Rice Farmers' Perception Of Climate Variability In South Konawe District Of Southeast Sulawesi

Haji Saediman, La Ode Lasmin, Muhammad Aswar Limi, Usman Rianse, Laode Geo

Abstract: Climate variability can have severe impacts on agriculture, especially on rice as the water-intensive crop that depends heavily on precipitation and temperature. This research aimed to find out perception of rice farmers toward climate variability. The study was conducted in Cialam Jaya village, Konda sub-district, South Konawe district, Southeast Sulawesi. Data were collected using a questionnaire-based interview method and Focus Group Discussion. Sixty-seven rice farmers were selected as respondents using simple random sampling method. Descriptive statistics was used to analyze the data. A large percentage of farmers perceived increased temperature, erratic rainfall, and increased extreme weather events, and the climate data supported these perceptions. A large percentage of farmers also believed that climate variability had impact on rice farming, which included changes in planting calendar, flooding, difficulty in harvesting, pest and disease occurrence, and increased frequency of droughts. Information on these local perceptions can be used to design adaptation strategies to improve rice production system to be more efficient and adaptable to climate variability in the future.

Keywords: Climate variability, farmers, perception, rice farming, Sulawesi.

1 INTRODUCTION

Climate variability has become a significant threat to global food availability. This is because climate variability affects agriculture [1], either directly or indirectly. The direct effect is through variability of climatic factors such as increased temperature and erratic rainfall that influence physiological processes of the crop [2]. The indirect effect is through climate variability effect on factors that influence plant growth and production such as water supply, soil fertility, and pests and diseases [3]. In addition, extreme weather conditions such as floods and droughts cause significant crop and livestock damage [4],[5], and have negative impact on the livelihoods of farmers [1],[6]. Overall, climate variability could negatively affect food production, food availability, and food accessibility for a large percentage of the population, especially in developing countries [7]. In Indonesia, rice production has a significant role in the economy of the country. Rice is the most important staple food [8],[9] which is consumed by 97% of the population [10]. Rice production contributes to income generation, improves food security [11], generates employment, and promotes environmental conservation. However, climate variability may reduce these rice farming roles and multi-functionality. Climate variability negatively affects rice growth, development, and production [12]. Some studies have confirmed that climate variability will severely compromise rice yields [13],[14],[15]. Climate variability effects on rice farming include a shift of growing season and harvesting time, changes in the planted and harvested area, and changes in production and productivity [16]. The negative impact that climate variability may have on rice production may include decreased yields, reduced grain quality, land destruction due to flood, pest and disease occurrence, decreased soil fertility, drought incidence, and high weed incidence [15]. Rice is the first most important crop in Southeast Sulawesi [17] which is cultivated mostly in low-land areas. Cialam Jaya village is one of the major rice production areas in South Konawe District of Southeast Sulawesi. The village came into being with the arrival of the state-sponsored migrants from Ciamis of West Java and Lamongan of East Java in 1975, and since then has been popular as a rice production area. In order for the village to continue performing the role of rice producing area, farmers need to carry out appropriate adaptation strategies towards climate variability. However, in Indonesia, especially in Southeast Sulawesi, there is limited information about perception of farmers regarding climate variability and its impact on rice farming. Understanding such farmers' perception is crucial to identify solutions to improve rice production system to be more efficient, effective, and adaptable to climate variability in the future. This paper seeks to ascertain smallholder rice farmers' perception of climate variability. The specific objectives were to (i) find out knowledge of rice farmers regarding climate variability; (ii) determine rice farmers' perception of climate variability; (iii) find out data evidence on the changes in temperature and rainfall; and (iv) determine perception of rice farmers regarding climate variability and its impact on rice farming.

