Partnership system on rice farm-based pumping irrigation in Wajo District, Indonesia

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Abstract. A partnership is a form of pooling of different resources to generate a greater output. It is widely applied to small scale economic development, including rice farms. The objective of the study is to analyze the pattern of partnership among enterprises in the input rice agribusiness. This study was conducted on two villages that are affected by the lake ecosystem in Sabbangparu Sub-district, Wajo District, South Sulawesi Province with 70 farmers selected using simple random sampling. The result indicated that the partnership in rice farming could develop because it is supported by the availability of irrigation services and activity on the risk-sharing of crop failure due to flooding. Water and production inputs are two basic needs that can be met; the easiness, efficiency, and risk-sharing of rice farming management can be realized; and the limited capital and frequent flooding problems can be overcome through a partnership system. The partnership model on various food commodities can be developed to improve the welfare of farmers and increase the income of the agricultural sector and region.

1. Introduction

Mutual symbolism is a form of pooling of different resources or cooperation between actors generating a greater output [1]. This model was implemented in the form of a partnership and is widely applied to small scale economic development, including in the food sector. Rice is a food product that is produced from small-scale farming and is cultivated by many farmers in Indonesia[2,3]. The characteristics of agricultural products, especially for intensive crops including as rice has a high production risk and price fluctuations due to the influence of nature, including climate change [4,5]. Therefore the farmer as a rice producer do not have a bargaining position in the market. Small-scale rice farming was related to many types of businesses. Therefore, the type of work tends to lead on specialization in turn to the partnership becomes a necessity to encourage efficiency and effectiveness in the rice industry [6]. Partnership in agricultural business was developed in the concept of agribusiness[7,8].

Rice is one of the food commodities with an intensive cultivation system, and it should be developed in the agribusiness model. The linkages between subsystems driven rice commodity into an
industrial product. The cohesiveness system should be supported by a partnership pattern. A partnership is an important pattern to increase farm productivity, meet the population's growing food needs for rice, creates job opportunities, encourage related businesses to be more efficient, and ultimately improve the welfare of rice agribusiness actors. Many partnership studies have been carried out on palm oil [9] [10,11], cocoa [12,13], poultry [14], and other agricultural commodities. Whereas rice studies still focus more on technology adoption [15,16], marketing [17,18], and pricing policies [19,20]. The objective of this study is to analyze the pattern of partnership among enterprises in the input subsystem, farmers in the production subsystem, the processing subsystem, marketing institutions and supporting subsystems. Processing and marketing subsystems are referred to as downstream subsystems and generally managed by one enterprise.

The results of the study are expected to be used as a model for agribusiness development in annual crops or intensive crops for other food commodities. If this model can be developed in various food commodities in Indonesia, food commodities can be developed as industrial products that improve the welfare of farmers, related businesses, and increase the income of the agricultural sector and region.

2. Methods

Rice is a staple food commodity for most of Indonesia's population and is cultivated by most farmers with small-scale businesses [21]. Agricultural technology in the field of rice is highly developed as the result of the green revolution, and it keeps continuing with the support of science and technology development through research activities [22,23]. Farm management has also changed from almost the majority of work in the rice production process carried out by farmers changing to specialization [24].

Rice farming, as intensive farming, requires relatively more capital than most other crops. The process of rice production is related to many types of businesses that lead to job specialization as the development of technology and management in the rice industry. Agribusiness is a system consisting of input, production (cultivation), processing, marketing, and supporting subsystems. Agribusiness can develop if it is supported by partnerships among subsystems where the farm as a production subsystem is the principal in the agribusiness system [8].

The form of specialization that develops is the various types of work carried out by different business units, for example, land management, manufacture of organic fertilizers and pesticides, transportation, harvesting, storage, financing, etc. This progress has encouraged the development of partnership patterns in agricultural businesses, including in rice commodities. The agribusiness system on rice commodities can be seen in the upstream agribusiness system consisting of providers of agricultural production facilities, such as seeds, fertilizers, pesticides, fuels, and irrigation water.

Water is already counted as an agricultural input and has an equivalent value to other factors of production, such as land and human labor. Many production subsystems were supported by other subsystems; input subsystems, marketing subsystems, and supporting subsystems. Commonly, the processing and marketing subsystems were carried out by one business unit, especially in food commodities, including rice. Supporting subsystems with various businesses were created by developing business specializations, such as the use of tractor services for land preparation, planting services, fertilizer and pesticide application services, transportation, and harvesting. All business activities carried out by each subsystem are variables analyzed to illustrate the partnership pattern in the rice agribusiness system.

This research was conducted in Sabbangparu Sub-district, Wajo District, South Sulawesi Province, applied a survey research method on two villages, Mallusesalo and Pallimae, with 70 farmers selected by simple random sampling, which both villages are affected by the lake ecosystem. -The majority of farmers in this village make rice farming as the main occupation. The irrigation system used in this farming is draining water from the lake by using a pump. The data analyzed in this study are the patterns of cooperation between farmers in the production subsystem and the entrepreneurs of production facilities in the input subsystem, including in the activities of pump operators who provide water to farmers as a substitution of water from conventional irrigation systems or rainwater; the pattern of cooperation between rice farmers in the production subsystem and the processing and
marketing subsystems, such as sales and production prices; supporting subsystems, such as financing, use of land preparation services, planting, application of fertilizers and pesticides, harvesting and transportation of products. The analytical method used is descriptive using matrix tables to present information that is easily understood.

3. Result and Discussion

3.1. Study Site
Sabbangparu sub-district is one of five sub-districts in Wajo Regency, which is partly located around Lake Tempe. There are 15 villages in Sabbangparu Subdistrict, with a population of 26,294 and 4,872 farm households in 2018. The area of irrigated agricultural areas in six villages affected by the lake ecosystem is greater or around 56.15 percent of the total area underwater. This data shows that water for irrigating rice fields is sourced from lakes.

Table 1. A number of population, farmers dan agricultural land based on the ecosystem in Sabbangparu sub-district, 2018.

| Description                  | Unit | