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FACTORS INFLUENCING THE COST OF ADAPTATION TO SEASONAL FLOODS IN BARITO KUALA REGENCY OF SOUTH KALIMANTAN PROVINCE, INDONESIA

Muzdalifah*, **Fajeri Hairin**, **Hanafie Usamah**
Department of Agribusiness, University of Lambung Mangkurat, Indonesia
*E-mail: muzdalifah@ulm.ac.id

ABSTRACT
Disaster is an event or series of events that threaten and disrupt community life. Flood disasters result in loss of life, environmental damage, and financial losses. Flood impacts affect the flood distribution locations and the socio-economic conditions of households in the post-flood period. The occurrence of flood-related damage experienced by households results in expenses for repairs and preventing further damage from future floods. These expenses constitute adaptation costs incurred by households and are influenced by various factors, leading to variations in the amount spent by each household. In general, this research aims to: 1) Identify household perceptions of seasonal floods in Barito Kuala Regency; 2) Identify the factors influencing adaptation costs in facing seasonal floods in Barito Kuala Regency. Based on the research outcomes, the adaptation strategies employed by the community in the Jejangkit District consist of active and passive adaptations. Active adaptation includes changing occupations and securing belongings, while passive adaptation involves knowledge of the seasonal calendar and reducing household expenses. Economic adaptation includes raising grain storage, working as laborers or motorcycle taxi drivers, and requesting money transfers from family members. Social and cultural adaptation involves solidarity systems in the form of providing food aid and assisting in evacuations through communal efforts.

KEY WORDS
Flood disaster, adaptation cost, community, disaster.

Climate change is one of the climate phenomena that occur due to an increase in global temperatures. Global warming is caused by human activities that extensively exploit nature. This leads to an increase in carbon monoxide gas due to the greenhouse effect, emissions from industries, uncontrolled use of Chlorofluorocarbons (CFCs), declining forest areas, and vehicle pollution from gasoline fuel. Climate change has become a serious topic of discussion in both developed and developing countries due to its negative effects, one of which is the occurrence of frequent extreme weather events in recent times. This is evidenced by the establishment of the Intergovernmental Panel on Climate Change (IPCC), which aims to provide input to policymakers in designing policies for adaptation and mitigation of the potential risks of climate change.

Indonesia is a tropical country characterized by high rainfall during the rainy season. Consequently, in some areas during the rainy season, there are flood disasters that result in casualties and both human and property losses. Almost every rainy season, flood disasters occur in various places, with varying locations and levels of damage.

Heavy rainfall is one of the active factors causing floods. Due to heavy rain, rivers can overflow, increasing the likelihood of flooding. Additionally, intense localized rainfall plays a crucial role in causing inundation floods, especially in floodplain and flood-prone areas with consistently high soil moisture levels. Therefore, with the onset of rain, rainwater quickly becomes surface runoff.

Floods with a widespread impact also struck the South Kalimantan region in mid-January 2021. The Agency for the Assessment and Application of Technology (BPPT) stated that the estimated losses from the flood disaster in South Kalimantan amounted to Rp1.349 trillion, with losses in the community's productivity sector at approximately Rp604.562 billion and losses in the agricultural sector at around Rp216.266 billion. The flood resulted in more

than 200 thousand hectares of agricultural land for food crops and horticulture being damaged.

The flood events that occur in Barito Kuala Regency disrupt the activities of the community, resulting in significant economic losses. These economic losses encompass physical, economic, environmental, and social aspects. Economic losses experienced by the community include damage and loss of buildings and household equipment owned by the people. Furthermore, these events also lead to a decline in environmental quality, causing various diseases.

Barito Kuala Regency, as one of the flood-affected regions, experiences several impacts on households due to floods. These impacts include a decrease in income resulting from the loss or disruption of work activities, as well as a decrease or even a failure in agricultural production. The increasing flood-prone areas during the rainy season cause damage to a wider area, leading to higher impacts on the local population, especially in Barito Kuala Regency. Many livelihoods in this region rely heavily on the cultivation of staple crops, predominantly among low-income residents. Farmers whose lands are inundated will engage in various other activities to meet their household needs.

The occurrence of damage due to floods experienced by households results in costs for repairs and prevention of further flood-related damage. These costs are adaptation expenses incurred by households and are influenced by various factors, so the amount of expenses incurred will vary for each household.

This research aims to analyze household perceptions of the seasonal flood impacts and the factors influencing the adaptation costs incurred in dealing with seasonal floods in Barito Kuala Regency.

