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Analysis of Factors Causing Difficulties in Use of Rice Land in the Irrigation Area of the Tojo Region and West Tojo

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Abstract:- In one of the areas in Tojo Una-Una Regency, the rice fields are irrigated rice fields with a surface irrigation system, where the water source comes from a river which flows into the rice fields. However, in the dry season, the water demand for rice fields in these two regions cannot evenly meet the water needs of rice fields in both regions, thus affecting farmers' production results. The aim of this research is to find out what factors make it difficult for farmers to utilize rice fields in the irrigation areas of the Tojo and West Tojo regions and to find out the strategies used by farmers to overcome difficulties in utilizing rice fields in the irrigation areas of the Tojo and West Tojo regions . Respondents in this study were 281 respondents including rice field farmers in the Tojo region and farmers in the West Tojo region. Data analysis uses Factor Analysis. The magnitude of the influence resulting from all these factors reached 62,445%, while the remaining 37,555% was influenced by other factors whose influence was not significant. The strategies implemented by farmers to overcome difficulties in utilizing rice fields in the irrigation areas of Tojo and West Tojo regions include repairing irrigation networks, building groundwater irrigation pumps, improving the quality of farmers' human resources through regular extension activities, arranging planting pattern schedules, changing systems. distributing water during the dry season, and reactivating the P3A (Water User Farmers Association).

Keywords:- *Water, Regions, Farmers, Systems, Distribtion.*

I. INTRODUCTION

One of the areas in Tojo Una-Una Regency, Central Sulawesi Province, namely Tojo and West Tojo Districts, is an agricultural barn that contributes to economic income in the agricultural sector in Tojo Una-Una Regency. The area of rice fields for the Tojo region is 402 hectares with annual production reaching 1 874.05 tons , and the land area in the West Tojo region is 335 hectares with annual production reaching 1 . 561.71 tons, which is all of the rice fields is an irrigated rice field with a surface irrigation system, where the water source comes from a river which flows into the rice field area. However, in the dry season, the water demand for rice fields in these two regions cannot evenly meet the water needs .of rice fields in both regions, thus affecting farmers' production results. This may occur because irrigation water processing and distribution management is still uneven as a result of the poor performance of the P3A (Water User Farmers Association) in carrying out operations and maintenance of irrigation networks in tertiary plots, and apart from that, the P3A is less active in discussing management issues. irrigation water with farmers.

Then another problem is that the low quality of human resources for rice farmers in these two regions makes it difficult for them to utilize their rice fields for agricultural activities, this can be seen from their ignorance in processing post-harvest land for planting short-term crops during the post-harvest break.The aim of this research is to find out what factors make it difficult for farmers to utilize rice fields in the irrigation areas of the Tojo and West Tojo regions and to find out the strategies used by farmers to overcome difficulties in utilizing rice fields in the irrigation areas of the Tojo and West Tojo regions.

II. LITERATURE REVIEW

A. Land Resources

Land is a limited natural resource whose use requires planning with the aim of improving the welfare of the community.[1] Land use is one of the important factors that can influence the development of city structure.

Land is needed in all aspects of human life. And also as the main factor influencing other natural resources. Many factors influence the value of a piece of land such as topography, fertility, and location. Land is a natural resource used in the production process to produce food, fiber, building materials, mining materials, or raw materials needed in modern life.[2] In general, the types of land use can be residential land, commercial and industrial land, agricultural pasture land, forests, mining land, transportation and public services, and unused barren land. In the modern world, commercial and industrial use of land will provide the highest income. Settlements are the next highest land use, then agricultural land, and forests and grazing fields. Therefore, land use patterns are also influenced by the distance from the city or market.

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B. Rice Fields

Rice fields are a medium or means for producing rice. Fertile rice fields will produce good rice.[3] Indonesia is an agricultural country where part of its territory is agricultural, which can produce more rice. However, due to the construction of factories or other buildings on agricultural land, agricultural production is decreasing.[4] Then rice fields also provide benefits for the environment, namely controlling floods and erosion, recycling water and organic waste. Meanwhile, it has a negative value related to the environment, namely the production of methane gas by rice fields, which is one of the contributors to greenhouse gases. Rice fields can store rainwater, especially during heavy rains, and drain and seep it slowly into river bodies and downstream areas.

C. Irrigation

Irrigation is any or all activities related to efforts to obtain water for agricultural purposes.[5] The efforts carried out may include: planning, making, managing and maintaining facilities for taking water from water sources and distributing the water regularly and if there is excess water by disposing of it through drainage channels.

Drip irrigation and bulk irrigation are not yet widely used by farmers in Indonesia, but this method is still used only on research fields and land cultivated by modern farmers.[6] Several considerations are used to determine how to provide irrigation water to plants, including the availability of water sources, the type of technology used, type of plant, topography, financial availability, and so on.

D. Irrigation Rice Fields

Irrigated rice fields are agriculture with regular irrigation, not dependent on rainfall.[7] Meanwhile, non-irrigation, in contrast, relies on natural water such as rainwater, ebb and flow of river/sea water, and seepage water. Irrigated rice fields are rice fields that use a regular (technical) irrigation system. Irrigation for irrigated rice fields comes from a dam or reservoir. Irrigation of rice fields is carried out by farmer groups known as darmotirto in Java and subak in Bali. In irrigated rice fields, farmers can harvest 2-3 rice crops.[8]

The development of water system canals is exceptionally fundamental to back the supply of nourishment, so that water accessibility in water system regions will be satisfied indeed in spite of the fact that the water system zones are distant from surface water sources (streams).[9] This cannot be isolated from water system designing endeavors, specifically giving water with the correct quality, right space and right time in an successful and conservative way.

