World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Analysis of adaptation level of farmers affected by floods in paddy fields in Karang Agung Village, Jejawi District, Ogan Komering Ilir regency

Ari Nurrahman [1] and Nurilla Elysa Putri [2,*]

[1] *Agribusiness Study Program, Faculty of Agriculture, Sriwijaya University, Palembang Indonesia.*
[2] *Department of Social Economics, Faculty of Agriculture, University of Sriwijaya, Palembang Indonesia.*

World Journal of Advanced Research and Reviews, 2024, 23(02), 1886–1896

Publication history: Received on 09 July 2024; revised on 19 August 2024; accepted on 22 August 2024

Article DOI: https://doi.org/10.30574/wjarr.2024.23.2.2541

Abstract

The objective of this research is to: (1) To find out the impact of flooding occurring on the wilderness in the village of Karang Agung (2) To know the analysis of the degree of adaptation to the influence of the flood on the land of the farmers (3) to know the adaptation efforts of farmers through clusterization analysis. This research was done in the village of Karang Agung. Research methods used are survey methods and purposive sampling methods. The total sample taken is 31 farmers showing that: the impact of the flood on the management of the farm, the cultivation and marketing statistics and the strategy of financing the farm still affected by the floods, as well as the farmers' rate of adaptation is still low this is reinforced by the low result of the clustering of farmers.

Keywords: Farming; Flood; Adaptation; Flood impact

1. Introduction

Indonesia, as a tropical country, is experiencing heavy rainfall that can be affected by climate change. The impact of climate change in this region is evident through fluctuations in the intensity of rainfall that raise problems such as floods and droughts. Farmers are the most affected by this climate change. The agricultural sector is heavily dependent on the climate, as changes in rainfall patterns can interfere with rainy seasons and droughts, thereby increasing the likelihood of harvest failure due to flooding and dryness [1].

Flooding is one of the natural phenomena that arise as a result of high rainfall causing a congestion of water that can not be conducted by the drainage system in a particular area, resulting in significant losses. The effects of floods are often difficult to cope with, both by the general public and by the farmers. Changes in life strategies are also experienced by peat farmers to cope with the risks of climate change, such as the spills and floods that occur on their farmland. Farmers are turning to farming that is not focused on plants, such as gardens, backyards, or other fields. This is due to the inability of wild land that is no longer reliable as a primary source of income for them. Nevertheless, agriculture remains the main option preferred by peasants. Furthermore, they may also be seeking livelihoods in non-agricultural sectors, such as being farm workers, construction workers, or traders, because farming other than peas can no longer meet their living needs [2].

Rice fields are the main focus and primary resource for rural communities to fulfil food crop needs. In areas without irrigation systems, water availability is highly dependent on rainfall patterns. Potential climate change may create an imbalance between water supply and crop water requirements. This encourages farmers to adapt crop matching practices [3].

* Corresponding author: Nurilla Elysa Putri

One of the areas in South Sumatra that is prone to flooding is Ogan Komering Ilir Regency, based on data from the Food Crops and Horticulture Protection Centre of South Sumatra Province that the incidence of flooding in Ogan Komering ilir Regency experiences up and down intensity every year. Ogan Komering ilir Regency is one of the affected by floods amounting to 4,118.25 thousand hectares with a loss of 2,421.25 thousand hectares [4]

This flooding event has become a problem in Karang Agung village of Jejawi district of Ogan Komering Ilir Regency. Because the flooding will affect the destruction of agricultural land resources, the rate of adaptation of farmers and environmental problems. In addition, the impact of the floods has led to a decrease in productivity in the agricultural fields, such as the congestion of the wilderness that can be caused by high rainfall and resulting in flooding. As a result of these floods, farmers are required to adapt in dealing with the flood of the land that is the primary livelihood to survive. Therefore, in this study, researchers want to see the rate of adaptation in rice field farmers in Karang Agung village, jejawi district, Ogan Komering ilir regency, South Sumatra.

