.

3.3 Determinants of farmers' adaptation responses to climate variability

Binary logistic regression analysis analyzes the determinants of adaptation responses to climate variability. The study's results (Table 3) show that farmer participation in organizations and perceptions of climate variability hurt farmers' adaptation responses. This means that the involvement of farmers in farmer groups and the high perception of farmers on the impact of climate variability will provide opportunities for farmers not to adapt. This is because the facts in the field show that many farmer groups have been formed but are inactive. The large number of farmer groups formed is only used to obtain subsidized assistance from the government. This means farmer groups focus on something other than their farming activities but are only used as a forum for obtaining subsidized aid. The results of this study are based on the research of Salampessy et al [21], which said counseling in farmer groups did not affect farmer behavior; farmers made adaptations not because of counseling in farmer groups. Farmers get information about climate change from outside farmer groups. It turns out that farmer groups do not influence in providing knowledge about climate change, which farmers should be a place for learning, discussing, and exchanging information for farmers.

Table 3. Results estimation.

Variable	B	Wald	Sig.
Constant	3.485	6.794	0.009
Age	-0.014	0.213	0.644
Formal education	-0.074	2.320	0.128
Farming experience	0.046	2.115	0.146
Membership organization	-1.470	12.038	0.001*
Climate variability perception	-0.118	4.105	0.043*

*Significance at level 5%

4 Conclusion

Farmers have a low adaptive response when dealing with climate variability. Adjusting plant varieties depending on the season and seeking complete information on climate variability is an adaptation response that rainfed farmers always carry out. To adapt to climate variability, most farmers must diversify their livelihoods outside the agricultural sector, intercrop, or pump water from irrigation canals. Farmers' participation in farmer groups, as well as farmers' perceptions of the impact of climate variability, have a negative effect on farmers' adaptation responses in dealing with climate variability. To avoid the worst impacts of climate variability, all parties, including farmers, village officials, government, or related agencies, must increase cooperation and communication on all matters related to anticipation, mitigation, and adaptation strategies that must be carried out, as well as controlling these strategies.

Disclosure of Interests. The author declares that the manuscript is original and contains no plagiarised text.

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