ISSN No:-2456-2165

Rainfed and Irrigated Rice Farmers Profiles: A Case Study from Banggai, Indonesia

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Abstract:- Irrigation has been practiced for a long time in Asian countries, including Indonesia. This study examines the differences in the profiles of rice farmers in irrigated and non-technically irrigated lowland rice. The characteristics studied included demographic characteristics, social, economic, and cultural characteristics, as well as lowland rice productivity. The research was conducted using a survey method. The location selection was made deliberately. Three villages represent farmers with rice fields that have technical irrigation, namely Central Timur, Tirta Sari, and Tirta Jaya villages and three villages that do not have technical irrigation, namely the villages of Rusa Kencana, Mansahang, and Central Timur. From each village, because not all of the people were farmers, 20 respondents who only had lowland rice farming were selected. The determination of the respondent farmers was selected using the stratified random sampling method. The results showed that farmers in the Singkoyo Irrigation Area had a distribution of productive age (41-50 years) with the highest level of education being elementary schools and on average being farmers who owned their land. Proportionally, there are no significant differences in the demographic, socio-economic, and cultural characters of the villages that are irrigated and those that are not. Character differences exist in the aspect of land area and land ownership status. The number of respondent farmers in villages that have access to technical irrigation that has more than one hectare of land is more than respondents in villages that do not have access to technical irrigation. On the other hand, the number of respondents who own land is more in villages in villages that have access to technical irrigation than respondents who are in villages that do not have access to technical irrigation. The highest productivity of lowland rice is found in villages that have access to technical irrigation water, namely in Central Timur, Tirtasari, and Tirta Jaya villages compared to villages that do not have access to technical irrigation water, namely in the villages of Rusa Kencana, Mansahang, and Jaya Kencana.

Keywords:- *Paddy Rice, Irrigation, Characteristics, Productivity.*

I. INTRODUCTION

In Central Sulawesi, there is a legacy of the new order infrastructure which is still being used by farmers with the maintenance of rejuvenation to this day by the government. One of them is the Singkoyo weir in Banggai Regency, Indonesia, which was built in 1986, while the irrigation network was completed in 1987 and started operation in 1988. The main source of water from this irrigation area comes from the Singkoyo River with a length of 61.57 Km and a watershed area of 35,802. 40 Ha. Rice farmers using irrigation flow from the Singkoyo weir are institutionalized in the water farmers association. Where there are farmers who cultivate rice fields with different irrigation water flows. However, there are also villages with around 200 well-known farmers in several villages that do not access the Singkoyo irrigation system.

Routinely, the Central Sulawesi Provincial Government through the Operations and Maintenance Assistance Task Force has budgeted the maintenance of irrigation at the Singkoyo weir. For example, in 2018 and 2019, the Government has budgeted IDR 5,740,107,000 and IDR 3,369,102,625 with total budget of IDR 29,028,226,884 for the maintenance of irrigation in Singkoyo weir for the last five years [1, 2].

Effects of different irrigation into the community depending on the project, such as project scale, water sources, and project management and irrigation projects. There are many indications that resources determine the continuity of life. In addition to the effects of climate change (such as rising temperatures, erratic rainfall, and low agricultural yields), surface airflow and soil change due to changes in land use. In line with combined irrigation with farmer welfare [3]. Irrigation water is the most important determinant of increased agricultural yield [4]. Economic development and human population, place a large demand on resources, both for domestic and agricultural purposes, thus requiring joint strategic action to increase agricultural production. There are indications of water scarcity that interfere with environmental degradation and decreasing groundwater resources, an economic scarcity that lacks investment in meeting air needs or human capacity that can meet air demand are factors that can affect the production and welfare of farmers in general.

ISSN No:-2456-2165

The understanding of villages and farming communities in one irrigation area is still relatively limited. As a result, some government programs tend cannot run optimally or are not on target. Each village has different characters and needs, and different cultures. This study hypothesized that there is a relationship between irrigation and the characteristics of social and economic of farmers. This study figured out the understanding of the different profiles of farmers associated with irrigation water access.