2 METHODOLOGY

Data collection was carried out from April to May 2019 in Cialam Jaya village, Konda sub-district, South Konawe district. The village was purposively selected because it has long been well-known as a rice producing village. The village has a population of 1,935 in 2018. The area has tropical climate with two major seasons, namely, dry and rainy seasons. The dry season usually takes place for three months from August to October. It has 215 ha of rice farming, but other varieties of crops are also grown. Rice farming is the primary livelihood, followed by livestock keeping, cultivation of secondary food crops and horticulture, and non-farm jobs. The average temperature is 24-28 ^{0}C. Respondents consisted of 67 rice farmers who were selected randomly. Data collection was done using questionnaire-based interviews and Focus Group Discussions (FGDs). The semi-structured questionnaires assessed socioeconomic and demographic characteristics, knowledge of climate variability, perception of farmers regarding climate variability, perception of farmers regarding the impact of climate variability, and opportunities and constraints in rice farming. For qualitative methods, two focus group discussions (FGDs) were conducted by the research team using an interview guideline on the broad topics of climate variability and its impact on rice farming. One FGD was held with five farmers, and another one with five agricultural extension officers at Konda subdistrict Agricultural Extension Office. Data on temperature and rainfall were obtained from Kendari Maritime Meteorology Office. Descriptive statistics such as percentage and mean were used to analyze data and information. Responses to perception

were designed to be reported on a 3-point Likert scale, where "agree" was given the value of 3, "neutral" as 2 and "disagree" as 1. Responses of the questions were categorized according to their mean scores. Mean scores of 1.00 – 2.00 were classified as "disagree" and mean scores of 2.01 – 3.00 were classified as "agree."

3 RESULTS AND DISCUSSION

3.1 Characteristics of respondents

The age of the majority of respondents (59.7%) ranged between 21-50 years, and the remaining 40.3% had the age range of 51 years and above with the average age of 47 years. The majority of respondents (61.2%) had a household size of 5-7 members with the mean household size of 5 persons. A large proportion of respondents (80.6%) had more than five years of rice farming experience. A greater percentage of respondents (94.0%) had a farm size of 0.5-2.0 ha, with an average of 1.1 ha. With regard to education level, about half of respondents (49.3%) only completed elementary school, 47.8% completed junior high school, and the remaining 17.9% completed senior high school.

3.2 Knowledge of climate variability

Table 1 presents farmers' perceived knowledge of climate variability. All respondents said they had heard the term climate variability or climate variability. When asked about their understanding of climate variability, however, only 58.2% declared that they understand sufficiently the meaning of the term, while 34.3% acknowledged they understand it "a little," and the remaining 7.5% acknowledged they do not understand the term at all. The results imply that most respondents have already some knowledge about climate variability. Farmers associate climate variability with the changes in temperature, rainfall, and extreme weather events, but seem unsure about the causes of climate variability and its long-term implication in the future. The results of this study agree to finding of Suprihati, Yuliawati, Soetjipto, and Wahyono [18] that 98% of farmers in Tlogolele village in Boyolali district of Central Java have heard and been aware of climate variability, although many could not explain it very well. Nwalieji and Onwubuy [19] also reported that most farmers in Anambra State of Nigeria already knew regarding the concept of climate variability. Sources of awareness of climate variability for rice farmers might include personal observation and experience, social media, radio/TV, extension officers, fellow farmers, friends, Non-Governmental Organizations (NGOs) and newspapers [19],[20]. In this regard, it is noteworthy that Konda subdistrict is bordered by Kendari municipality, the provincial capital with a population of 381,628 people in 2018. The village has been the leading supplier of fresh farm products to Kendari and, as such, village residents have often made visits, transaction, and interaction in general with Kendari residents. Such a close location to the urban area might contribute to their cosmopolitan attitude and high exposure to the topics widely discussed in various kinds of the media, such as climate variability, leading to their high awareness of the term climate variability.

***Table 1**. Knowledge of respondents on climate variability*

Knowledge of climate variability	*Answer*	*N*	*%*
Have heard of climate variability?	*Yes* *No*	*67* *0*	*100.0* *0.0*
Understand the meaning of climate variability?	*Yes* *A little* *No*	*39* *23* *5*	*58.2* *34.3* *7.5*

3.3 Perception of climate variability

Table 2 presents the farmers' perception of climate variability. The study results showed that rice farmers in the study village have a clear perception of climate variability. A large percentage of the farmers (85.1%) interviewed affirmed that temperature has become hotter. This farmers' perception is consistent with the climate data in the area which show that there has been a gradual increase in the temperature in the last 20 years (Fig. 1). Climatic data shows that the average minimum temperature was 21.3 ^{0}C from 1999 to 2008, which increased to 23.2 ^{o}C from 2009 to 2018. Likewise, there has been an increase in maximum temperature from 32.1 ^{0}C during the period of 1999-2013 to 33.0 ^{0}C during the period of 2014-2018. Farmers' perception of an increase in temperature in the study village is in line with farmers' perception in Indonesia and other countries [12],[18],[21,[22]. Temperature increases can have adverse effects on quantitative and qualitative attributes of rice yields [2], including on rice growth and development and the quality of rice grain.

