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Farmers' Perceptions of the Impact of Climate Change and Their Adaptation Strategies in Rice Farming in Sibulue Subdistrict, Bone Regency, South Sulawesi Province

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Abstract

This study aims to: (1) determine farmers' perceptions of climate change, (2) determine farmers' perceptions of the impact of climate change on rice paddy production, and (3) their adaptation strategies in rice paddy farming in Sibulue District, Bone Regency, South Sulawesi Province. The sample determination used a census. So the number of selected farmer samples was 38 farmers. The analysis used was descriptive analysis by combining scoring, in this case, the question items will be given answers according to a 5-level Likert scale where the Likert scale has 2 forms of statements, namely positive statements and negative statements, and descriptive statistical analysis by combining scoring and percentages of respondents' answers. The results of the study showed that farmers' perceptions of climate change in Sibulue District, Bone Regency included the frequency and intensity of rainfall becoming uncertain in the high category (3.74), and more frequent flooding in the category (3.51). Farmers' perceptions regarding the impact of climate change on rice farming production in Sibulue District, Bone Regency include crop damage due to strong winds in the high category (3.78), and reduced access to food in the category (3.51). Rice farmers' adaptation strategies in facing climate change in Sibulue District, Bone Regency include using superior varieties or seeds (95%), using climate-smart technology (95%), changing cropping patterns (92%), cultivating other crops on dry land (89%), using pesticides (new types, increasing or decreasing the dosage) (89%), adjusting planting times (82%), and changing irrigation techniques (82%).

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INTRODUCTION

Agriculture is one of the main sectors in the economies of many countries, including Indonesia. As the main provider of food, this sector plays a crucial role in ensuring national food security and providing livelihoods for millions of people. In Indonesia, the agricultural sector contributes around 13% of the Gross Domestic Product (GDP) and employs around 15% of the total workforce (Santoso and Widodo, 2020).

The agricultural sector is highly vulnerable to climate change because it affects cropping patterns, planting times, production, and crop quality (Nurdin, 2011). Several studies show that the negative impacts of climate change can reduce potential agricultural production. The climate variables that most influence crop growth are rainfall, temperature, and humidity. These changes can reduce agricultural production by 5-20%. The magnitude of this decline can affect national food security.

Climate change is caused by various factors, including human activities such as fossil fuel combustion, deforestation, and industrialization, which increase the concentration of greenhouse gases in the atmosphere. As a result, there has been a global temperature increase that affects ecosystems, hydrological cycles, and weather patterns around the world (IPCC, 2021).

One commodity that is vulnerable to climate change is rice. Rice, as a staple food for more than half of the world's population, is highly dependent on stable climatic conditions to grow well. Changes in rainfall and temperature patterns due to climate change can disrupt critical phases in rice growth, such as planting, flowering, and ripening. Prolonged droughts can reduce the availability of irrigation water, while excessive rainfall can cause flooding that damages crops. In addition, increased temperatures can accelerate the evaporation of water from the soil and plants, as well as disrupt the photosynthesis process that is essential for rice growth (Daryanto, 2011).

The impact of climate change is also evident in the increase in pest and disease attacks on rice crops. Warmer temperatures and high humidity create ideal conditions for the development of pests such as planthoppers and diseases such as blast (leaf blight). Climate change can also cause geographical shifts in rice cultivation areas, forcing farmers to adapt to new varieties that may be more resistant to changing climatic conditions. All these factors contribute to a decline in crop yields and rice quality, which could ultimately threaten food security in many countries that rely on rice as a staple food (Suryana, 2010).

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The people of Sibulue District need to adapt to climate change in order to maintain sustainable rice production. One way to adapt is by adopting agricultural technologies that are more resistant to climate change, such as rice varieties that are resistant to drought and flooding. In addition, farmers also need to improve efficient irrigation systems and implement environmentally friendly agricultural practices, such as the use of organic fertilizers and integrated pest management. Education and training on these adaptation techniques are essential so that farmers can anticipate and reduce the negative impacts of climate change on their yields. Cooperation between local governments, research institutions, and farmer communities is also necessary to develop effective and sustainable adaptation strategies (Adimihardja and Mulyani, 2016).