E. Difficulties in Utilizing Rice Fields

A prominent obstacle to the use of irrigated rice fields is the problem of soil fertility due to the possibility of symptoms of iron and manganese poisoning, so one way to do this is to determine the height of standing water and leaching Fe and Mn with irrigation.[10] Even though it is in an irrigated area, there are several factors that become obstacles for farmers in managing their rice fields. Apart from that, the explanations above show that there are many difficult factors in utilizing rice fields, so that from these factors there are several factors that are used as observation variables in this research, which include the increase in water use for the industrial and household sectors. , climate change, irrigation maintenance problems, local water reserves are also decreasing, silting of reservoirs/rivers, flooding, irregular irrigation, rainfall distribution, condition of irrigation network infrastructure, level of vulnerability to drought, soil physical parameters, land hydrology, engineering cultivation, irrigation methods from plot to plot, and water user organizations.

III. RESEARCH METHODS

The investigate strategy is one of a arrangement of investigate carried out, which can depict the investigate methods or methods that will be utilized to compile the inquire about.

➢ *Types of Research*

This sort of inquire about is expressive investigate with the point of portraying inquire about objects or investigate comes about. A strategy that capacities to depict or give an diagram of the question beneath think about through information or tests that have been collected as they are, without carrying out examination and making for the most part acknowledged conclusions.[11]

➢ *Research Location*

The study location is in the Tojo and West Tojo areas , Tojo Una-Una Regency, Central Sulawesi Province. For implementation, this research is planned to be carried out from June to July 2023.

➢ *Data Collection Techniques*

Data collection techniques in this research use 2 data management methods, namely:

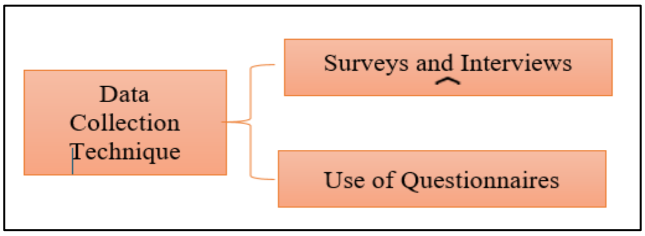

Fig 1: Data Collection Techniques

➢ *Research Instrument*

Estimation scale A estimation scale is an assention utilized as a reference to decide the length and shortness of the interims in a measuring instrument, so that when the measuring instrument is utilized in estimation it'll create quantitative information.[12] The estimation scale in this investigate employments a Likert scale . The Likert scale may be a scale utilized to degree the demeanors, conclusions and recognitions of a individual or bunch of individuals almost social wonders. The Likert scale detailing is as takes after:

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Table 1: Questionnaire Answer Criteria

No	Criteria Evaluation	Likert Scale
1	Strongly Agree (SS)	5
2	Agree (S)	4
3	Neutral (RR)	3
4	Disagree (TS)	2
5	Strongly Disagree (STS)	1

➢ *Data Analysis*

Deep data analysis study This use technique analysis statistics quantitative with using *Statistical Product And Service Solution* (SPSS) software, namely analysis factor.[13]

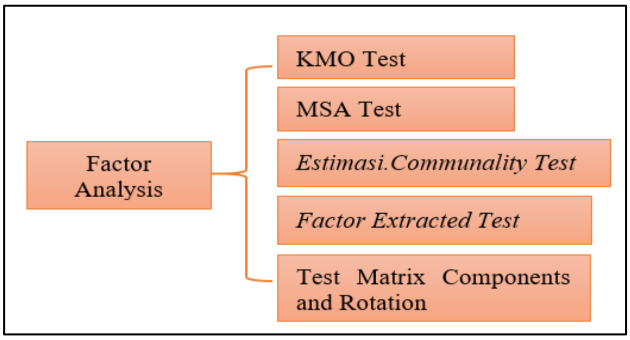

Fig 2: Factor Analysis

IV. RESULT AND DISCUSSION

A. *General Description of Respondents*

The general picture of the respondent describes the respondent's characteristics of the situation, nature or specific characteristics that can provide an overview of the respondent's situation. The questionnaire distributed in this research is as many as 281 questionnaires, this is in accordance with the number of subjects in this research which are some rice paddy farmers in Tojo and West Tojo Subdistricts. For that, first the following will be displayed some characteristics of respondents in general according to age, gender, last education, land area, and monthly income of farmers.

B. *Descriptive Statistics*

Section contains the results of the questionnaire distributed along with a description and simple analysis of existing trends including the educational background and work experience of the respondents. The discussion will discuss each question assisted by *statistical analysis* and graphs.

➢ *Characteristics of Respondents Based on Age*

The picture Fgure 3, appears that the larger part of respondents based on age are 40-49 a long time with a rate of 38%, at that point taken after by respondents within the 30-39 year age gather with a rate of 31%, at that point respondents with an age run of 50-59 a long time have a rate of 17%. , the rest are respondents with an age run of 20 - 29 a long time with a rate of 14 %. This shows that the larger part of rice agriculturists in both districts are those of beneficial age.