II. MATERIALS AND METHODS

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2.1. Study Sites

The Study were carried out in the Singkoyo Irrigation Area, Banggai Regency, Central Sulawesi Province, Indonesia. The research location was selected purposively. The basis for consideration was chosen as a research location through the following criteria: (i) Singkoyo Irrigation Area is a central authority irrigation area with a area of 3.037 ha, where 14 villages are the scope of weir services and the locations are affordable for research; (ii) the level of participation and cooperation between farmers in the area is very high and is open to conducting focus group discussions; (iii) there are two groups water user farmer groups that have obtained technical irrigation networks and have been used as research objects, and (iv) there are farmer groups that not able to access irrigation water.

2.2. Data sources and analysis

The data collected were quantitative and qualitative, which consists of primary data and secondary data. Primary data is taken directly from the program's target farmers as the object of research using a questionnaire as the main data collection tool. Meanwhile, secondary data were obtained from documents related.

The target population in this research is all components irrigated or not irrigated by technical irrigation which is analyzed descriptively. In the irrigated area of Singkoyo, Banggai Regency, there are two farmer groups who are members of association of water user farmers, including farmers who are irrigated with irrigation from weir and who are not irrigated by weir. The village was chosen deliberately. Three villages represent farmers with rice fields that have irrigation, namely Central Timur, Tirta Sari, and Tirta Jaya villages and three villages that do not have technical irrigation, namely the villages of Rusa Kencana, Mansahang, and Central Timur. From each village, 20 respondents were selected. The determination of the respondent farmers was selected using the stratified random sampling method [5].

Data analysis follows demographic characters, age, including percentage of farmers according to the last education level obtained, large area of paddy rice field, the status of landowner, source of water irrigation. Characteristics of social, economic, and culture were identified by observation and in-depth interview. Paddy rice farming productivity was calculated as production (kg) per land area (m^2).

III. RESULTS AND DISCUSSION

3.1. Demographic Characteristics

Respondent characteristics include age, education level, land area, land ownership status, and source of irrigation are provided in Table 1.

Table 1. Characteristics of rice farmer respondents in villages that are irrigated and not irrigated by weir in the Singkoyo Irrigation Area

Nr.	Aspects	Number of Respondent in Each Village					
		Rusa Kencana	Mansahang	Jaya Kencana	Sentral Timur	Tirta Sari	Tirta Jaya
1.	Age						
	• < 25	-	1	-			2
	• 25-40	4	7	4	4	4	9
	• 41-50	9	3	8	9	6	4
	• 51-60	3	6	5	5	4	4
	• 61-70	4	3	3	2	6	1
2.	Educational Level						
	• No school	2	5	2	2	-	1
	• Elementary	14	11	10	8	10	14
	• Junior high school	4	2	2	5	2	3
	• Senior high school	-	2	5	4	5	2
	• Bachelor	-		1	1	3	
3.	Land area						
	• ≤ 0.25 ha		-	-			
	• 0.25-0.5 ha	9	5	5	1		
	• 0.51-0.75 ha	5	8		2	4	4
	• 0.76-1 ha	2	5	8	3	3	2
	• >1 ha	4	2	7	14	13	14
4.	Land status						

ISSN No:-2456-2165

Nr.	Aspects	Number of Respondent in Each Village					
		Rusa Kencana	Mansahang	Jaya Kencana	Sentral Timur	Tirta Sari	Tirta Jaya
	• Landowner	16	20	16	14	17	5
	• Rent	4	-	4	6	3	15
5.	Source of water irrigation						
	• Weir	-	-	-	20	20	20
	• Rainfed, water pump	20	20	20	-	-	-