***Table 2.** Farmers' perception of climate variability*

Climate variability Perception	*Response*	*N*	*%*	*Mean score*
Temperature becomes hotter	*Agree* *Neutral* *Disagree*	*57* *3* *7*	*85.1* *4.5* *10.4*	*2.7*
Rainfall more irregular and unpredictable	*Agree* *Neutral* *Disagree*	*54* *3* *10*	*80.6* *4.5* *14.9*	*2.7*
Extreme weather events occurred more frequently	*Agree* *Neutral* *Disagree*	*51* *2* *14*	*76.1* *3.0* *20.9*	*2.6*

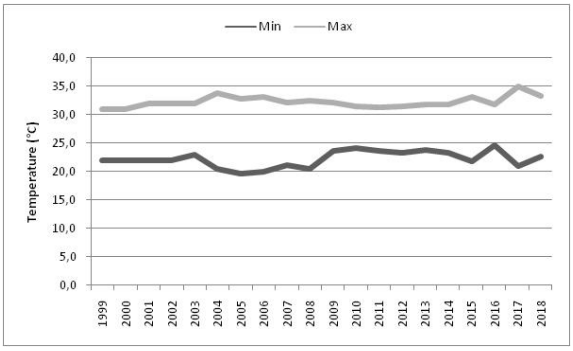

***Fig. 1**. Trend in minimum and maximum temperatures during the period of 1999-2018*

With respect to precipitation, a great percentage of respondents (80.6%) said that there had been changes in rainfall, namely, in its timing and distribution in a cropping season or within the year. Farmers are of the opinion that the timing and distribution of rains become more erratic and are often different from the regular pattern. The regular pattern can be seen from the average monthly rainfall in the last 15 years (Fig. 2). Examples of deviation from the regular pattern include less rain in November, December and January, and more rain in April, August and October. As can be seen in Fig. 3, the climate data show that there is a slightly increased trend

in average annual rainfall in the last 20 years. However, if the data are divided into two ten-year periods, the average annual rainfall does not indicate any significant change. The average rainfall is 2,190 mm in the period of 1999-2008 and 2,158 mm in the period of 2009-2018. Likewise, during the period of 1999-2008 and 2009-2018, the number of days with rains in a year is 179.5 and 180.1, respectively. Perhaps it is for this reason that most farmers did not perceive noticeable changes in annual rainfall amount. These results disagree to most findings in other studies where decreased rainfall [1],[6],[13],[21],[22] is perceived to have taken place in the last decade or two. Chaulagain and Rimal [23] reported that farmers in Kailali district in Nepal had perceived increased rainfall as a result of climate variability.

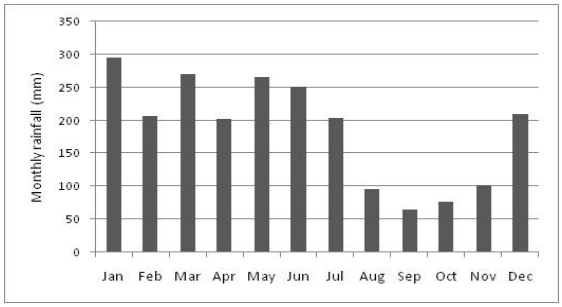

Fig. 2. *Average monthly rainfall for the period of 2004-2018*

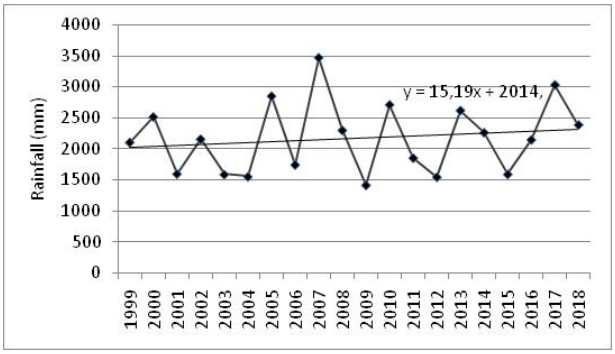

Fig. 3*. Trend in average annual rainfall in the period of 1999 2018*

Extreme weather events are also said to be the indicators of climate variability. A large percentage of the respondents (76.1%) perceived increased occurrence of extreme weather events particularly intense rains and flooding. Farmers were more concerned with intense rains and flooding because of their direct adverse effects on the crops. This result is supported by the climate data. For example, intense rains take place during May-June in 2017 and 2018 with rainfall of more than 400 mm per month. The monthly rainfall of May 2017 even reached 880 mm. Intense rain also occurred in July 2013 with the monthly rainfall reaching 770 mm. As a result, heavy flooding occurred in 2013, 2017, and 2018 which brought about severe damage to rice farming in some areas, resulting in harvest failure.

3.4 Perception of Climate variability Impact

Table 3 shows the perceived impact that climate variability can have on rice farming. According to farmers, the impact that climate variability can have on rice farming includes changes in planting calendar, increased frequency of flooding, difficulty in harvesting, more frequent occurrence of pest and disease, and more frequent droughts. A large percentage of farmers provided affirmative responses to the first four kinds of impact. Their mean scores range from 2.6 to 2.7, which imply that farmers "agree" with the impact of climate variability. The only impact that farmers are at "disagree" level is on more frequent drought.

Table 3. *Farmers' perception of climate variability impact*

Impact of Climate variability	*Response*	*N*	*%*	*Mean Score*
Change in planting calendar	*Agree* *Neutral* *Disagree*	*50* *3* *14*	*74.6* *4.5* *20.9*	*2.6*
More frequent flooding	*Agree* *Neutral* *Disagree*	*50* *4* *13*	*74.6* *6.0* *19.4*	*2.6*
More frequent droughts	*Agree* *Neutral* *Disagree*	*15* *31* *21*	*22.3* *46.3* *31.3*	*1.9*
Difficulty in harvesting	*Agree* *Neutral* *Disagree*	*56* *2* *9*	*83.6* *3.0* *13.4*	*2.7*
More frequent pest and disease occurrence	*Agree* *Neutral* *Disagree*	*56* *4* *7*	*83.6* *6.0* *10.4*	*2.7*

In line with the irregularity of the timing and distribution of rain, farmers perceived changes in the planting calendar and more frequent flooding (Table 3). The rainy season for the October-March period is expected to start in November with rice planting completed at the beginning of January. However, due to the irregularity of rainfall timing and distribution, rice planting is sometimes postponed until February. For the April-September period, the planting time ideally starts in May but is often delayed until June and even July. With respect to flooding, respondents reported that it only occurs in particular rice fields which are located in the low-lying areas. However, flooding is perceived to be more frequent recently than in the past. The delay in rice planting is not only due to weather variability but also to farmers' involvement in other livelihood activities. In general, due to problems associated with production and market risks, farmers perceive rice farming as riskier and less competitive compared to other crops or other types of livelihoods. They are then growing other crops or involved in other types of livelihoods [24], such as livestock keeping, secondary food crops, horticulture, vegetable intermediaries and retailers, and non-farm activities. Therefore, when the rain comes, while ensuring the adequacy of rains, they do not feel the pressure to start land preparation and rice-planting operations immediately. Since farmers prefer to do concerted planting, any delay by some farmers will make other farmers postpone the planting. The delay in rice planting has some implications. The delayed planting will lead to a delay in the harvesting. Farmers who do the planting in February will harvest the plant in May, which is usually the peak of the rainy season. Late harvesting in May faces the risk of flooding, leading to harvest failure. Also, muddy paddy land during excessive rains disturbs the operation of a combine-harvester. In such condition, owners or operators of the combine-harvester often refuse to do the harvesting. There were often cases in which crops were not harvested because of the problem mentioned above, resulting in the loss for farmers. Finally, late harvesting will leave very little time for preparation of the next growing season, leading again to the