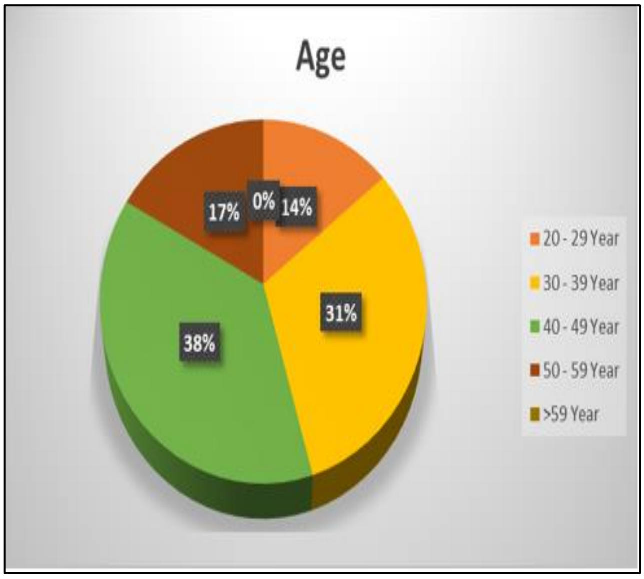

Fig 3: Respondents by Age

➢ *Respondents Based on Education Level*

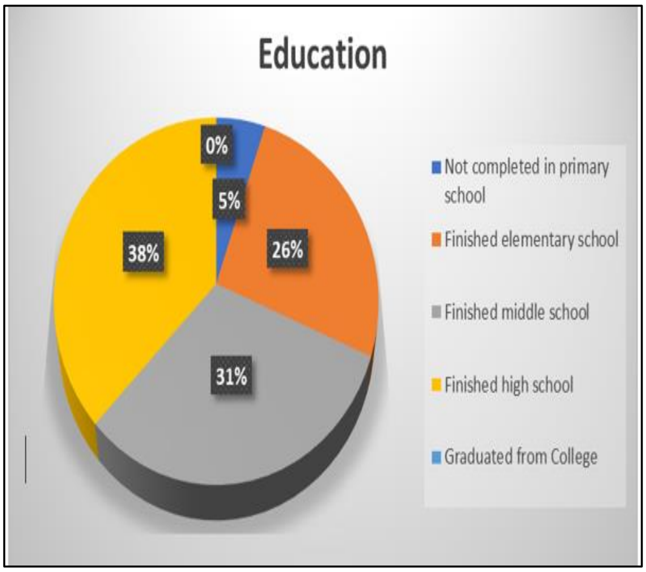

Fig.4. Respondents according to education level

From what is clarified within the picture, it can be seen that the larger part of respondents in terms of their last level of instruction, respondents with tall school instruction rule, specifically with a rate of 38%. Next in second place are those with a final education of junior high school with a percentage of 31%, next in third place are those with a final education of elementary school with a percentage of 25%, meanwhile there are a small number of respondents who have never completed their education at elementary school level at 5%.

- *Characteristics of Respondents Based on Monthly Income*

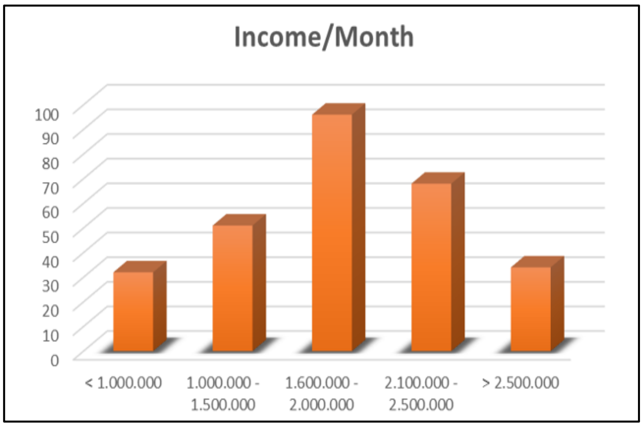

Fig 5: Respondents According to Monthly Income

After looking at the results of the research explained in the picture, it shows that some of the respondents who were rice farmers in this study had sufficient income to meet their monthly needs, which ranged between IDR 1,600,000 - IDR 2,000,000, which is a percentage by 34%, followed by those who earn between Rp. 2 . 1 00.00 0 – Rp.2 ,500,000 with a percentage of 24%, then those who earn between Rp.1,000,000 – Rp.1,500,000 are 18%, and the minority of respondents have income above Rp. 2,000,000 with a percentage of 3%, and below Rp. 1,000,000 with a percentage of 12%.

- *Characteristics of Respondents Based on Land Area*

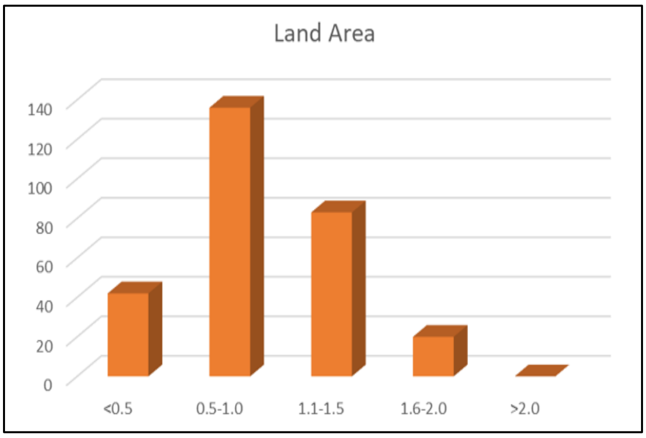

Fig 6: Respondents According to Land Area

Based on the picture, it can be seen that the majority of respondents have a rice field area of between 0.5-1.0 hectares with a percentage of 48%, then the second largest are respondents with a rice field area of 1.1-1.5 hectares with a percentage of 30%, then the minority of respondents with land area below 0.5 hectares with a percentage of 15%, and respondents with land areas between 1.6-2.0 hectares with a percentage of 7% of the total respondents involved in this research.

C. *Validation Test Results*

To decide whether or not a address is fitting to be utilized in a survey, a Bivariate Pearson relationship test (Pearson's Item Minute) is more often than not carried out. This legitimacy test is carried out by relating each thing score with the entire score gotten from the survey comes about. Each question thing that connects essentially with the overall score shows that each address thing can provide bolster for truly replying what you need to investigate. The strategy is to form a comparison between the calculated r and the r table (r Item minute) with a importance level of 5% (0.05). If r tally ≥ r table (2-sided test with sig. 0.05) at that point the instrument utilized is altogether connected with the entire score or announced substantial. So with a add up to of 115 respondents included, with a certainty level (sure interim) of 95% or level of noteworthiness (α) = 0.05, the r table esteem is 0.195.

From the approval test utilizing SPSS, it can be concluded that all address things are substantial with r calculated > r table, which implies the relationship list is tall so that the information on each pointer can be analyzed assist.