The characteristics of the respondents in Table 1 show that the largest percentage of respondents' age is in the age range 41 to 50, which is 33%. Based on the age grouping of workers, the respondent farmers in the study locations had the largest proportion of productive farmers. In the aspect of education, half of the total respondents, or 56% have an elementary school education level. Based on direct interviews, this condition was because the village community at that time was constrained to continue their education to the next level due to cost problems. The proportion of land ownership is dominated by land area of more than one hectare, which is 45% of the total respondent farmers. Land ownership covering an area of 0.76-1 ha; 0.51-0.75 ha; and 0.25-0.5 ha have the proportions 19%, 19%, and 17% respectively. Of the total land area, 73% of respondents owned their land and the remaining 27% were farmers who were tenants of land. Proportionally, there is no significant difference in demographic characters in villages irrigated with technical irrigation and those that are not, both in terms of age and education level. Character differences exist in the aspect of land area and land ownership status. There were more respondents in villages that had access to technical irrigation with more than one hectare of land (41 respondents) than respondents in villages that did not have access to technical irrigation (13 respondents). On the other hand, the number of respondents who own land is more in villages in villages that have access to irrigation from weir (52 respondents) than respondents in villages that do not have access irrigation (36 respondents).

The productivity of agricultural labor is closely related to the productive age. The aging of the agricultural workforce will affect agricultural output [6]. In the context of this research, the largest proportion of respondent farmers is in the age range 41 to 50, which is 33%. The age range is categorized into productive age. Productive farmers are in the age range of 15-54 years. This age is considered to have a productive performance in doing farming to increase productivity or the results of farming activities carried out.

Tang and MacLeod explain that older workers are on average less productive than younger workers and that the aging of the workforce has a direct impact on productivity growth [7]. Li and Zhao's research shows that the agricultural labor force exhibits an aging phenomenon that is not conducive to the development of agricultural production as a whole [8]. In particular, Siliverstovs et al. found that increased aging had a statistically significant detrimental effect on the share of employment in agriculture, manufacturing, construction, and the mining and quarrying industries [9]. Yang et al. have studied the impact of the age of the agricultural labor force on the efficiency of agricultural land use in areas with different levels of economic development, and they conclude that households with a large proportion of young workers have lower land-use efficiency than households whose labor mostly done by parents [10]. Woodsong found that agriculture occupies an important place in the lives of many parents, the concentration of parents in rural areas may have negative consequences for agricultural production [11]. Zhang et al. found, surprisingly, that the proportion of male households among farm laborers did not significantly influence the occurrence of neglect at the parcel level, perhaps because the male farm laborers were very old (mean age over 56 years) [12]. These experts believe that the aging of the existing agricultural workforce has an impact on agricultural production. However, a study by Hu and Zhong using rural fixed-point data to measure planting decisions and investment rates of old and young farmers concluded that rural aging at this stage does not have a negative impact on agricultural production [13].

This research shows that most of the respondent farmers have elementary education. Education has an important meaning in agricultural development. Education improves the agricultural skills and productive abilities of farmers [14]. Education makes it easy for farmers to follow some written instructions on the application of adequate and recommended doses of chemicals such as fertilizers and pesticides [15]. Numerical understanding also helps farmers calculate the costs and benefits of adopting certain agricultural technologies. So far there has been no agreed-upon among experts studying the impact of farmer education on agricultural productivity. One group of studies found the important role of education in increasing agricultural productivity [17, 18]. On the other hand, studies like Battese and Coelli et al. [19] and Narayanamoorthy [20] found no significant impact of education on agricultural productivity and efficiency. Another study find even a significant negative impact of education on agricultural efficiency [21].

One of the typical agricultural areas in Central Sulawesi is the existence of agricultural land which is still quite large compared to agricultural areas in Java which are managed by farmer households. This study found that on average the respondent farmers owned more than one hectare of land.

There are differences of opinion among experts about the relationship between farm size and productivity. There is a great deal of literature linking farm size and productivity.

ISSN No:-2456-2165

One view is that there is an inverse relationship between land size and productivity [22]. This side of the debate argues that large agriculture suffers from 'scale diseconomies'. Smaller farms tend to use inputs more intensively and can therefore obtain higher yields. In response to this, there is an opposing view that smaller farms are limited by access to modern technology and agricultural services.

