

Sustainable Strategy for Rice Crop Management in Pinrang Regency, South Sulawesi, Indonesia

Medar M Nur¹, Ramli Umar¹, Suprpta², Arfandi¹, Rusman Rasyid³, Rosmini Maru¹, Abdul Mannan², and Sukri Nyompa^{1*}

¹Graduate Program of Geography Education, Universitas Negeri Makassar, 90224, Makassar, Indonesia

²Department of Geography, Faculty of Mathematics and Natural Science, Universitas Negeri Makassar, 90224, Makassar, Indonesia

³Geography Education Study Program, Faculty of Teacher Training and Education, Universitas Negeri Khairun, 97735, Ternate, Indonesia

Abstract. Climate change is one of the trending topics to be discussed at both the practical and political levels. Climate change has a significant effect on rice plants because rice cultivation is dependent on climate elements, especially rainfall, and temperature, the phenomenon of climate change has triggered an increase in the intensity of extreme events such as floods and droughts, causing crop failure, crop failure and even cause puso. Pinrang Regency is one of the regions in Indonesia that feels the impact of climate change on the agricultural sector. The research aims to develop appropriate adaptation strategies to climate change for rice crop management. The technique of collecting data is through in-depth interviews with respondents, namely rice farmers in Pinrang Regency using a purposive sampling technique. Data analysis uses SWOT analysis (strengths, weaknesses, opportunities, and threats), by determining internal factors and external factors and formulating climate change adaptation strategies for rice crop management in Pinrang Regency using an analytical tool, namely the SWOT matrix. The results showed that the strategies that could be implemented for the management of rice plants in Pinrang Regency were cultivating farmers by applying irrigation technology, developing water management technology, optimizing the performance of farmer groups, providing intensive climate information, and cultivating environmentally friendly technologies.

1 Introduction

Climate change is a significant change that has occurred over a long period. Climate change has an impact on human life, especially in the agricultural sector. Cultivation of food crops is very dependent on climate, especially rainfall, and temperature, there is a significant impact of climate change on rice crops [1]. Climate change can pose a threat to the level of agricultural production, especially rice agricultural products which are food that is needed in the future on the Asian continent and other continents, examples of climate change are temperature changes in long-term trends, rainfall, and increase variability in extreme events. According to [2]. The agricultural sector is very vulnerable to future climate change and climate variability, including increasing extreme climate events, changes in temperature and rainfall will result in changes to soil and water regimes which will in turn affect agricultural productivity. The impact of these changing conditions on agriculture is already being seen, but there are still sizeable gaps in our knowledge of how agricultural systems will be affected by short-term and long-term climate change, and what implications will this change bring, especially the most vulnerable for the livelihoods of rural communities.

The majority of Indonesian people work as farmers. Because of the extent of agriculture in Indonesia, most Indonesians work as farmers. In an agrarian country, Indonesia, the population works as farmers. Of course, climate phenomena have a significant impact on the national economy as a whole. According to [3] concerns about new agricultural production, especially food crops, and the development sector, as well as various aspects of daily life, are considered a negative impact of climate change. In the future, agricultural development will face quite tough challenges, including 1) decreased productivity and production which must be overcome through technological innovation; 2) degradation of soil and air resources, which reduces soil fertility and causes pollution; 3) climate variability and change resulting in floods and droughts; 4) land conversion, which fragments agricultural land.

Decreased agricultural productivity can be caused by force majeure or in other words beyond human control such as natural disasters, Indonesia is located in the ring of fire, so Indonesia will be more often affected by natural disasters, one of the disasters caused by climate change (eg drought and floods). Meanwhile, national food sovereignty is an important issue that is always a priority in every policy. National food sovereignty, which originates from food security, however, is disrupted by the impact of climate change.

* Corresponding author: sukrinyompa@unm.ac.id

Extreme climate events including El Nino/La Nina, rising sea surface temperatures, dipole modes, and east/west monsoons have affected the rainy season in Indonesia [4].

One of the regencies in South Sulawesi that has extensive rice barns, namely Pinrang, therefore climate information is needed, but information about climate in Pinrang Regency is still lacking especially in the agricultural sector. Pinrang Regency is one of the regions in Indonesia that is experiencing the impact of climate change on the agricultural sector, one of the impacts of the changes being felt is pest attacks on rice plants which affect rice production. Climate change is widely expected to make pest infestation more widespread, and coupled with the uncertainty of how climate change will directly affect crop yields, the interactions between insects and plants in ecosystems remain unclear [5]. Pinrang Regency is one of the rice-producing districts in the Province of South Sulawesi with potential land so that many residents work as farmers and make farming their main job. The agricultural sector has an important role in the economy of Pinrang Regency, one of the most produced food crop commodities in Pinrang Regency is rice. Based on 2021 BPS data, the production of rice plants in Pinrang Regency in 2020 reached 638,982 tons (an increase compared to 2019, which was only 589,515 tons) harvested from an area of 108,302 Ha or with a productivity of 5.90 tons/Ha, when compared to 2017, production in 2019 has decreased where production in 2017 was 629,909 tons with a harvest area of 105,726 Ha or with productivity of 59.58 kw/Ha. Pinrang Regency is in second place for rice producers in the province of South Sulawesi after Soppeng Regency, but in the last 10 years, rice productivity in Pinrang Regency cannot be said to be in good condition, in the results of evaluating land characteristics for irrigated lowland rice [6].

According to [7] There were 70% of rice farmer respondents said they were feeling the impacts of climate change in the agricultural sector. Climate problems have resulted in crop failures and decreased agricultural yields so it has greatly affected the economy of the people who only work as farmers and make it their main source of livelihood. Meanwhile, starting in early 2022, an irrigation canal work project has been established, which will prevent farmers in several sub-districts in Pinrang district from going down to their fields (not planting rice), this will greatly affect the income of farmers, but their survival, there will be some continue to plant rice or go down to the fields depending on rainwater or a rain-fed rice field system, and the majority experience crop failure.

Various agricultural problems are caused by climate change in Pinrang Regency, to be able to reduce these impacts farmers must have the right adaptation strategy for processing rice plants, to maintain the productivity of rice farming in Pinrang Regency. Farmers implement change adaptation strategies to reduce the risk that these changes will harm their agricultural income [8]. Adaptation strategies are efforts or methods that are carried out by individuals or groups to overcome the problems faced to achieve the expected

goals, whereas according to [5] climate change adaptation can be seen as a process of continuous implementation of existing risk management strategies and reduce the potential risks from the impacts of climate change.

2 Research Methods

This research is a mixed method research (combined research) between qualitative methods and quantitative methods. The research was conducted in Pinrang District, South Sulawesi, Indonesia. Data collection was carried out through in-depth interviews with farmers to obtain the necessary data. The sample of this research is 60 people who are used as respondents. Data analysis uses the SWOT analysis method, which determines internal factors and external factors, internal factors consist of strengths and weaknesses, while external factors consist of opportunities and threats. As a planning method used, swot analysis evaluates the factors that become strengths, weaknesses, opportunities, and threats that may occur in achieving the objectives of a business activity or institution on a broad scale [9]. After the SWOT factors are determined, then create a SWOT IFAS and EFAS matrix to develop strategies, then determine alternative strategies using the SWOT quadrants.

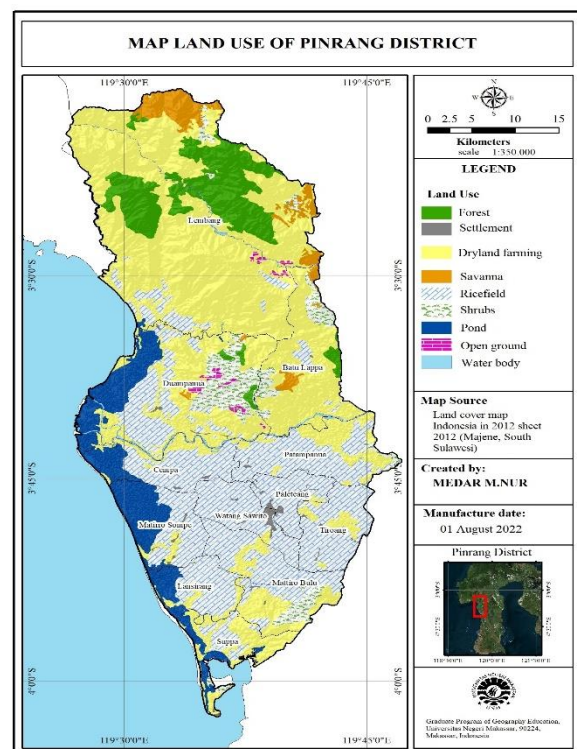


Fig. 1. Map Land Use Of Pinrang District

3 Result and Discussion

Current climate change has made food crop farmers as well as horticultural crops suffer a lot of losses, due to erratic weather conditions causing erratic planting and harvesting seasons, making it difficult for farmers to predict the weather during the planting season [10].

According to [11] stated that farmers fully know and feel the changes that occur as a result of climate change such as changes in the planting season, temperature changes, changes in rainfall, extreme weather in the form of changes in rainy days, and wind rain. temperatures are getting warmer, and attacks, but farmers have not been able to explain in detail what climate change is, besides that farmers are also feeling the effects of climate change, including farmers experiencing a decrease in crop yields. Rice fields are all agricultural activities in wetlands with a mound pattern. The area of land use for rice fields in Pinrang Regency is 54,921 Ha or 29.28% of the total area of Pinrang Regency spread over sub-districts in Pinrang Regency. Based on the results of research and SWOT analysis, including the weaknesses, strengths, opportunities and threats of rice farming in Pinrang Regency, namely:

3.1 Internal Factors

According to [12] this factor affects the formation of strengths and weaknesses. Where this factor concerns the conditions that occur within the company or activity/project and affect the formation of company decisions or activities/projects. Furthermore, according to [13] Strengths (strengths) of internal factors that support the company to achieve its goals, and weaknesses (Weaknesses) of internal factors that hinder the company from achieving its goals

Table 1. Internal factors (strengths and weaknesses of agriculture in Pinrang district)

Strength	Weaknesses
good production quality.	The use of varieties that are not following the season.
supportive human resources.	Cultivation techniques depend on the experience of farmers.
awareness of farmers about the impact of climate change.	Lack of farmer participation in field extension management activities.
available seed breeding land.	Controlling the impact of climate change is not optimal
farmer groups.	Low farmer education
supporting facilities and infrastructure.	Determination of the planting schedule is not optimal
extensive agricultural land potential.	Farmers' cooperation culture is slowly being left behind
available agricultural cultivation technology.	Uneven distribution of government subsidies

3.2 External factors

These factors affect the formation of opportunities and threats, where these factors relate to conditions that occur outside the company or activities/projects and influence decision-making [12]. Furthermore, according to [13] opportunities are external factors that support the

company to achieve its goals, while threats are external factors that hinder the company from achieving its goals.

Table 2. External factors (Opportunity and Threat of agriculture in Pinrang district)

Opportunity	Threat
Development and improvement of agricultural infrastructure	Climate change
High grain demand	Lack of information about climate
Land conversion into rice fields.	Low grain prices
Government support for agriculture.	High nests of plant-disturbing organisms
development of cultivation technology.	Limited cultivation tools and materials (expensive and difficult to obtain).
	Limited irrigation water.

3.3 Data Analysis

Based on the problem formulation that has been stated previously, to formulate an adaptation strategy, a SWOT analysis is used. After knowing the internal factors and external factors, then these factors will be analyzed using the IFAS matrix (internal strategic factor analysis summary) and EFAS (External Strategy Factor analysis summary) as follows:

3.3.1 Matrix IFAS (Internal Factors Analysis Summary)

After the internal strategic factors are identified, the IFAS matrix (Internal Factors Analysis Summary) is used to find out how big the role of internal factors is in the company by formulating these internal strategic factors in terms of strengths and weaknesses[14].

Table 3. IFAS Matrix for Agriculture in Pinrang

Internal factors	Weight	rating	Score
(Strenght)			
Good production quality	0.08	4	0.30
Supportive human resources	0.08	4	0.32
Awareness of farmers about the impact of climate change	0.08	4	0.30
Available seed breeding land	0.03	2	0.06
Available agricultural cultivation technology	0.07	3	0.20
Extensive agricultural land potential	0.08	4	0.32
Supporting facilities and infrastructure	0.07	3	0.19
Fermer groups	0.04	2	0.08
Sub Total	0.53		1.82
(Weakness)			
The use of varieties they are not following the season	0.07	4	0.29
Cultivation techniques depend on the experience of farmers	0.08	4	0.30

Lack of framer participation in field extension management activities	0.06	3	0.17
Controlling the impact of climate change is not optimal	0.04	2	0.08
Low farmer education	0.03	2	0.06
Determination of the planting schedule is not optimal	0.04	2	0.07
Uneven distribution of government subsidies	0.08	4	0.30
Farmers' cooperation culture is slowly being left behind	0.08	4	0.30
Sub Total	0.46		1.59
Total of strengths and weakness	1		

From the IFAS matrix above, it can be seen that the total strength of 1.82 is greater than the total score of the weakness variable (1.59) so it can be said that in the preparation of climate change adaptation strategies for rice plant management in Pinrang Regency, the strength variable is more influential than the weakness variable.