D. *Reliability Test Results*

The reliability test results for each variable question item in this research can be seen in Table 3.

Table 1: Reliability Test Resultsults

Reliability Statistics	
Cronbach's Alpha	N of Items
0.737	2 6

Looking at the unwavering quality test comes about displayed in table 4.7, it is known that the Cronbach Alpha esteem is more prominent than 0.60. So it can be said that all explanation things on each figure are announced solid so that information from the survey comes about can be handled advance.

E. *Factor Analysis*

The stages of the calculate investigation prepare are selecting fitting markers for figure investigation by carrying out the KMO and Bartlett's Test, MSA Test, at that point deciding the number of variables by extricating pointers and pivoting components and at last naming the variables.

- *Kaiser Meyer Olkin (KMO) calculations and Bartlett's Test*

The initial step that needs to be taken to test the feasibility of the analysis is to see whether an assumption is fulfilled as a condition for factor analysis to be carried out. To find out whether the data in this study can be processed in factor analysis depends on two important aspects in this analysis, namely the *Kaiser-Meyer-Olkin* (KMO) coefficient and *Bartlett's Sphericity test* . The conditions for fulfilling this test are by looking at the resulting KMO and *Bartlett's Sphericity test values. If the Kaiser-Meyer-Olkin Measure of Sampling Adequacy value* is greater than 0.5 and the significance value is below 0.05 then the factor analysis can

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be processed further. To find out the results of *the KMO and Bartlett's Test,* see the following table.

Table 2: KMO dan *Bartlett's Test*

Meyer-Olkin Measure of Sampling Adequacy		**0.774**
Bartlett's Test of Sphericity	Approx. Chi-Square	1113.145
	df	325
	Sig.	0.000

Based on the table it can be seen that the resulting KMO value is 0.7 74 , of course the analysis results show that this value is above 0.5. Then apart from that, *Bartlett's Test* shows that the significance value obtained from the results of this analysis is 0.000, which is a value smaller than 0.05. So from these results the data in this research is suitable for processing at the next stage.

- *Measure Of Sampling Adequacy (MSA)*

Table 3: MSA Value Results

	MSA value	Criteria	Information
X1	.749a	> 0.5	Meet MSA Requirements
X2	.860a	> 0.5	Meet MSA Requirements
X3	.842a	> 0.5	Meet MSA Requirements
X4	.686a	> 0.5	Meet MSA Requirements
X5	.856a	> 0.5	Meet MSA Requirements
X6	.690a	> 0.5	Meet MSA Requirements
X7	.782a	> 0.5	Meet MSA Requirements
X8	.773a	> 0.5	Meet MSA Requirements
X9	.799a	> 0.5	Meet MSA Requirements
X10	.797a	> 0.5	Meet MSA Requirements
X11	.694a	> 0.5	Meet MSA Requirements
X12	.793a	> 0.5	Meet MSA Requirements
X13	.838a	> 0.5	Meet MSA Requirements
X14	.604a	> 0.5	Meet MSA Requirements
X15	.858a	> 0.5	Meet MSA Requirements
X16	.826a	> 0.5	Meet MSA Requirements
X17	.773a	> 0.5	Meet MSA Requirements
X18	.738a	> 0.5	Meet MSA Requirements
X19	.819a	> 0.5	Meet MSA Requirements
X20	.735a	> 0.5	Meet MSA Requirements
X21	.821a	> 0.5	Meet MSA Requirements
X22	.694a	> 0.5	Meet MSA Requirements
X23	.631a	> 0.5	Meet MSA Requirements
X24	.827a	> 0.5	Meet MSA Requirements
X25	.764a	> 0.5	Meet MSA Requirements
X26	.583a	> 0.5	Meet MSA Requirements

The Measure of Sampling Adequacy (MSA) analysis process was carried out, no factors were found that were below standard, meaning that the 26 factors had an MSA value above 0.5 so that the data from these 26 factors could be processed further.

- *Factor Extraction (Factor Extruded)*

Factor analysis always tries to produce fewer factors than the number of variables being processed. The approach used to determine the number of factors obtained in this research is based on eigenvalues , *variance* presentation and *scree plot* . Factors will be formed from components that have an *eigenvalue* with the criteria for *an eigenvalue* >1. The *eigenvalue* arrangement is always ordered from largest to smallest.

In Total Variance Explained above shows that there are 7 factors formed from the 2 6 sub-factors entered. Each factor *eigenvalue* > 1. *Component* 1 has *an eigenvalue* of 6,827 with *a Variance* of 26,258%, *Component* 2 has *an eigenvalue* of 2,290 with *a Variance* of 8.809%, *Component* 3 has *an eigenvalue* of 1,817 with *a Variance* 6.989 %, *Component* 4 has *an eigenvalue* of 1.510 with *Variance* 5.809 %, *Component* 5 obtained *an eigenvalue* of 1.361 with *a Variance* of 5.233%, *Component* 6 obtained *an eigenvalue* of 1.280 with *a Variance* of 4.924%, and *Component* 7 obtained *an eigenvalue* of 1.150 with *a Variance* of 4.423%, and the *eigenvalue* describes the relative importance of each factor in calculating the variance of the 26 factors analyzed. The total variance from the 26 factors that have been extracted becomes 7 factors, which to find out the influence value of the seven factors is as follows:

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26.258% + 8.809% + 6.989% + 5.809% + 5.233% + 4.924% + 4.423% = 62.445%

The amount *of variance* that can be explained by the seven newly formed factors shows the magnitude of the influence that these 26 factors have on farmers' difficulties in utilizing rice fields in the irrigation areas of the Tojo and West Tojo regions , where after adding up *the variance* values, the total influence produced is obtained. These 26 factors account for 62.445 % while the remaining 37.555% is influenced by other factors outside of the factors identified in this research. Then, apart from the table above, the factor extraction in this research can also be seen in the following *Scree Plot image* .