3.2. Social, Economic and Cultural Characteristics

The maintenance of Singkoyo wier are usually prepared by observers and irrigation officers together with association of water user farmers association in the process of carrying out operations and maintenance by the Central Sulawesi Province CKSDA Office or Sulawesi III Palu River Basin. Types of maintenance that involve water user farmers association are grass cutting, sludge dredging (sedimentation clearing), garbage cleaning in leakage closure channels, network security, while door painting and door lubrication are carried out by Water Gate Guard Officers. Maintenance work is carried out periodically and during the implementation of the work, there is no conflict either in the upstream, middle, and downstream areas.

The structure of the farming community in the Singkoyo Irrigation Area is divided based on land ownership into two major groups, namely owners and tenants. Cultivators or better known as agricultural laborers have the lowest social power with limited economic activities on the mobilization of wage laborers to landowners. Some of them try to carry out other economic activities, but they are still limited to the types of small businesses. This is different from the landowner who have a more varied economic activity and a much larger scale. The development of the social structure of the village community at this time still recognizes the existence of these two strata, but the existing economic activities have developed so that the welfare of farmworkers (cultivators) can further increase. Parallel partnership patterns have also been formed between farmworkers and landowners.

The culture of cooperation has long been inherent in the communities in Toili District, especially around the Singkoyo Irrigation Area, which originated from the transmigration community of Java and Bali Provinces in a smaller scope, namely the people who live around the Singkoyo Irrigation Area, the culture of cooperation has been ingrained from generation to generation and its implementation depending on the social activities carried out by the community in their customary culture. The cooperation activities of farmer communities who live in the Singkoyo Irrigation Area in agricultural activities are integrated into Balinese customary law, usually called: (i) Mapag Toyo, namely the customary activity to ask for water;

Pengwiwit, namely rice planting activities; (ii) Neduh is an activity carried out when the rice is pregnant (well); (iii) Ngusaba, namely community activities when the harvest arrives.

All agricultural business activities from processing to harvesting are carried out jointly by the community from one farmer to another to reduce production costs and labor scarcity which have been a problem in conducting farming activities. In irrigation, cooperation is carried out on the aspects of maintaining the irrigation network in the work of lifting sedimentation, grasping, removing trash in the canal, and repairing canals/embankments. From the observations in the field, cooperation activities in the implementation of maintenance activities are carried out three times a year, namely at the beginning of the planting season.

Since the reform of water resources, the roles and responsibilities of Subak institutions have been further enhanced. To realize broader roles and responsibilities, institutional reform is also carried out through the establishment of an institutional hierarchy of water user farmers based on their participation in the development and management of the irrigation system.

Within the broad scope of the irrigation area, Subak plays a greater role in the management of tertiary blocks, while in the network management at the tertiary, secondary, and primary levels, the Subak activities gather themselves in water user farmers association institutions. This water user farmers association institution plays a role in building relationships between communities in the upstream, middle and downstream parts of the irrigation area.

The social problem faced by farmers in the Singkoyo Irrigation Area is the low participation of farmers in exploitation (operation) and maintenance (EP) activities along with the Singkoyo irrigation network. Four factors cause low farmer participation, namely: (i) limited capacity of irrigation network services, (ii) the inability of the community to operate the irrigation network properly, (iii) limited ability to adapt to local conditions, and (iv) existence (creation) dependence on the government.

Farming communities in the irrigation network area of Singkoyo have a very strong institutional structure and community leadership but find it difficult to accept technological input from outside. Many community leaders own more land than other farmers. When it comes to groups of farmers using water, the problems raised are colored by a reflection of the interest in obtaining water individually and not objectively.

3.3. Rice Paddy Productivity

The highest productivity of lowland rice is found in villages that have technical irrigation, namely in the villages of East Central, Tirtasari, and Tirta Jaya (Table 2). The results of the paired t-test analysis showed a significant difference in productivity between villages that have and do not have technical irrigation ($p = 0.0002$).

Table 2. Average rice production, land area and productivity.