delay in planting time. The delayed planting time during the period of April-September faces the risk of the dry season in August and September especially during El Nino years. A vast majority of farmers (83.6%) agreed that changes in the climatic factors had led to more pest and disease occurrences. In the study village, the main pest and disease that attack rice plants are rat, armyworm Spodoptera spp, birds, brown planthopper, and rice blast. These more occurrences of pest and disease are in line with the finding of Fosu-Mensah, Vlek, and MacCarthy [6] that changes in temperature and rainfall had led to an increase in pest and disease outbreak. Less rain during the rice-growing season could also lead to pest and disease outbreak [12]. The only impact that farmers' responses are at the "disagree" level is the increased drought with a mean score of 1.9. Some farmers perceived increased frequencies of drought as a result of El Nino events. However, many farmers said that dry months are more certain to occur in the period from August to October, and the only issue is with the rainfall amount during that period. Due to their connections with El Nino, prolonged droughts are usually predictable far in advance. In addition, many respondents believe that the impact of the droughts can be anticipated should farmers have a strong discipline to commence rice sowing and transplanting as per the recommended schedule. If farmers start rice sowing and transplanting in May then the harvest can be completed in August. This way, farmers can minimize the effect of the drought on rice farming.

4 CONCLUSION

Smallholder rice farmers perceived changes in the climate factors in the last decade or two. Farmers' perception on the changes in climate factors included increased temperature, irregular and less predictable precipitation, and more frequent extreme weather events. These farmers' perceptions were in line with the meteorological data on the trend in local temperature and rainfall. Farmers had perceived climate variability impacts, which include changes in planting calendar, more frequent flooding, difficulty in harvesting, and more frequent pest and disease occurrence. These perceptions of farmers regarding climate variability agree to the results of many studies regarding the vulnerability of rice farming to climate variability. Further studies need to find out adaptation strategies that the farmers have adopted and assess their effectiveness. Researchers and policymakers need to identify suitable adaptation strategies and assist their implementation to improve the present rice farming system to be more productive and adaptable to climate variability.

5 ACKNOWLEDGMENT

The authors would like to thank field extension workers at Konda subdistrict agricultural extension office, who had provided information during FGD and assisted researcher team to meet and discuss with farmers.

6 REFERENCES

[1] M.A. Haque, S.S. Yamamoto, A.A. Malik, and R. Sauerborn, "Households' perception of climate change and human health risks: A community perspective," Environmental Health, vol. 11 no. 1, 2012

[2] N.E. Korres, J.K. Norsworthy, N.R. Burgos, and M. Oosterhuis, "Temperature and drought impacts on rice production: An agronomic perspective regarding short- and long-term adaptation measures." Water resources and rural development, 9, pp. 12-27, 2017.

[3] J.R. Porter, L. Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell, and M.I. Travasso, "Food security and food production systems." In: C.B. Field et al. (Eds.), Climate change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 485–533. 2014

[4] P. Watkiss, S. Pye, G. Hendriksen, A. Maclean, M. Bonjean, N. Jiddawi, Y. Shaghude, M.A. Sheikh, and Z. Khamis, The economics of climate change in Zanzibar. Global Climate Adaptation Partnership (GCAP), 2012.

[5] M. Baragé, B. Moussa, and J. Comby, "Climate change perception and adaptation strategy associated with farming techniques in Tamou district western Niger," African Journal of Agricultural Research. 13(30), 1496-1507, 2018.

[6] B.Y. Fosu-Mensah, P.L.G. Vlek, and D.S. MacCarthy, "Farmers' perception and adaptation to climate change: a case study of Sekyedumase district in Ghana." Environ Dev Sustain, 14, pp. 495–505, 2012.

[7] E. Tari, I. Brown, and W. Chikagbum, "Climate change, Disaster Risk Management And The Urban Poor In Port Harcourt Metropolis," International Journal of Scientific & Technology Research. vol. 4 no. 5, pp. 58-65, 2015.