Therefore, it is necessary to conduct research on farmers' perceptions of the impact of climate change and their adaptation strategies in rice farming in Sibulue District, Bone Regency, South Sulawesi Province.

METHOD

This research was conducted in three villages in Sibulue District, Bone Regency, South Sulawesi Province, namely Pakkasalo Village, Ajang Pulu Village, and Taddang Palie Village. The research locations were determined *purposively*, considering that Pakkasalo Village, Ajang Pulu Village, and Taddang Palie Village are the areas with the highest rice production among other villages in Sibulue District. The research was conducted from July 2024 to November 2024.

The population consisted of all farmers who had been cultivating rice for at least 15 years in Sibulue District, Bone Regency, up to the present time, namely 38 rice farmers spread across three villages, namely 13 in Pakkasalo Village, 12 in Ajang Pulu Village, and 13 in Tadang Palie Village. According to Arikunto (2012), if the population is less than 100 people, the sample size is taken as a whole. Based on this study, because the population is less than 100 respondents, the author took 100% of the population in the three villages, namely 38 respondents. The problem formulation regarding farmers' perceptions of the effects of climate change and their adaptation strategies in rice farming in Sibulue District, Bone Regency, South Sulawesi Province, was analyzed using qualitative data analysis with a Likert scale or scoring.

The analysis for the first and second objectives was conducted using descriptive analysis by combining scoring and qualitative description. In this case, the questions were answered using a 5-point Likert scale, which has two types of statements: positive and negative. Scoring or the Likert scale is a scale used to measure the attitudes, opinions, and perceptions of a person or group about a phenomenon or event (Sugiyono, 2012). The scale used to measure the level

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of assessment of rice farmers' respondents regarding climate change and the effect of climate change on rice farming production is a scale of 1 to 5, which can be seen in Table 1.

Table 1 Five-Point Likert Scale

Symbol	Description	Assessment Score	
		Positive Question	Negative Questions
SS	Strongly Agree	5	1
S	Agree	4	2
N	Neutral	3	3
TS	Disagree	2	4
STS	Strongly disagree	1	5

According to Sugiyono (2011), a measurement scale is an agreement used as a reference to determine the length of intervals in a measuring instrument, so that the measuring instrument produces qualitative data.

Next, create categories for the respondents' answers by finding the interval using the Likert scale formula according to Sugiyono (2012) as follows:

$$I = \frac{Highest\ Score - Lowest\ Score}{K}$$

Thus, the scale categories can be determined as follows:

- Very Low with a scale of 1.00-1.80
- Not High with a scale of 1.81-2.60
- Moderately High with a scale of 2.61-3.40
- High with a scale of 3.41-4.20
- Very High with a scale of 4.21-5.00

The analysis for the third objective was conducted using descriptive statistical analysis by combining the scores and percentages of the respondents' answers. According to Sugiyono (2013) , descriptive statistical analysis is statistics used to analyze data by describing or depicting the collected data as it is. In this case, to calculate the probability (percentage) of the adaptation strategies implemented by farmers, the results of the respondents' answers are divided by the total number of respondents and then multiplied by 100%. The simple formula for calculating the percentage is as follows:

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$$\% = \frac{Total\ pieces}{Number\ of\ Total} \text{ X } 100\%$$

RESULTS AND DISCUSSION

Respondent Characteristics

The following are the identities of respondents based on the age of farmers in Sibulue District, Bone Regency, South Sulawesi Province, based on age, education, number of dependents, income, and land area.