2. Material and methods

The research was conducted in Karang Agung Village, Jejawi District, Ogan Ilir Regency. the location selection was carried out purposively, the area is one of the areas in Jejawi District that experienced flooding. the sample criteria of this study were rice farmers who already had a minimum experience of under 10 years and had a maximum land area of 2 hectares. the population of rice farmers in Karang Agung Village was 102 people with a sample size of 31 rice farmers.

The method used to answer the first objective, namely the impact of flooding on rice fields in Karang Agung Village, Jejawi Subdistrict, Ogan Komering Ilir Regency, was answered using a guttman scale. There are only two intervals on the guttman scale, namely agree and disagree [5]. Data processing using percentage calculations using the percentage formula [6] as follows:

$$P = \frac{F}{N} x\ 100\%$$

Explanation:

P: percentage
F: frequency (respondent's answer)
N: number of respondents

If the calculation has been done, then the results of the presentation calculation are used to look at each indicator affected or not affected by the adaptation of the farmer. As for the percentage criteria used in detail [7] as follows:

Table 1 Presentation of Assessment Criteria

No	Percentage	Criteria
1	0-50%	Not Affected
2	50-100%	Affected

If the calculation in the form of a percentage is obtained 0%-50%, it is included in the criteria not affected by flooding. Meanwhile, if the number 51%-100% is obtained, it is included in the flood affected criteria.

To answer the second objective, namely analysing the level of adaptation to the impact of flooding on rice fields, using a Likert Scale or Score calculation. The form of adaptive capacity to flooding is divided into 3 indicators, which can be seen in Table 2.

Table 2 Farmer Adaptation Indicators

No	Indicator	Parameters	Criteria
1	Farm Management	Tillage	Low
		Gardening or raising livestock in the yard	Medium
		Increase in embankment height	High
2	Cultivation Strategy	Changing the planting system and the cultivar of planting	Low
		Longer stock supply	Medium
		Use of flood-resistant seedlings	High
3	Marketing and Farm Capital Strategies	Selling rice to the market	Low
		Buying input on credit	Medium
		Farm capital from banks and non-governmental organisations	High

Based on Table 2. Each indicator has sub-indicators measured with 3 questions. These indicators are then grouped into class intervals by giving a score of 3 for the high category, score 2 for the medium category and score 1 for the low category. The formula that will be used to create class intervals is as follows:

$$NR = NST - NSR$$

$$PI = NR : JIK$$

Explanation:

NR : Range Value
NST : Highest score value
NSR : Lowest score value
PI : Interval length
JIK : Number of class intervals

Table 3 Class interval per indicator

No	Class interval value (total score)	Class interval value (per-indicator)	Class interval value (per- question)	Criteria
1	9,00 ≤ x ≤ 15,00	3.00 ≤ x ≤ 5.00	1.00 ≤ x ≤ 1.67	Low
2	15,00 < x ≤ 21,00	5.00 < x ≤ 7.00	1.67 < x ≤ 2.34	Medium
3	21,00 < x ≤ 27,00	7.00 < x ≤ 9.00	2.34 < x ≤ 3.00	High

Source: Primary Data Processing Result, 2024

For the third objective, namely analysing the clustering of adaptation levels to flood impacts using the K-means method using the SPSS application where this method is categorised in the clustering method. The stages in the K-means method are [8] as follows:

Determine how many clusters to form, where the value of K is the number of clusters or the number of clusters.

Determine the initial cluster centroid. The initial centroid is determined randomly from the existing data and the number of initial centroids is equal to the number of clusters.

After determining the initial centroid, each data will find its closest centroid by calculating the distance of each data to each centroid using the correlation formula between two objects, namely Euclidean Distance.

$$deuclidea\ (x, y) = \sqrt{\sum_{i=1}^{n}(xi - yi)^2}$$

Explanation:
d(x,y) = Data distance to x to the center of the cluster
y xi = Data i on data attribute to n
yi = J data on data attribute to n

After calculating the distance of the data to its centroid, the next step is to group the data based on the minimum distance. A data will become a member of a cluster that has the closest (smallest) distance from its cluster centre.