[8] H. Saediman, M.A. Limi, Rosmawaty, P. Arimbawa, and Y. Indarsyih, "Cassava Consumption and Food Security Status Among Cassava Growing Households in Southeast Sulawesi," Pakistan Journal of Nutrition, vol. 15 no 12, pp. 1008-1016, 2016

[9] M. Zani, H. Saediman, S. Abdullah, L. Daud, and L. Yunus, "Determinants of Household Food Expenditure in A Cassava Growing Village in Southeast Sulawesi," Academic Journal of Interdisciplinary Studies, vol. 8 no. 3, pp. 301-309, 2019 (in press).

[10] Badan Pusat Statistik, Pengeluaran untuk Konsumsi Penduduk Indonesia: Berdasarkan hasil SUSENAS Maret 2018. Jakarta, Indonesia: BPS RI, 2018.

[11] H. Saediman, S. Aisa, M. Zani, M.A. Limi, and W. Yusria, "Food Security Status of Households in a Cassava-Growing Village in Southeast Sulawesi, Indonesia," Journal of Agricultural Extension, vol. 23 no. 1, pp. 199-209, 2019

[12] N.T. Chung, A. Jintrawetb, and P. Promburom, "Impacts of seasonal climate variability on rice production in the Central Highlands of Vietnam." Agriculture and Agricultural Science Procedia, 5, pp. 83–88, 2015

[13] A Tripathi and A.K. Mishra, "Knowledge and passive adaptation to climate change: An example from Indian farmers." Climate Risk Management 16, pp. 195–207, 2017.

[14] B. Rao, P.S. Chowdary, V.M. Sandeep, V.U.M. Rao, and B. Venkateswarlu, "Rising Minimum Temperature Trends over India in Recent Decades: Implications for Agricultural Production. Global Planet. Change 117,

pp. 1–8, 2014.
[15] H.U. Nwalieji and C.O. Uzuegbuna, “Effect of climate change on rice production in Anambra State, Nigeria.” Journal of Agricultural Extension, vol. 16 no. 2. pp. 81-91, 2012
[16] Ruminta, “Analisis penurunan produksi tanaman padi akibat perubahan iklim di Kabupaten Bandung Jawa Barat.” Jurnal Kultivasi, vol. 15 no. 1, pp. 37-45, 2016
[17] H. Saediman, “Prioritizing Commodities in Southeast Sulawesi Province of Indonesia Using AHP Based Borda Count Method,” Asian Social Science, vol. 11 no. 15, pp. 171-179, 2015.
[18] Suprihati, Yuliawati, H. Soetjipto, and T. Wahyono, “Persepsi Petani dan Adaptasi Budidaya Tembakau-Sayuran atas Fenomena Perubahan Iklim di Desa Tlogolele, Kecamatan Selo, Kabupaten Boyolali.” J. Manusia dan Lingkungan vol. 22 no. 3, pp. 326-332, 2015.
[19] H.U. Nwalieji and E.A. Onwubuya, “Adaptation Practices to Climate Change Among Rice Farmers in Anambra State of Nigeria.” Journal of Agricultural Extension, vol. 16 no. 1, pp. 42-49, 2012
[20] E.G. Luka and H. Yahaya, “Sources of Awareness and Perception of the Effects of Climate Change among Sesame Producers in the Southern Agricultural Zone of Nasarawa State, Nigeria.” Journal of Agricultural Extension, vol. 16 no. 2, pp. 134-143, 2012.
[21] U. Bhandari, “Socio-economic and Climate Change Issues on Vegetable Seed Production in Rukum District.”Acta Scientific Agriculture vol. 3 no. 2, pp. 81-88, 2019.
[22] P. Koirala, “Impact of Climate Change on Rice Production in Tanahun, Nepal.” Acta Scientific Agriculture, vol. 3 no. 2, 91, 2019
[23] D. Chaulagain and P.R. Rimal, “Coping Mechanisms of Local People to Mitigate Climate Change Impacts on Water Resources in Kailali District-Nepal.” International Journal of Scientific Technology & Research. vol. 8 no. 4, pp. 117-121, 2019
[24] H. Saediman, Mustika, L. Nalefo, M. Tufaila and M. Zani, “Cost and returns analysis of rice farming and brick production in South Konawe District of Southeast Sulawesi.” International Journal of Scientific & Technology Research, vol. 8 no. 10, pp. 835-838, 2019.