Table 1. Respondent Identity

Respondent Identity		Number	Percentage
Age (Years)	15-54	25	65.78
	≥ 55	13	34.22
Level of Education	No schooling	7	18.42
	Elementary	23	60.52
	Junior High School	3	07.90
	High School	4	10.52
	D3/S1	1	02.64
Number of dependents (persons)	1-3	18	47.37
	4-6	20	52.63
Farmers' Income	Above minimum wage	3	07.90
	Below UMK	35	92.10
Land Area (ha)	0.5-2.0 (Medium)	28	73.69
	> 2.0 (Large)	10	26.31

Based on Table 1 above, it can be explained that the identity of the respondents in this study is as follows;

1. Farmers in Sibulue District, particularly in Ajang Pulu Village, Tadang Palie Village, and Pakkasalo Village, with productive ages, numbering 25 respondents (65.78%) and non-productive ages, numbering 13 respondents (34.22%). Productive age allows for a decent change in life because they still have better physical abilities to work compared to non-productive age, whose physical abilities will decline/weaken. Farmers of productive age will be younger in running their farms and more capable of overcoming problems in farming. Meanwhile, non-productive age or 0-14 years old is not included in the category of research respondents.

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2. The average education level of rice farmers in Sibulue Subdistrict is elementary school, with 23 farmers or 60.52%. There are 7 farmers or 18.42% who did not attend school or did not complete elementary school. At the junior high school level, there are 3 farmers or 7.90%. Then, at the high school level, there are 4 farmers with a percentage of 10.52%. And at the D3/S1 education level, there is 1 farmer with a percentage of 02.64%. Based on this data, the highest level of education among farmers in Sibulue Subdistrict is elementary school (SD) with 23 people and a percentage of 60.52%. In this case, it can be seen that rice farmers in Sibulue Subdistrict will have difficulty quickly adopting new innovations and technologies in the face of climate change. In line with Soekartawi's (2006) opinion, education can influence farmers' mindsets in both accepting and applying innovations
3. Respondents with 1–3 dependents numbered 47.37%, while those with 4–6 dependents numbered 52.63%. There were no households with more than 6 family members.
4. The average income of rice farmers in Sibulue District, Bone Regency, is below the Regency/City Minimum Wage (UMK). The Regency/City Minimum Wage for Bone Regency is IDR 3,385,145, while the average income of farmers is around IDR 500,000.00 - IDR 1,000,000.00 per month. The average income of rice farmers in Sibulue Subdistrict is below the UMK for 35 respondents with a percentage of 92.10%, while 3 farmer respondents have an income above the UMK with a percentage of 7.90%. Even though the average farmer income is below the UMK, farmers in Sibulue Subdistrict , are still able to meet their daily needs. This is because farmers in Sibulue Subdistrict prioritize their income for buying food and other necessities rather than buying or fulfilling their desires.
5. Rice farming households in Sibulue Subdistrict have an average land area of 0.5-2.0 hectares, which is classified as medium-sized land, accounting for 53 (79%) farmers, including both small and large families. Ten (75%) farmers have a land area of 2.5 hectares. Meanwhile, no farmers with small land areas were found. The land area cultivated by farmers can also affect the income of farming households, so that the larger the land area owned, the greater the opportunity for farmers to earn higher incomes. Therefore, land area is one of the factors for earning higher incomes from farming, which helps farming households meet their food needs.

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Farmers' Perceptions of Climate Change

Perception is basically a process in which a person interprets, understands, and gives meaning to a phenomenon based on their experience, knowledge, and socio-cultural conditions. For farmers, perceptions of climate change are very important because they will influence the way they make decisions in managing their land and crop patterns. Climate change, which is characterized by shifting seasons, rising temperatures, erratic rainfall, and an increase in the frequency of natural disasters such as floods and droughts, is often felt directly by farmers in the field. Farmers' perceptions of climate change can be seen in the following table:

Table 2. Farmers' Perceptions of Climate Change

Statement	Number of Farmers Based on Respondents					Scale	Category
	1	2	3	4	5		
2.1	0	0	11	27	0	3.71	Height
2.2	0	0	12	26	0	3.68	Height
2.3	0	0	10	28	0	3.74	Height
2.4	0	0	12	26	0	3.68	Height
2.5	0	2	15	21	0	3.51	High

Table 2 shows farmers' perceptions of climate change. There are five statements presented in the climate change indicator.