3.3.2 Matrix EFAS (External Factors Analysis Summary)

After the external strategic factors are identified, the EFAS matrix (External Factors Analysis Summary) is used to find out how big the role of external factors is in the company by formulating those external strategic factors in the opportunity framework (Opportunities) and threats [14]

Table 4. EFAS Matrix for Agriculture in Pinrang

External factors	Weight	Rating	Score
(Opportunity)			
Development and improvement of agriculture infrastructure	0.09	3	0.26
High grain demand	0.10	4	0.42
Land conversion into fields	0.06	2	0.12
Government support for agriculture	0.09	4	0.38
Development of cultivation technology	0.10	4	0.40
Sub Total	0.45		1.60
(Threats)			
Climate change	0.10	4	0.42
Lack of information about climate	0.10	4	0.40
Low grain prices	0.09	3	0.25
High nests of plant-disturbing organisms	0.10	4	0.40
Limited cultivation tools and materials(expensive and difficult to obtain)	0.09	3	0.26
Limited irrigation water	0.06	2	0.12
Sub Total	0.54		1.88
Total opportunity and threats	1		

From the EFAS matrix above, it can be seen that the total threat variable is 1.88 greater than the total opportunity variable (1.60), so it can be said that in the preparation of climate change adaptation strategies for the management of rice plants in Pinrang district, it is necessary to pay more attention to and minimize threats so that the goal can be achieved.

3.4 SWOT Analysis

The preparation of the SWOT matrix is carried out after the identification of internal and external factors. The SWOT matrix can provide an alternative climate change strategy for rice crop management in Pinrang Regency. From the results of data management for internal and external factors, the total score for each factor is obtained, as follows:

- total score for strength factor = 1,82
- total score for weakness factor = 1,59
- total score for opportunity factor = 1,60
- total score for Threats factor = 1,88

Then the horizontal axis (X) is obtained as an internal factor (strengths-weaknesses), as follows:

$$X = (1,82 - 1,59) = 0,23$$

As for the vertical axis (Y) as an external factor (opportunities-threats), the ordinal values are obtained as follows:

$$Y = (1,60-1,88) = -0,28$$

In the SWOT analysis diagram, the coordinate values (X, Y) or (0.23; -0.28), are located in quadrant 2, namely with an alternative strategy (S-T), as follows:

- Empowerment of farmers to apply rain harvesting technology by utilizing the availability of existing agricultural infrastructure (dams and ditches).
- Development of water management technology
- Optimizing the work of farmer groups for the welfare of their members.
- There is a need for information on climate change and intensive information on climate change/conditions.
- Optimizing the management of agricultural cultivation to maintain production quality to minimize losses due to low grain prices.
- Training on environmentally friendly technology cultivation.
- Implement environmentally friendly cultivation, such as the use of low-emission varieties and the use of organic fertilizers.

4 Conclusion

The enormous impact of climate change is a challenge for the agricultural sector. The adaptation strategies carried out by people experiencing climate change for the negative impacts are of course different in each region. Research conducted by [15] explains that the strategy that has been carried out by the community, especially farmers, is to change their schedule or

planting time, the agroforestry system, or community tumpang sari. Apart from the community, the government also plays a role in supporting community adaptation to climate change. the role of the community is realized by the existence of intervening policies that can protect farmers from the threat of climate change, for example, easy access to capital, subsidies, and adjustments to modern technology. Meanwhile, according to [16] climate change adaptation is carried out in two ways, namely technology adoption and management adoption. Where in the adoption of technology that can be adopted as an adaptation strategy to climate change, namely: adjustment of planting season, use of superior varieties resistant to drought, soaking, and salinity, as well as the development of water management technology, for the second adoption, namely: farming that needs to be implemented (the business was which saves water by reducing the height of the inundation in the rice fields, immersing the remaining plants in the ground, accelerating planting with appropriate technology).