METHODS OF RESEARCH

This analysis aims to identify various household perceptions of flood impacts in Barito Kuala Regency. Data analysis employs descriptive analysis with the Likert scale method. The identification of flood impacts consists of perceptions regarding the social, economic, and environmental impacts of floods. The Likert scale method is used to determine an individual's or a group of people's responses to an object measured through a scale comprising a set of attitude-related questions, which are written, organized, and analyzed to yield numerical values for those responses. Descriptive analysis using the Likert scale method in this research is utilized to understand the perception of flood impacts based on primary data obtained through questionnaire interviews with respondents.

The range of values obtained can determine the level of agreement of respondents based on the existing assessment criteria.

The criteria for social, economic, and environmental impacts are as follows.

1. Social Impact:
   - The local government does not function effectively in addressing the issues caused by floods;
   - Floods lead to food shortages within households.
2. Economic Impact:
   - Floods lead to an increase in agricultural production costs;
   - Floods result in a decrease in household income.
3. Environmental Impact – floods result in a decrease in environmental quality.

Respondents who perceive the impact of floods will fall within the agree to strongly agree scale. Respondents who assess that the impact of floods is not in line with their experience will fall within the disagree to strongly disagree scale.

The range of values on the normal scale can be interpreted as respondents not feeling the impact of floods too significantly.

Household adaptation choices will influence the amount of expenditure incurred. It is suspected that there are specific factors influencing households to spend money to mitigate flood-related losses. The analysis of factors affecting household adaptation costs to floods uses a multiple linear regression model. According to Juanda (2009), a multiple linear

regression model is a linear function of several independent variables X_1, X_2, X_3,....X_n and an error component. Regression analysis describes the linear relationship between two or more variables, with independent variables (X) and dependent variables (Y).

Household adaptation costs can be measured by the total expenditure for adaptation actions. The factors influencing the level of adaptation include the age of the head of the household (X_1), household expenditure (X_3), the number of family dependents (X_4), and rice farming productivity (X_5). Mathematically, the regression equation can be formulated as follows:

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where: Y = Expenditure for adaptation (Rp/year); β_0 = Intercept; $\beta_{1,..,4}$ = Elasticities of independent variables; X_1 = Age of the head of the household (years); X_2 = Household expenditure (Rp/month); X_3 = Number of family dependents; X_4 = Rice farming productivity (kg/ha).

RESULTS AND DISCUSSION

Flood is an event or condition where an area or land becomes submerged due to an increased volume of water. Flooding will inundate the land to varying heights, depending on the elevation of the land. Seasonal floods occurring in Barito Kuala Regency have resulted in various impacts on households, especially those of farmers.

Based on the survey results, respondents stated that floods are a common occurrence. This is due to the annual flood phenomenon, making floods a familiar occurrence. Flooding happens twice a year, in December - January and May-August. In December - January, floods typically last for 2 - 3 weeks on average, while in May-August, the average duration of floods is 6 - 8 weeks.

A disaster generally results in various impacts on households residing in the affected area. Likewise, with flooding in residential and agricultural areas in Barito Kuala Regency, especially in the Jejangkit Subdistrict. The impact of flooding in this research is divided into three categories: 1) Social impact, which includes the local government's failure to address issues caused by flooding and food shortages resulting from floods, 2) Economic impact, which involves increased agricultural production costs and a decrease in household income, and 3) Environmental impact, which encompasses a decline in environmental quality.

Statements of perception regarding the impact of floods are classified into five scale indicators, namely: Strongly Agree (SA); Agree (A); Neutral (N); Disagree (D); and Strongly Disagree (SD) with corresponding score values of 5, 4, 3, 2, and 1. The distribution of respondents' perceptions regarding the social, economic, and environmental impacts of floods can be seen in Table 1.

Table 1 – Respondent's perception of flood impacts

No	Flood Impact	Number of criteria (individuals).					Score	Final result
		SS	S	B	TS	STS		
Social Impact								
1	The local government does not function to address issues caused by flooding.	0	0	15	20	12	97	Disagree
2	Floods result in food shortages within households.	4	12	14	14	3	141	Normal
Economic Impact								
3	Floods increase agricultural production costs.	19	10	13	4	1	183	Agree
4	Floods lead to a decrease in family income.	20	12	8	5	2	184	Agree
Environmental Impact								
5	Flooding results in a decline in environmental quality.	6	15	14	11	1	155	Normal

Source: Primary Data Processed (2023).

Based on Table 1, the first point regarding social impacts, which is that the local government is not functioning to address the issues caused by flooding, yields a final result of disagreement, with a total score of 97. This score signifies that respondents disagree that

the local government is not functioning to address the issues caused by flooding. The number of respondents who disagree is 20 individuals (42.55%). The perception of respondents who disagree is because they have received assistance in the form of bamboo to create walkways inside their homes when floodwaters exceed the foundation level. Additionally, the government has also provided assistance in the form of staple foods such as rice, instant noodles, and sugar.