1. Statement 2.1 "increase in temperature" that they feel during farming is in the high category with a scale of 3.71. The majority of respondents, 27 people (71%), agreed that there has been an increase in air temperature, which is relatively hotter. Farmers feel that every year the temperature in their area is getting hotter. Data from the BMKG in Maros Regency, South Sulawesi, also proves this, where the average air temperature for the period 1991-2020 was 26.7°C, while in 2024 it was recorded at 27.5°C, higher than in 2023, which was 27.2°C.
2. Statement 2.2 "the timing of the rainy and dry seasons has become unpredictable" was also rated highly, with a score of 3.68. The majority of respondents, 26 people (68%), agreed that the unpredictable timing of the rainy and dry seasons had an impact on their farming activities. Farmers feel that the unpredictable shift in seasons makes it increasingly difficult for them to predict the beginning and end of the rainy and dry seasons. When it should be raining, it is still dry, and vice versa. This condition makes it

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difficult for farmers to determine the planting time, while the uncertain dry season also disrupts the stability of water availability.

3. Statement 2.3, "the frequency and intensity of rainfall have become unpredictable," was also rated highly with a score of 3.74. The majority of respondents, 28 people (73%), agreed that the frequency and intensity of rainfall have become unpredictable. Meanwhile, 4 respondents stated that the current rainfall was the same as the previous year. This statement falls into the agree category because farmers directly feel the impact of the unpredictable frequency and intensity of rainfall, namely that farmers often have difficulty planning the planting and harvesting times for their rice fields.
4. Statement 2.4 "frequent droughts" was rated high with a scale of 3.68. The majority of respondents, 26 people (68%), agreed that droughts often occur in their area. Drought is one of the factors that causes crop failure and decreased production in rice farming due to water shortages.
5. Statement 2.5 "frequent flooding" was also rated highly with a score of 3.51. The majority of respondents, 21 people (55%), agreed that flooding often occurs in their area. This is due to high rainfall intensity and the fact that most of the farmers' land is located near rivers, causing some rice fields to be flooded and some farmers to suffer losses.

Table 3. Farmers' Perceptions of the Impact of Climate Change on Rice Farming Production

Statement	Number of Farmers Based on Respondents					Scale	Category
	1	2	3	4	5		
3.1	0	0	9	29	0	3.76	Height
3.2	0	0	10	28	0	3.73	Height
3.3	0	0	11	27	0	3.70	Height
3.4	0	0	12	26	0	3.68	Height
3.5	0	0	11	27	0	3.70	Height
3.6	0	0	12	26	0	3.68	Height
3.7	0	0	12	26	0	3.68	Height
3.8	0	0	12	26	0	3.68	Height
3.9	0	0	11	27	0	3.70	Height
3.10	0	0	8	30	0	3.78	Height
3.11	0	0	18	20	0	3.51	Height
3.12	0	0	15	23	0	3.59	Height
3.13	0	0	10	28	0	3.73	High

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E-ISSN: 2986-0733

Table 3 shows that there are 13 questions presented regarding farmers' perceptions of the impact of climate change on rice field productivity.