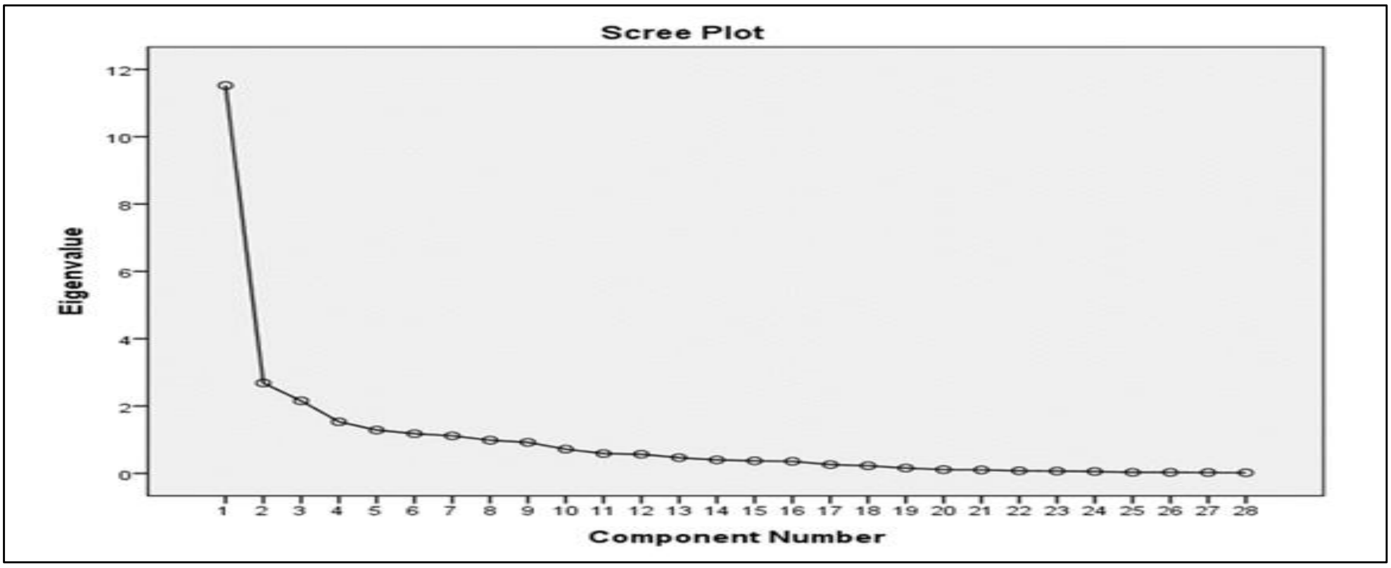

Fig 7: Scree Plot

The figure shows that there are seven components that have eigenvalues above 1, so that the results of extracting these factors produce seven new factors that have been formed.

- *Matrix Components and Rotation*

The next stage is to determine several of the most dominant items in each section, which can be seen from the results of the analysis in *the Component Matrix* which outlines the distribution of each factor studied in the seven factors that have been formed. By analyzing the weighting factors, it is very good to be able to determine which item gets a place with which factor by looking at the size of the weighting factor for each item against the seven factors that form.

The extraction results from the analysis process show that it is very difficult to determine sub-factors or dominant indicators with the highest values included in the factors because the resulting correlation values are almost the same for each item. As a solution, it is necessary to rotate factors which are expected to describe the distribution of each item so that it is clearer and easier to understand.

F. Damage to Irrigation Infrastructure, Physical and Chemical Properties of Soil, and Weak Knowledge of Farmers

The results of the factor analysis show that one of the factors that makes it difficult for farmers to utilize rice fields in irrigated areas in the Tojo and West Tojo regions is damage to irrigation infrastructure, physical and chemical properties of the soil, and weak knowledge of farmers. From the results of factor analysis, this factor has the highest *variance value* , namely 26,258%, so it can be said that this factor is the factor with the highest or most dominant influence compared to other factors. This factor arises due to several problems such as damaged irrigation network infrastructure, abnormal soil acidity levels, reduced nutrient content in the soil, high levels of water infiltration in the soil, and farmers' weak knowledge regarding proper land management.

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Fig 8: Damage to Drainage Pipe Structures in Irrigation in Tojo District