Based on the clustering, the next step is to find a new centroid based on the membership of each cluster by calculating the average of the data of each cluster.

Return to step 3. The loop stops when there is no more data to move.

3. Results and discussion

3.1. Identity of respondents

Tabel 4 Characteristics of Respondents

No	Identity	Amount (People)	Percentage (%)
1	Age (Years)		
	36-45	12	38.71
	46-55	4	12.90
	56-65	9	29.03
	>65	6	19.35
2	Farming Experience (Years)		
	<10	5	16.13
	10-20	11	35.48
	>20	15	48.39
3	Land Area (Ha)		
	0,5	2	6.45
	1	21	67.74
	2	8	25.81

Source: Primary Data Processing Results, 2024

3.2. Impact of Flooding on Rice Fields

The impact of flooding on paddy fields in this study can be seen from 3 indicators, namely farm management, cultivation and marketing strategies and farm capital strategies. In each indicator given questions with 3 questions each, to see the impact of flooding on paddy fields can be seen in Table 5.

Table 5 Impact of Flood on Rice Fields in Karang Agung Village

No	Indicator	Frequency of Respondents Answers		Total	Percentage (%)		Total (%)
		Yes	No		Yes	No	
1	Farm Management	82	11	93	88%	12%	100%
2	Cultivation Strategy	76	17	93	82%	18%	100%
3	Marketing and Farm Capital Strategies	43	50	93	46%	54%	100%

Source: Primary Data Processing Results, 2024

In Table 5. it can be seen that the affected farm management indicators are 88%, while the affected cultivation strategies are 82% and the affected marketing and farm capital strategies are 46%. Based on the results of the analysis of the impact of flooding on rice fields from each indicator can be seen from the discussion below

3.3. Indicator Farm Management

The impact of flooding based on farm management indicators can be seen in Table 6. The following

Table 6 Indicator Farm Management

No	Indicator	Frequency of Respondents Answers		Total	Percentage (%)	
		Yes	No		Yes	No
1	The creation of slopes reduces the impact of flooding.	28	3	31	90%	10%
2	Making a field for gardening or livestock.	25	6	31	81%	19%
3	Ascension of the threshold	29	2	31	94%	6%
	Amount	82	11	93	88%	12%

Source: Primary Data Processing Results, 2024

Based on Table 6. above, it can be seen from field research that based on the indicator of making mounds affected by flooding because water can still enter farmers' rice fields which makes rice submerged. Indicators of making yards for gardening Because the yard of the farmer's house is very limited with the distance between houses very close together and located on the edge of the river which makes it difficult for farmers to do gardening in the yard of the house. Indicators of raising embankments still affected by flooding on farmers' land

3.4. Cultivation Strategy

The impact of flooding based on cultivation strategy indicators can be seen in Table 7

Table 7 Indicator Cultivation Strategy

No	Indicator	Frequency of Respondents Answers		Total	Percentage (%)	
		Yes	No		Yes	No
1	Changes planting patterns and selects suitable varieties	27	4	31	87%	13%
2	Provision of harvest stocks	25	6	31	81%	19%
3	Flood-resistant seed	24	7	31	77%	23%
	Amount	76	17	93	82%	18%

Source: Primary Data Processing Results, 2024

Based on Table 7 above, indicators can be seen of changing the pattern of cultivation and the selection of suitable varieties, due to the long flooding of farmers' land, which makes it impossible to change the patterns of planting and select suited varieties. For the indicator of supply of crop stocks due to flooding, farmers are unable to increase their crop stock because their land is submerged. Flood-resistant seed indicators can still last only for not-too-long flood soaking, when there is a long flood-soaking will cause the seed to rot even to death

3.5. Indicator Marketing and Farm Capital Strategies

The impact of flooding based on marketing indicators and farming capital strategies can be seen in Table 8