1. Statement 3.1 "changes in cropping patterns" is in the high category with a scale of 3.76. The majority of respondents, 29 people (76%), agreed that they had often experienced changes in cropping patterns in recent years. This greatly affects their farming because it is difficult to predict the onset of the rainy season.
2. Statement 3.2, "The frequency and intensity of pest and disease attacks have increased," is in the high category with a scale of 3.73. The majority of respondents, 28 people (74%), agreed that the frequency and intensity of pest and disease attacks have increased. Pests and diseases are the main obstacles in rice cultivation, such as rats, planthoppers, leaf rollers, stink bugs, stem borers, stem rot, leaf rust, and bacterial blight. These attacks can cause great losses for farmers, ranging from a decline in quality and yield to the risk of crop failure and financial losses.
3. Statement 3.3 "planting schedule" was also rated highly with a score of 3.70. The majority of respondents, 27 people (71%), agreed with changing the planting schedule. The planting schedule is an effort that takes into account several aspects, including plant age, climate, and treatment. Currently, most farmers in Sibulue sub-district still apply planting schedules based on the month and the occurrence of the rainy and dry seasons. This greatly affects their farming activities because it can cause problems and even crop failure due to prediction errors.
4. Statement 3.4, "decreased water availability," was rated high with a score of 3.68. The majority of respondents, 26 people (68%), agreed with the statement about decreased water availability. Water availability greatly affects the growth and production of paddy rice. Some farmers in the Sibulue sub-district rely heavily on rainwater because the distance from the river to their fields is quite far and difficult to reach. Water shortages will inhibit the rate of photosynthesis, cause rice leaves to curl, reduce rice seedlings, stunt rice growth, delay flowering, and cause empty grains.
5. Statement 3.5, "the risk of crop failure has increased," was rated high with a score of 3.70. The majority of respondents, 27 people (71%), agreed that the risk of crop failure has increased. In this case, the climate greatly affects the rice harvest. One of the causes of crop failure is the rainy season, which accelerates the reproduction of rats. Then, when the weather is warm, cloudy, and there is frequent drizzle, planthoppers will attack rice plants during the growth phase until the milk ripening phase. Planthoppers attack rice

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plants by sucking the sap from the flower stalks and rice grains. This causes the rice grains to be empty or unfilled.

6. Statement 3.6 "decline in production" is in the high category with a scale of 3.68. The majority of respondents, 26 people (68%), agreed with the decline in production. In this case, farmers feel a decline in production caused by various factors, namely unpredictable weather changes, pest and disease attacks, seed quality, and inappropriate use of fertilizers.
7. Statement 3.7 "increased risk of agricultural losses" is in the high category with a score of 3.68. The majority of respondents, 26 people (68%), agreed that the risk of agricultural losses had increased. This was due to reduced production yields and climate uncertainty.
8. Statement 3.8 "disruption to the photosynthesis and metabolism of plants" is in the high category with a score of 3.70. The majority of respondents, 27 people (70%), agreed that there is disruption to the photosynthesis and metabolism of plants. The photosynthesis of rice plants is directly related to chlorophyll content. Chlorophyll is a pigment that absorbs light in the process of photosynthesis. In this case, disturbances in the photosynthesis and metabolism of rice plants are caused by various factors such as disease, pests, and water shortages, which are characterized by dry and curled rice leaves, brownish rice stems, and chlorosis in rice seedling leaves.
9. Statement 3.9 "crop damage due to strong winds" was in the high category with a score of 3.78. The majority of respondents, 30 people (79%), agreed that strong winds cause crop damage. According to farmers, strong winds can damage rice plants by knocking them down, making them difficult to harvest. This damage can occur when the rice has started to form grains or is maturing. Damage to rice plants due to strong winds can take the form of fallen rice plants, reduced yields, difficulty in harvesting, and disruption of the nutrient transfer process.
10. The statement "reduced access to food" was in the high category with a scale of 3.51. The majority of respondents, 20 people (53%), agreed that access to food was reduced. This was due to climate change and the inability to access food sources.
11. Statement 3.11 "food availability is disrupted" is in the high category with a scale of 3.59. The majority of respondents, 23 people (60%), agreed that food availability is disrupted. In terms of food availability, climate is one of the main causes of economic instability for farmers.

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12. Statement 3.12 "income decline" is in the high category with a scale of 3.73. The majority of respondents, 28 people (74%), agreed that income had declined. In this case, if there is a decline in production, farmers' income will also decline.

Table 4. Adaptation strategies of rice farmers in facing climate change in Sibulue District, Bone Regency

Adaptation Strategies	M	%M	TM	%TM
Using superior varieties or seeds	36	95	2	5
Changes in cropping patterns	35	92	3	8
Cultivating other crops on dry land	34	89	4	11
Use of pesticides (new types, increasing or decreasing dosage)	34	89	4	11
Adjustment of planting time	31	82	7	18
Changes in irrigation techniques	31	82	7	18%
Use of new fertilizer, or increasing or decreasing the dosage	29	76	9	24
Use of climate-tolerant varieties	28	74	10	26
Intensifying group cooperation	27	71	11	29
Participating in training and education programs	25	66	13	34
Collaborating with farmers or other institutions	24	63	14	37
Raising livestock or fish	23	61	15	39
Changes in soil cultivation techniques	20	53	18	47
Soil conservation practices	10	26	28	74
Working outside the agricultural sector	3	8	35	92
Diversification of post-harvest products to obtain added value	2	5	36	95