The adaptation strategies carried out by people experiencing climate change for the negative impacts are of course different in each region. Based on the results of the analysis that has been carried out, it can be seen that the most appropriate strategy in dealing with climate change for rice crop management in Pinrang Regency is Empowering farmers to apply rain harvesting technology by utilizing the availability of existing agricultural infrastructure (reservoirs and ditches), Development of management technology water, Optimizing the work of farmer groups for the welfare of their members, There is a need for counseling on climate and information on intensive climate change/conditions, Optimizing the management of agricultural cultivation to maintain product quality to minimize losses due to low grain prices, Training in environmentally friendly technology cultivation, Implementing cultivation environmentally friendly, such as the use of low-emission varieties and the use of organic fertilizers. In addition, adaptation efforts need to be balanced with mitigation efforts, namely by reducing sources or increasing greenhouse gases (the use of organic fertilizers and low-emission varieties).

References

1. Ruminta. Analysis of decreasing production of paddy due to climate change in Bandung district West Java. *J Kultiv.* 2016;**15**(1):37–45.
2. Liu DL, Macadam I, Anwar muhudin rajin, Kelly G. *Adapting agriculture to climate change : a review.* Springer. 2012;
3. Surmaini E, Runtunuwu E, Las I. Upaya sektor pertanian dalam menghadapi perubahan iklim. *litbang Pertan.* 2011;**30**(1):1–7.
4. Andrianyta H, Hermawan H. Analisis perubahan perilaku petani sebagai adaptasi terhadap dampak perubahan iklim di daerah iklim kering Nusa Tenggara Timur. *Pros Semin Nas Agroinovasi Spesifik Lokasi Untuk Ketahanan Pangan Pada Era Masy Ekon ASEAN [Internet].* 2017;571–84.
5. Skendži S, Zovko M, Paja I. The Impact of Climate Change on Agricultural Insect Pests. *Insects.* 2021;**12**(440):1–31.
6. Wunangkolu R, Rismaneswati R, Lopulisa C. Karakteristik Dan Produktivitas Lahan Sawah Irigasi Di Kecamatan Duampanua Kabupaten Pinrang. *J Ecosolum.* 2019;**8**(1):34.
7. Kamaluddin A, Kaimuddin. Tingkat Kerentanan Dan Adaptasi Terhadap Perubahan Iklim Berbasis Ekosistem Padi Di Provinsi Sulawesi Selatan. *J Din Pengabd.* 2019;**5**(1):71–82.
8. Rasmikayati E, Djuwendah E, Mukti GW, Rachmat B. analisis strategi adaptasi terhadap perubahan iklim pada petani padi di jawa barat. 2015;46–52.
9. Utsalina dwi safieoh, Primandari LA. Analisis Swot dalam penentuan bobot kriteria pada pemilihan strategi pemasaran menggunakan analytic network process. *J Ilm Tek Inform.* 2020;**14**(1):41–50.
10. Tando e. Review : pemanfaatan teknologi greenhouse dan dalam budidaya tanaman hortikultura. *Buana Sains.* 2019;**19**(1):91–102.
11. Nuraisah G, Kusomo R. Impact Of Climate Change On Pady Farming In Wanguk Village Anjatan Subdistrict Indramayu District. *Agribisnis.* 2019;**5**(1):60–71.
12. Nisak Z. Analisis SWOT untuk menentukan strategi kompetitif. 2014;
13. Harisudin M. Metode penentuan faktor-faktor keberhasilan penting dalam analisis SWOT. *ilmu-ilmu Pertan.* 2019;**3**(2).
14. Rumambi AC, Soepeno D, Tampenawas JLA. Determination of Marketing Strategy in Increasing Competitive Advantage By Using SWOT Analysis in the Middle of The Covid-19 Pandemic. *J Emba.* 2022;**10**(3):615–23.
15. Nurhayati D, Dhokhikah Y, Mandala M. Presepsi dan Strategi Adaptasi Masyarakat Terhadap Perubahan Iklim di Kawasan Asia Tenggara. *J Lingkung berkelanjutan.* 2020;**1**(1):00–00.
16. Adib M. Pemanasan Global, Perubahan Iklim, Dampak, dan Solusinya di Sektor Pertanian. *BioKultur.* 2014;**3**(2):420–9.

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