Table 8 Indicator Marketing and Farm Capital Strategies

No	Indicator	Frequency of Respondents Answers		Total	Percentage (%)	
		Yes	No		Yes	No
1	Rice is hard to come by and prices are soaring	28	3	31	90%	10%
2	Loans (seeds, fertilisers, pesticides etc.). At the farm shop	7	24	31	23%	77%
3	Capital loans from banks, co-operatives or non-governmental organisations	8	23	31	26%	74%
	Amount	43	50	93	46%	54%

Source: Primary Data Processing Results, 2024

Based on Table 8. above, it can be seen that the indicator of rice is difficult to obtain and soaring prices are affected because farmers still sell a lot of harvested stock directly to middlemen and the price depends on the middleman. In the indicator of loans (seeds, fertilisers, pesticides and others) in the research location there are no agricultural shops. Then for the indicator of capital loans from banks, cooperatives or non-governmental organisations, there is no impact. This is because there are no banks, co-operatives or self-help organisations, and farmers prefer to borrow from relatives to avoid overdue payments when borrowing from these institutions.

3.6. Adaptation Level of Flood Affected Farmers in Rice Fields

The level of adaptation of flood affected farmers can be seen from 3 indicators, namely farm management, cultivation strategies, as well as marketing and farm capital strategies. Then each indicator has 3 parameters with each parameter having 3 questions each, then it will be measured with 3 criteria, namely low, medium and high. To see the level of adaptation of farmers affected by flooding can be seen in Table 9.

Table 9 Adaptation Level of Flood Affected Farmers in Rice Fields

No	Indicator	average score	Criteria
1	Farm Management	4,35	Low
2	Cultivation Strategy	4,28	Low
3	Marketing and Farm Capital Strategies	4,72	Low
	sum of scores	13,00	Low

Source: Primary Data Processing Results, 2024

Based on Table 9. the data obtained from the analysis showed that the respondent farmers answered the level of adaptation of farmers affected by flooding on rice fields in Karang Agung Village with low criteria with an average score of 13.00. With the level of adaptation of farmers that is still low because the farm management carried out by farmers is still inappropriate. Adaptation in carrying out cultivation strategies by farmers is still low, because the floods that occur are relatively high and take a long time to recede. then for marketing adaptation and farming capital strategies carried out by farmers are still low, because farmers experience losses due to flooding. And in the farming capital strategy, the adaptation level is still low for farmers to borrow capital from banks, cooperatives or non-governmental organisations because in Karang Agung Village there are no facilities from these institutions or organisations.

3.7. Indicator Farm Management

Each indicator in this study has 3 parameters, namely soil management, gardening or raising livestock in the yard, and making dykes. The results of the analysis of the level of adaptation of farmers to farm management indicators can be seen in Table 10

Table 10 Indicator Farm Management

No	Parameter	average score	criteria
1	Land management	1,54	Low
2	Gardening or breeding in the fields	1,46	Low
3	Embankment construction	1,35	Low
	Sum of score	4,35	Low

Source: Primary Data Processing Results, 2024

The level of adaptation of farmers in soil management with an average score of 1.54 with low criteria, although farmers have done soil management such as raising the mound of land is still affected by flooding, because the discharge of flood water is so high that farmers' land is easily submerged and farmers' rice fields are in the lowlands which can make the land recede for a long time. Then the level of adaptation of farmers in gardening in the yard with an average score of 1.46 with low criteria. Because the farmer's house is located on the banks of the river which is vulnerable to flooding, as well as the distance between houses so close together that it is not possible for farmers to garden in their yards or raise livestock in their yards. The level of adaptation of farmers in making embankments with an average score of 1.35 with low criteria. Making embankments or increasing the height of the embankment and even widening the height of the embankment around rice fields affected by flooding has a low level of adaptation, this is due to large floods that make water enter with high water discharge so that the embankments made by farmers can break down and even be destroyed.

3.8. Indicator Cultivation Strategy

The cultivation strategy indicator has 3 parameters, namely changing cropping patterns and cultivars, providing stocks of crops and food, and flood-resistant seeds. The results of the analysis of the level of adaptation of farmers to indicators of cultivation strategies can be seen in Table 11.