Irrigation Status	Vilage	Production (ton)	Land area (ha)	Productivity
Villages that do not have irrigation access	Rusa Kencana	1,75	0.86	2.04
	Mansahang	1.35	0.74	1.82
	Jaya Kencana	2.49	1.15	2.17
Villages that with irrigation access	Sentral Timur	9.11	3.58	2.55
	Tirtasari	4.45	1.59	2.81
	Tirta Jaya	3.53	1.62	2.18

Research in the irrigated area of Singkoyo shows that rice productivity is better in villages that have technical irrigation compared to villages that do not have technical irrigation. Many factors affect productivity apart from the availability of irrigation. For example, this study found that the on-farm practices carried out are still conventional, this method is characterized by a state of cultivation that still manages the soil without a time interval between demolition and soil remodeling, direct seed planting is carried out without use irregular or cropping lines, and inconsistently using basic fertilizers. With on-farm practices like this will cause stagnation in seedling growth, produce low productive tillers and of course reduce productivity.

System of Rice Intensifications (SRI), jajar legowo, which is a cultivation technology has been developed and socialized to farmers in the irrigation area of Singkoyo. However, not all farmers are willing to implement it. This can be one of the determinants of the level of rice productivity.

According to information from the water user farmer groups management of the Singkoyo Irrigation Area, the type of soil around the irrigation area is a laterite soil type that has a low fertility level because of the nutrients contained in it have undergone a nutrient leaching process by water runoff. sourced from rain and flooded puddles and then carried by the flow of water, causing mineral and nutrient content in the soil to also disappear.

Battese et al. studied the production function of rice farmers in India and found that production costs, labor, and the ratio of land irrigation to total land were significantly and positively related to rice production [23]. Diagne et al. explained that the production and technical efficiency of rice farmers in the Senegal River Valley [24]. They conclude that the production function is positively affected by soil, seed, fertilizer, and services and negatively affected by labor wages. They further estimate that fertilizers, herbicides, efforts to control birds as pests, use of post-harvest technology such as thresher cleaner affect the technical efficiency of rice production. Tiongco and Dawe studied the long-term evolution of productivity in rice farming in the Philippines [25]. They claim that long-term productivity has stagnated in key rice-growing areas of the Philippines. They concluded that emphasis should be placed on the potential for crop genetic yields to increase productivity and to alleviate poverty from agricultural systems. The use of improved varieties during the late 1960s more than doubled rice production from 3.9 million metric tons in 1961 to 9.6 million metric tons in 1990 (IRRI).

Other studies have found evidence that after years of intensive cultivation, yields decline in several long-term trials at constant input levels (Flinn and De Datta, 1984; Cassman and Pingali, 1995). If this trend manifests in farmers' land, then farmers will eventually be forced to abandon cultivation, adversely affecting farm incomes and food supply for consumers. Hence, some observers have raised concerns over the sustainability of the intensive irrigated rice cropping system [26]

Lynam and Herdt suggest total factor productivity (TFP) as a tool for measuring long-term sustainability. In this case, trends in long-run productivity estimate a production function that includes a time dummy variable [27]. This is conceptually similar to the TFP which measures output growth that is not due to growth in input use. Likewise, the production function which controls statistically for changes in input use, with time dummy variables can measure changes in output not due to changes in input. However, the estimation of the production function has the advantage of allowing statistical testing when comparing productivity between two different years. Despite these advantages, this technique is not commonly used for long-term productivity analysis because long-term data on individual farmers are relatively unusual.

IV. CONCLUSION

This study figured out that: (i) Farmers in the Singkoyo Irrigation area have a distribution of productive age (41-50 years) with the highest level of education being elementary school, and on average are farmers who own the land. Proportionally, there are no significant differences in the demographic, socio-economic and cultural characters of the villages that are irrigated and those that are not. Character differences exist in the aspect of land area and land ownership status. The number of respondent farmers in villages that have access to technical irrigation that has more than one hectare of land is more than respondents in villages that do not have access to technical irrigation. On the other hand, the number of respondents who own land is more in villages in villages that have access to technical irrigation than respondents who are in villages that do not have access to technical irrigation; (ii) the highest productivity of lowland rice is found in villages that have access to technical irrigation water, namely in Central Timur,

Tirtasari, and Tirta Jaya villages compared to villages that do not have access to technical irrigation water, namely in the villages of Rusa Kencana, Mansahang, and Jaya Kencana.

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