Table 4 shows that the majority of farmers have implemented various strategies to cope with climate change. As many as 95% of farmers use short-maturing, salt- and drought-tolerant, high-yielding varieties or seeds. In addition, 92% of farmers have changed their cropping patterns due to declining yields in drought-prone areas. Most farmers also grow other crops on dry land, such as corn, long beans, and cassava (89%), to stabilize their income. Other strategies that are widely practiced include the use of new pesticides or dosage adjustments (89%) as a means of controlling pests and diseases, as well as adjusting planting times (82%) by taking into account rainfall and water availability, both in the rainy season and in the dry season, which relies solely on rainwater.

In addition, 76% of farmers adjusted their fertilizer use, for example by switching to

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organic fertilizers to reduce dependence on chemical fertilizers and reduce production costs. A total of 74% of farmers also chose crop varieties that are tolerant to climate change, such as short-maturing varieties, varieties that are tolerant to salinity and drought, and varieties with low greenhouse gas emissions. Other strategies include intensifying group cooperation (71%), participating in training and education programs (66%), collaborating with government agencies on fertilizer and seed subsidies (63%), and raising livestock or fish (61%) as an additional source of income . These efforts show that farmers are trying to adapt in various ways to maintain the sustainability of their farming businesses amid the challenges of climate change.

CONCLUSION

Based on the results regarding farmers' perceptions of climate change and their adaptation strategies in rice farming in Sibulue District, Bone Regency, South Sulawesi Province, it can be concluded that farmers' perceptions of climate change in Sibulue District, Bone Regency, include the frequency and intensity of rainfall becoming unpredictable in the high category (73%), and more frequent flooding in the lowest category (55%).

Farmers' perceptions of the impact of climate change on the productivity of rice farming in Sibulue District, Bone Regency, include crop damage due to strong winds in the highest category (79%), and reduced access to food in the last high category (53%).

The adaptation strategies of rice farmers in facing climate change in Sibulue District, Bone Regency, include using superior varieties or seeds (95%), using climate-smart technology (95%), changing planting patterns (92%), cultivating other crops on dry land (89%), using pesticides (new types, increasing or decreasing dosage) (89%), adjusting planting times (82%), and changing irrigation techniques (82%).

REFERENCES

Adimihardja, A., & Mulyani, A. (2016). Agricultural Adaptation to Climate Change. Jakarta: Agency for Agricultural Research and Development.

Arikunto, Suharsini. (2012). Research procedures: a practical approach. Jakarta: PT Rineka Cipta.

Daryanto, H. (2011). The Effect of Climate Change on Rice Productivity in Indonesia. Journal of Agroclimatology, 3(1): 23-29.

IPCC. (2021). Climate Change 2021: The Physical Science Basis. Cambridge: Cambridge University Press.

Nurdin. (2011). Anticipating climate change for food security sustainability. North Sulawesi: Gorontalo State University.

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Santoso, D., & Widodo, A. (2020). The Impact of Climate Change on Agricultural Production in Indonesia. Jakarta: Agency for Agricultural Research and Development.

Soekartawi. 2006. Blended e-learning. Fire Engineering, 156(5), 16–18.

Sugiyono. (2011). Quantitative, Qualitative, and R&D Research Methods. Bandung: Alfabeta, CV.

Sugiyono. (2012:95). Quantitative, Qualitative, and R&D Research Methods. Bandung: Alfabeta, CV.

Sugiyono. (2013). Quantitative, Qualitative, and R&D Research Methods. Bandung: Alfabeta, CV.

Suryana, A. (2010). The Challenges of Climate Change on Food Security in Indonesia. Journal of Agricultural Policy, 5(1): 1-14.

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