Table 11 Indicator Cultivation Strategy

No	Parameter	Average Score	Criteria
1	Changing cropping patterns and cultivars	1,48	Low
2	Provision of crop and food stocks	1,46	Low
3	Flood resistant seedlings	1,33	Low
	Sum of score	4,28	Low

Source: Primary Data Processing Results, 2024

The level of adaptation of farmers in changing cropping patterns and planting cultivars is still low with an average score of 1.48. This is because all agricultural land is flooded and submerged for a long time so it will not be possible for farmers to change planting patterns. For the level of adaptation of flood-affected farmers by providing crop and food stocks is fairly low with an average score of 1.46. Because most farmers sell some or even all of the crops and food from previous farms, even though the flood event on rice fields with a long time. The level of adaptation of farmers in using flood-resistant seeds or seedlings is low with an average score of 1.33. Although flood-resistant seeds can survive in small-scale floods with a long enough, if a large-scale flood comes, the flood-resistant seeds will be damaged and can cause planting failure and even crop failure. This will cause farmers to shift the planting period, because the flood water discharge is erratic which causes farmers to reseed and replant and the harvest period will be delayed.

3.9. Indicator Marketing and Farm Capital Strategies

Farmers adapt to marketing indicators and farm capital strategies with parameters such as the amount of rice production and market prices, buying production inputs on credit at agricultural stores and farm capital from banks, cooperatives and non-governmental organisations. there are results of the analysis of the level of adaptation of farmers on marketing indicators and farm capital strategies can be seen in Table 12.

Table 12 Indicator Marketing and Farm Capital Strategi

No	Parameter	Average Score	Criteria
1	The amount of grain production and the market price	1,43	Low
2	Buying production inputs on credit at a farm shop	1,47	Low
3	Corporate assets from banks, corporations, and public institutions	1,46	Low
	Sum of Score	4,37	Low

Source: Primary Data Processing Results, 2024

The level of adaptation in the amount of rice production and market prices is still low with a score of 1.47. Because flooding on farmers' land with a long enough span of time can make farms experience crop failure, even though they can still do farm processing, they will get a decreased amount of production and quality which makes middlemen buy at low prices, besides that farmers only sell grain to middlemen not yet selling in the form of rice.

For the level of adaptation of farmers in buying production inputs on credit at agricultural shops is still low with an average score of 1.47, because in the location of farmers there are no agricultural shops. Some farmers have stocks of crops from previous farms that can be used in planting rice seeds again, then for the use of pesticides and fertilisers are not used by farmers because farmers' land is flooded and the agricultural tools used are still feasible. This is why farmers do not use farm capital to buy production inputs such as fertilisers, pesticides and new agricultural tools that are paid on credit at agricultural shops.

The level of adaptation of farmers in farm capital from banks, cooperatives and community self-help institutions is still low with an average score of 1.46. This is because in Karang Agung Village there are no services such as banks, cooperatives and non-governmental organisations that are sources of loans if they are available and the distance to go to the bank is very far, so that farmers only make loans among fellow farmers or with their own relatives.

3.10. Clustering the Adaptation Level Efforts of Flood Affected Farmers on Rice Fields in Karang Agung Village

Clustering is a way of grouping data based on members who have similarities or similarities in a group. Clustering has various methods that can be calculated based on determining the number of clusters, with cluster analysis being able to group similar data based on the same system and different ones belonging to different systems. This study has 3 clusters consisting of low, medium and high. There are 27 questions from this research related to the adaptation efforts of flood-affected farmers that can be done through cluster analysis in Karang Agung Village. Data clustering based on the adaptation efforts of flood-affected farmers in Karang Agung Village can be seen in Table 13

Table 13 Clustering the Adaptation Level Efforts of Flood affected Farmers

Distances between Final Cluster Centers			
Cluster	1	2	3
1		2.625	3.902
2	2.625		3.541
3	3.902	3.541	

Source: Primary Data Processing Results, 2024

Based on Table 13 shows the distance between clusters, so the greater the value or number, the greater the distance between clusters. Cluster 1 is 2.638 away from cluster 2 with cluster 3 being 3.902 away. The distance between cluster 2 and cluster 1 is 2.638 and cluster 3 is 3.541. The distance between cluster 3 and cluster 1 is 3,902 and cluster 2 is 3,902.