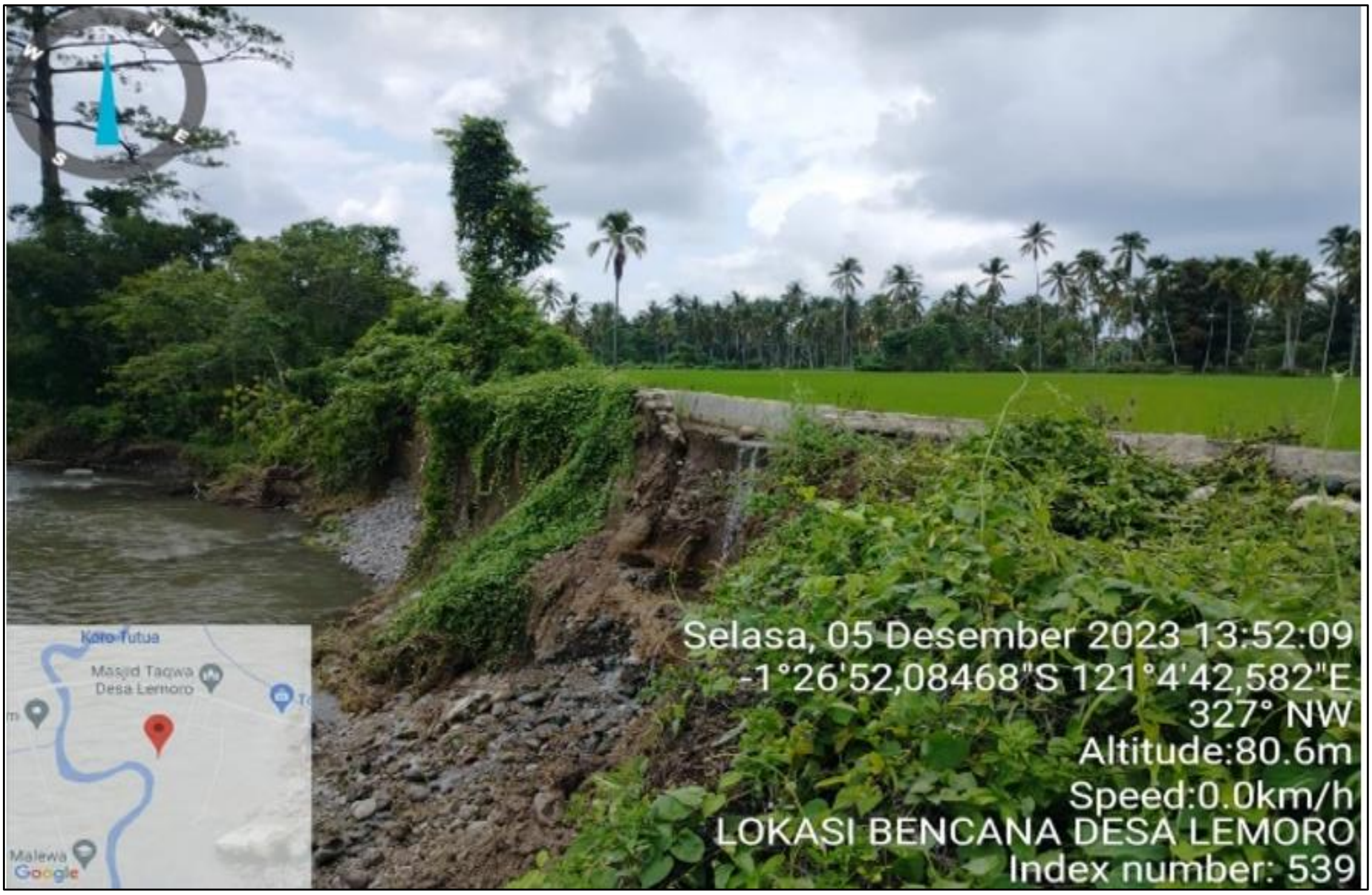

Fig 9: Damage to Drainage Pipe Structures in Irrigation in West Tojo District

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G. Hydrological Conditions due to Changes in Land Use and Climate

Then in this factor there is also the problem of climate change which makes it difficult for farmers in the Tojo and West Tojo regions to utilize their rice fields, which is characterized by the increasing intensity of extreme climate events such as prolonged dry seasons, to the extreme intensity of rain which in ultimately causing flooding in the area.

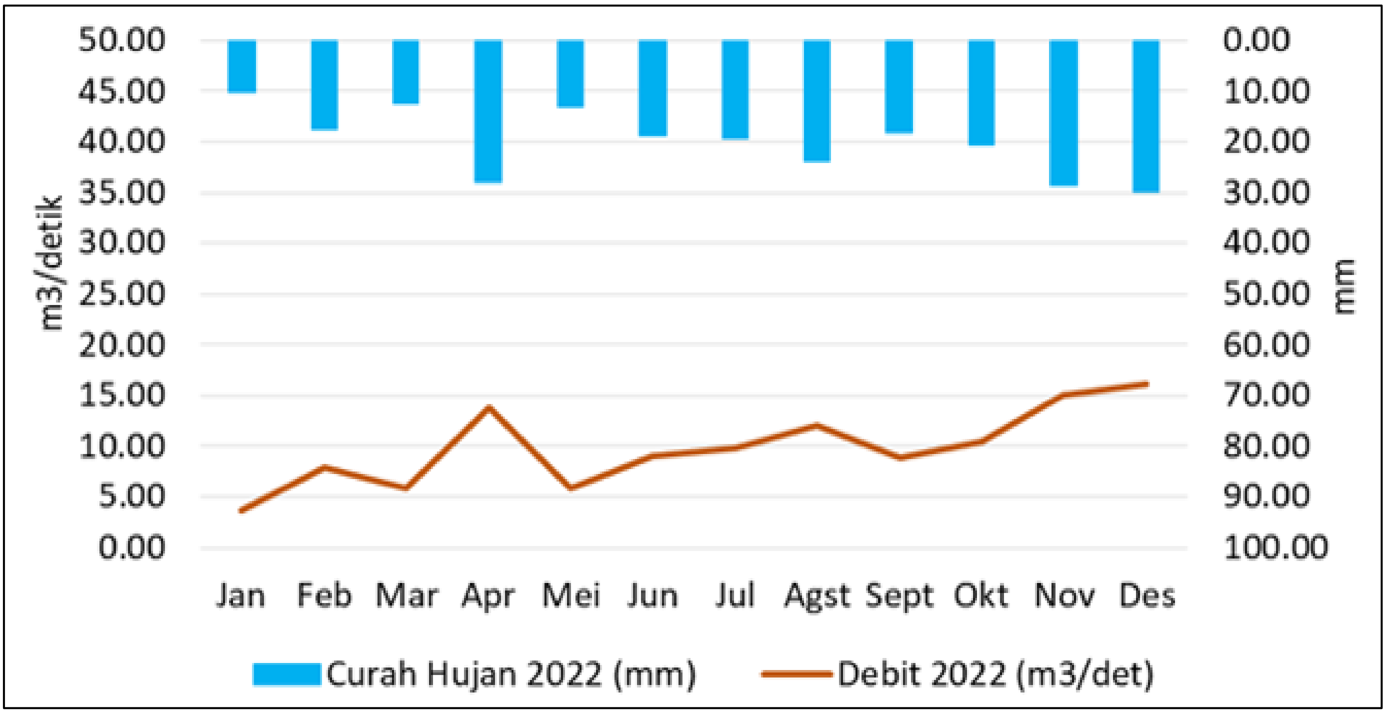

Fig 10: Changes in Irrigation Flow Discharge in Tojo District due to Rainfall in 2022