The second point regarding social impacts is that flooding leads to food shortages, with a total score of 141. This score falls within the normal range, indicating that if a flood occurs, respondents do not feel a significant decrease in the availability of household food. The number of respondents who agree is 12 individuals (25.53%), but there are also a relatively large number who perceive the situation as normal or disagree, totaling 28 individuals or 59.57%. Respondents generally prepare food supplies before a flood, including rice and other essential items. Additionally, the community feels greatly assisted because they receive food assistance from the government and social organizations.

The economic impact can be divided into two aspects: flooding increases agricultural production costs, and flooding leads to a decrease in household income. In the first point, the total score is 183. This score falls within the agree scale, signifying that respondents agree that flooding increases agricultural production costs. The number of respondents who agree is 19 individuals (40.43%), while 10 individuals (21.28%) strongly agree with this perception. This is because when the floodwaters recede, agricultural land requires repairs to the field dikes, and re-cultivation is necessary. Typically, those who strongly agree are individuals who own their own tractors and incur higher additional production costs compared to those who rent tractors. Farmers who rent tractors have a guarantee in case of crop failure due to flooding from the tractor owner and only pay 50% of the total land cultivation costs.

The second point on economic impacts indicates a total score of 184. This score falls within the agree scale, signifying that respondents agree that flooding leads to a decrease in household income. The number of respondents who strongly agree is 20 individuals (42.55%), and 12 individuals (25.53%) agree with this perception. This is because respondents have experienced a reduction in agricultural production, resulting in reduced income. Additionally, respondents rely on agriculture as their primary source of income. However, during floods, respondents switch professions to become fishermen to meet their family's needs, but the amount of fish caught is not consistent.

The results of respondents' perceptions regarding environmental impacts, specifically, the effect of flooding on environmental quality, show a total score of 155. This score falls within the normal range, indicating that respondents do not perceive a decline in environmental quality due to flooding. The number of respondents who stated "normal" is 14 people (29.79%). This is because respondents perceive a decline in environmental quality not only due to flooding but also due to many other factors that contribute to decreased environmental quality, such as pesticide use in agriculture. Meanwhile, 15 respondents (31.91%) agreed with this perception.

Table 2 – Factors Influencing Adaptation Costs

Independent Variable	Regression Coefficient	Standard Error	T-Test of H0: β(i) = 0		
			T-Statistic	P-Value	Reject H0
	b(i)	Sb(i)			at α = 0.05?
Intercept	572101.1	37046.78	15.443	0.0000	Yes
Age of the head of the household	0.4360483	0.108156	4.032	0.0001	Yes
Farmers' Expenditure	0.2331343	0.0639993	3.643	0.0004	Yes
Number of dependents	0.4604395	0.1015412	4.535	0.0000	Yes
Agricultural productivity	0.1511299	0.0498585	3.031	0.0031	Yes

Source: Primary Data Processed (2023).

The frequent tidal floodings that inundate residential areas in the Jejangkit Subdistrict have consequences for the surrounding households. The impact resulting from the flood leads to various costs incurred by households to implement adaptation strategies. This is done as an effort to reduce the risk of more significant consequences. The factors suspected

to influence the magnitude of adaptation costs are analyzed using a multiple regression model. The independent variables included in the model are the age of the head of the household (Age), farmers' expenditure in agricultural activities (Exp), the number of family dependents (Fm), and rice farming productivity (Prd). The dependent variable in this model is the total adaptation costs incurred by each household used as respondents. The model was obtained through data processing using Statistical Product and Service Solution (SPSS) 25. After model selection with the SPSS application, the regression output is presented in Table 2.

Based on the data processing conducted, the multiple linear regression equation for adaptation costs in this research is as follows:

$$\text{Adaptation costs} = 572101.1 + 0.436\ \text{Age} + 0.233\ \text{Exp} + 0.460\text{Fm} + 0.151\ \text{Prd}$$

Where: Cost = Total adaptation costs of respondents (in years); Age = Age of the head of the household (in years); Exp = Expenditure in agricultural activities (in Rp/season); Fm = Number of family dependents (individuals); Prd = Rice farming productivity (kg/ha).

Model evaluation in this research employs criteria from both statistical and econometric tests. The statistical test criteria involve examining the adjusted R2 value to measure the variation in the dependent variable, the F-value to test the model as a whole (F-test), and the t-value to test each regression coefficient (t-test). Econometric test criteria are employed to determine whether there are violations of assumptions in the model.

Criteria for Statistical Testing. The data processing results indicate that the regression equation with the dependent variable "adaptation costs" has an adjusted coefficient of determination (R2 adjusted) of 0.988. This value can be interpreted as follows: approximately 98% of the variation in total adaptation costs can be explained by the independent variables included in the model, while the remaining 2% is accounted for by other factors not included in the model.