The SPSS output of the anova table from the claterisation of the level of adaptation of farmers affected by flooding on rice fields can be seen in Table 13

Table 14 The SPSS output of the Anova

ANOVA			
No	**per question**	**F**	**sign**
1	P1	30.140	0.000
2	P2	91.376	0.000
3	P3	19.357	0.000
4	P4	21.506	0.000
5	P5	19.357	0.000
6	P6	.	.
7	P7	11.071	0.000
8	P8	.	.
9	P9	8.628	0.001
10	P10	30.140	0.000
11	P11	91.376	0.000
12	P12	9.740	0.001
13	P13	21.506	0.000
14	P14	19.357	0.000
15	P15	.	.
16	P16	3.749	0.036
17	P17	.	.
18	P18	5.221	0.012
19	P19	21.506	0.000
20	P20	19.357	0.000
21	P21	4.209	0.025
22	P22	.	.
23	P23	5.221	0.012
24	P24	21.506	0.000
25	P25	30.140	0.000
26	P26	19.357	0.000
27	P27	8.628	0.001

Source: Primary Data Processing Results, 2024

SPSS output shows that the effort level of adaptation of flood-affected farmers with a significant value (<0.05) which means that the effort level of adaptation of flood-affected farmers on rice fields in Karang Agung Village can be used to distinguish between clusters. Vice versa, if the significant value (> 0.05) then some efforts of farmers' adaptation level are not feasible to be included in the cluster. Based on the results of the SPSS test, all instruments have a significant value (<0.05), so all instruments can be used to distinguish each cluster.

Then there was a grouping of respondents who answered the question by grouping into 3 clusters which can be seen in Table 14.

Table 15 Clustering of Farmer Respondents on Farmer Adaptation Level Efforts Flood-affected Farmers in Rice Fields

	Number of Cases in each Cluster	number of farmers (people)
Cluster	1 Low	12
	2 Medium	9
	3 High	10
Valid		31
Missing		0

Source: Primary Data Processing Results, 2024

Based on Table 4.22. it can be seen that there are 12 respondent farmers who are included in cluster 1, namely very low, then 9 respondent farmers are included in cluster 2, namely medium and 10 respondent farmers are included in cluster 3, namely high.There are 12 respondent farmers in cluster 1 with low criteria, namely respondent 1, respondent 2, respondent 4, respondent 6, respondent 7, respondent 9, respondent 12, respondent 14, respondent 17, respondent 18, respondent 19 and respondent 30.

Meanwhile, for cluster 2 there were 9 farmer respondents with moderate criteria, namely respondent 15, respondent 22, respondent 23, respondent 24, respondent 25, respondent 26, respondent 27, respondent 28 and respondent 31.For cluster 3, there were 20 farmer respondents with high criteria, namely respondent 3, respondent 5, respondent 8, respondent 10, respondent 11, respondent 13, respondent 16, respondent 20, respondent 21, and respondent 29.

4. Conclusion

The impact of flooding on paddy fields in Karang Agung Village seen from 3 indicators found that the farm management indicator was affected with a percentage of 88% while for cultivation strategies affected with a percentage of 82%, for marketing and farm capital strategies affected with a percentage of 46%. Thus, the adaptation of farmers in rice fields is still affected by flooding. The level of adaptation to the impact of flooding on rice fields in Karang Agung Village which consists of 3 indicators, namely farm management, cultivation and marketing strategies and farm capital strategies on the level of adaptation of farmers is obtained with a score of 13.00. So, the level of adaptation to the impact of flooding on rice fields in Karang Agung Village is still low. Clustering of farmers on the adaptation efforts of flood-affected farmers in Karang Agung Village, most of which are included in cluster 1, which means that the adaptation efforts of flood-affected farmers are still low.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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