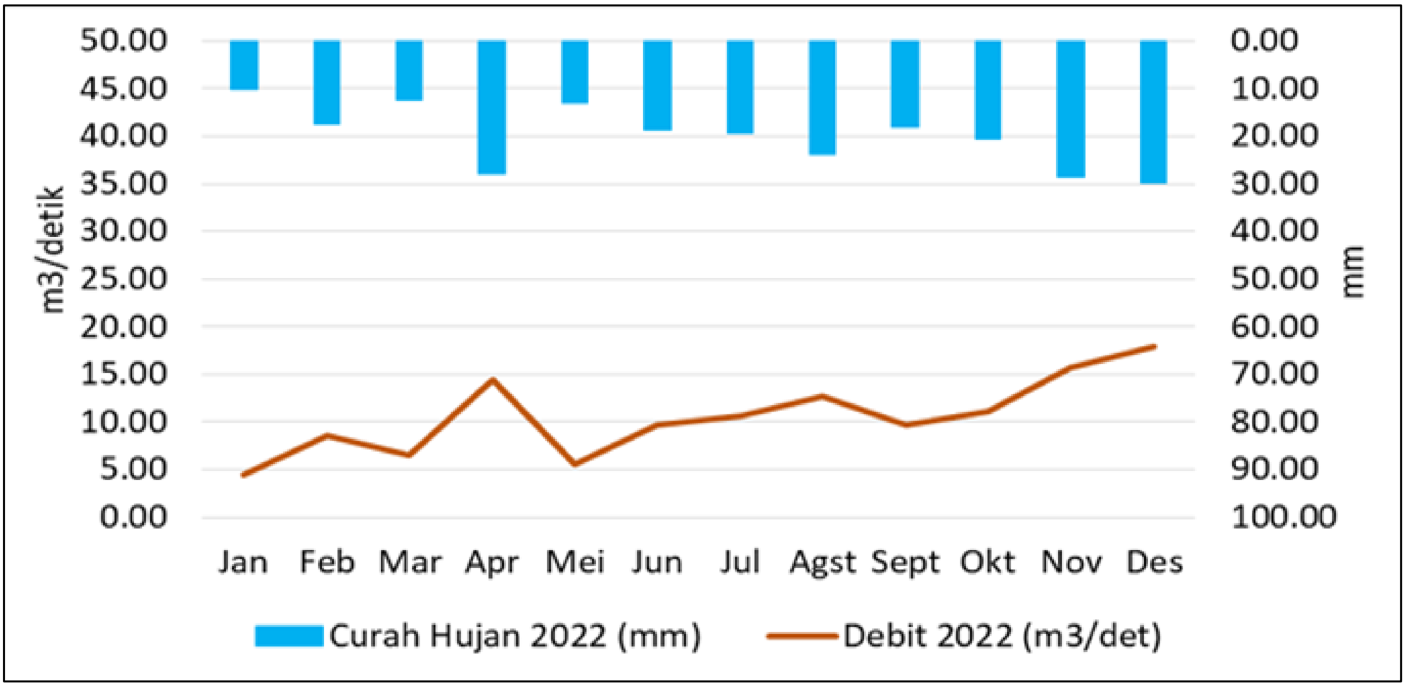

Fig 11: Changes in Irrigation Flow Discharge in West Tojo District Due to Rainfall in 2022

The occurrence of climate change has a direct impact on seasonal shifts which make it difficult for farmers to determine planting and harvest times for their crops. In addition, increasing fluctuations in temperature and air humidity can cause the growth and development of plant pest organisms. Changes in global temperature trigger prolonged dry seasons and extreme rainstorms which can disrupt the continuity of agricultural rhythms, especially lowland rice farming in the Tojo and West Tojo regions.

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H. Unstable Irrigation Water Discharge and Poor Irrigation Methods

When there is a decrease in river discharge, the water in irrigation canals also decreases, this has even happened during a severe dry season, the available river water is not able to reach all areas of rice fields, only some areas of rice fields can be accessed by irrigation, as a result, many rice fields are in poor condition for rice growth. , many even died.

The availability of river water for irrigation of rice fields is very important in agriculture, because water can maintain soil structure, inhibit and suppress the growth of weeds, regulate high and low soil temperatures, and carry nutrients needed by rice. However, the nature and amount of river water supply can be unpredictable, during the dry season the desired amount of water is difficult to obtain and can threaten the sustainability of the farming of rice farmers in the Tojo and West Tojo regions.

Fig 12: Irrigation Conditions during the Dry Season in Tojo District

I. Irrigation Management and Low Rainfall

Furthermore, another problem is that the very low rainfall in the area in the last few months has also made it difficult for rice farmers to cultivate their farming. The low rainfall in the past few months has had a big impact on the continuity of rice farming, because irrigation in the rice fields has become difficult, the impact of which could be in the case of drought in the rice fields, especially if the plants are still in the vegetative phase, at which time rice plants still need standing water to support the dissolution of their nutrients. Rice plants will lose nutrients, making rice susceptible to disease and even plant death.

J. High Rainfall, Inadequate Irrigation Networks, Land that does not have Shallow Springs, and Traditional Cultivation Techniques

Rainfall is very high, even though rice plants really need water during the vegetative period, if conditions exceed the limit it will certainly have a bad impact on the plants. Not only that, high levels of rainfall at inappropriate times, such as in the generative phase of plants, will also have a negative impact on plant yields, especially now that changes in weather conditions are felt to be quite extreme, this condition results in an increase in rainfall intensity. Even an increase in extreme rainfall intensity can result in quite bad situations, the most frequent of which is flooding. From this illustration, it can also be said that the impact of extreme rainfall conditions that occur in the agricultural sector can result in crop failure. Harvest failures that occur globally can have an impact on reducing productivity and the quality of the rice produced.