The F-test results indicate that overall, the independent variables (age of the head of the household, household expenditures, the number of family dependents, and rice farming productivity) have a significant impact on the total adaptation costs of each respondent's household. This implies that changes in total adaptation costs are influenced by changes in the independent variables simultaneously. The computed F-value is 2187.12 with a significance level of 0.000, corresponding to a probability of 99%. Therefore, it can be concluded that the independent variables collectively influence the dependent variable.

The t-test results indicate that all variables significantly influence the total adaptation costs of respondent households, namely, the age of the head of the household, agricultural expenditures, the number of dependents, and rice farming productivity significantly affect the total adaptation costs incurred by each respondent at the 1% significance level ($\alpha = 1\%$).

Productive age is the ideal age for working and possesses the ability to enhance work productivity, as well as having a substantial capacity to absorb innovative information and technology in the field of agriculture. The productive age is the ideal age for working effectively and remains robust for carrying out activities within farming and beyond.

In line with this, age also influences the allocation of costs for flood adaptation. Adult farmers are more aware of the losses caused by flood disasters. Based on their experience, adult farmers can also assess the level of expenditure for flood prevention compared to the losses incurred if they do not undertake flood prevention mitigation.

Capital is a means to engage in business. Capital in agriculture, along with other production factors, generates products. The adoption of agricultural technology to enhance agricultural productivity requires not only knowledge and skills but also the capital to purchase the necessary inputs. The capital factor plays a crucial role that farmers consider before engaging in agricultural activities.

Using a smaller production facility cost will result in lower income compared to farmers who use a larger production facility cost. The greater the number of production facility costs utilized, the relatively higher the income obtained. However, the use of production facility

costs must be adjusted to the needs; therefore, excessive production costs should be avoided as they can reduce both production and farmers' income.

The research results indicate that petunia cultivation expenditures have a positive impact on the cost of flood disaster prevention adaptation. The greater the expenses invested in farming, the higher the expected profits, and consequently, the higher the business risk. Therefore, farmers should make more significant efforts to reduce the risk of production failure, particularly from the threat of floods.

The coefficient value of the number of dependents indicates a positive value, which means that if there is an increase in the number of people in the family's dependents, the total adaptation costs for the respondents will increase, assuming that other independent variables remain constant. This is because the safety of family members from flood threats is the primary concern, so the more dependents a family has, the higher the effort put into adaptive measures.

Increasing rice productivity is one of the targets in efforts to enhance production. The achievement of rice productivity is closely related to the amount of input in terms of production facilities (fertilizers) provided to rice cultivation.

A positive coefficient value can be interpreted as follows: the higher the productivity, the greater the adaptation costs incurred. Achieving higher crop productivity has an impact on increasing production, but, on the other hand, this productivity achievement is accompanied by an increase in production facility costs. Therefore, safeguarding crops from disasters, especially floods, is a crucial factor in business management.

Efforts to prevent crop damage or production loss are made through various means, including risk identification, disaster risk awareness, mitigation planning, and allocating adaptation costs, among others.

CONCLUSION

Based on the research outcomes regarding the income analysis and household adaptation strategies to seasonal flooding in Barito Kuala Regency (case research: Jejangkit Subdistrict), the following conclusions can be drawn:

- The floods that occurred in the Jejangkit Subdistrict have resulted in various perceptions of their impacts. Overall, the community perceives the social and environmental impacts of the floods, but they do not have a detrimental effect on the well-being of the community. However, in terms of economic impacts, households experience losses in the form of reduced rice production, which has an impact on household well-being;
- The adaptation strategies employed by the community in the Jejangkit Subdistrict encompass both active and passive adaptation measures. Active adaptation includes changing professions and securing belongings, while passive adaptation involves understanding seasonal calendars and reducing household expenses. Economic adaptation involves raising grain storage facilities, working as laborers or motorcycle taxi drivers, and seeking financial assistance from family members. Social-cultural adaptation encompasses a solidarity system manifested through providing food aid and collectively participating in evacuation efforts;
- The factors significantly influencing the 1% significance level concerning adaptation costs are the variables of the head of the household's age, agricultural expenditure, the number of household dependents, and agricultural productivity.

Based on the research outcomes, the following recommendations can be suggested:

- To reduce the impacts felt by households due to recurrent flooding, it is necessary for the government to implement mitigation measures, thereby decreasing the losses incurred by households;
- Enhancing community participation through existing local institutions in carrying out adaptive actions fosters a strong sense of solidarity, resulting in an improvement in community well-being;

- The cost of adaptation borne by households is typically incurred annually, so the government needs to engage in public awareness campaigns and implement sustainable adaptation measures to minimize adaptation expenses for households.

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