K. Drought and the Absence of a Clear Working Structure Regarding Water Management

There is no work structure that regulates water use, the work structure referred to here is P3A (Water User Farmers Association). So far, the P3A that was formed has long been deficient in managing the regulation of irrigation water use, this is because many of its administrators are old. In fact, this association has an important role in the agricultural sector, namely ensuring the availability of irrigation water for agricultural land.

L. Water Resources Reserves are Depleting

This problem arises when there is a decrease in river discharge as a source of irrigation water for rice fields in the area. This problem only appears in the dry season, at which time rainfall in the area is very low, so that there is no rainwater falling to seep into the soil through the infiltration process, making groundwater sources depleted, so this also has an impact on reducing river discharge. , the source of which comes from groundwater.

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M. Strategies used by Farmers to Overcome Difficulties in Utilizing Rice Fields in the Irrigated Areas of the Tojo and West Tojo Regions

After knowing several factors that make it difficult to utilize rice fields in the irrigation areas of the Tojo and West Tojo regions which have been described above, the strategies used by rice farmers to overcome these problems are:

- Carrying out repairs to irrigation networks
- Building a groundwater irrigation pump
- Improving the quality of farmer human resources through regular extension activities
- Set a planting pattern schedule
- Changing the water distribution system during the dry season
- Reactivating P3A (Water User Farmers Association)

V. CONCLUSION

There are seven factors that make it difficult for farmers to utilize rice fields in irrigated areas in the Tojo and West Tojo regions , these seven factors are damage to irrigation infrastructure, physical and chemical properties of the soil, and weak knowledge of farmers, hydrological conditions due to changes in land use and climate, water discharge unstable irrigation and poor irrigation methods, irrigation management and low rainfall, high rainfall, inappropriate irrigation networks, land that does not have shallow springs, and traditional cultivation techniques, drought and the absence of a clear work structure regarding water regulation, and depleting water resource reserves. Then, the strategies carried out by farmers to overcome difficulties in utilizing rice fields in irrigated areas in the Tojo and West Tojo regions include repairing irrigation networks, building groundwater irrigation pumps, improving the quality of farmers' human resources through regular extension activities, arranging planting pattern schedules, change the water distribution system

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REFERENCES

[1]. S. R. Kellert, J. N. Mehta, S. A. Ebbin, and L. L. Lichtenfeld, "Community Natural Resource Management: Promise, Rhetoric, and Reality School o f F orestry and E nvironm ental Studies Yale U niversity N ew H aven, C onnecticut, U SA," 2000.

[2]. A. Behrens, S. Giljum, J. Kovanda, and S. Niza, "The material basis of the global economy. Worldwide patterns of natural resource extraction and their implications for sustainable resource use policies," Ecological Economics, vol. 64, no. 2, pp. 444–453, Dec. 2007, doi: 10.1016/j.ecolecon.2007.02.034.

[3]. G. N. Atlin, H. R. Lafitte, D. Tao, M. Laza, M. Amante, and B. Courtois, "Developing rice cultivars for high-fertility upland systems in the Asian tropics," in Field Crops Research, Elsevier, May 2006, pp. 43–52. doi: 10.1016/j.fcr.2005.08.014.

[4]. H. Long, Y. Liu, X. Li, and Y. Chen, "Building new countryside in China: A geographical perspective," Land use policy, vol. 27, no. 2, pp. 457–470, Apr. 2010, doi: 10.1016/j.landusepol.2009.06.006.

[5]. A. Mvungi, D. Mashauri, and N. F. Madulu, "Management of water for irrigation agriculture in semi-arid areas: Problems and prospects," Physics and Chemistry of the Earth, vol. 30, no. 11-16 SPEC. ISS., pp. 809–817, 2005, doi: 10.1016/j.pce.2005.08.024.

[6]. R. Saefuddin, D. Useng, and Z. Sirajuddin, "Capacity development of farmer group in using affordable micro-irrigation for small-scale farming in marginal land," APN Science Bulletin, vol. 2023, no. 13, pp. 112–129, 2023, doi: 10.30852/sb.2023.2223.

[7]. T. Weitkamp, G. Jan Veldwisch, P. Karimi, and C. de Fraiture, "Mapping irrigated agriculture in fragmented landscapes of sub-Saharan Africa: An examination of algorithm and composite length effectiveness," International Journal of Applied Earth Observation and Geoinformation, vol. 122, Aug. 2023, doi: 10.1016/j.jag.2023.103418.

[8]. S. Nguyen Khoa, K. Lorenzen, C. Garaway, B. Chamsinhg, D. Siebert, and M. Randone, "Impacts of irrigation on fisheries in rain-fed rice-farming landscapes," Journal of Applied Ecology, vol. 42, no. 5, pp. 892–900, Oct. 2005, doi: 10.1111/j.1365-2664.2005.01062.x.

[9]. G. Moschini et al., "Production and Supply YAIR MUNDLAK Chapter 2 Uncertainty, Risk Aversion, and Risk Management for Agricultural Producers Chapter 4 The Agricultural Innovation Process: Research and Technology Adoption in a Changing Agricultural Sector."

[10]. S. Fahad et al., "Major constraints for global rice production," in Advances in Rice Research for Abiotic Stress Tolerance, Elsevier, 2018, pp. 1–22. doi: 10.1016/B978-0-12-814332-2.00001-0

[11]. "Introduction to Research Methods."

[12]. "DEVISING ITEMS Lecture 3 Notes From."

[13]. M. Alwan and M. T. Alshurideh, "The effect of digital marketing on purchase intention: Moderating effect of brand equity," International Journal of Data and Network Science, vol. 6, no. 3, pp. 837–848, Jun. 2022, doi: 10.5267/j.ijdns.2022.2.012.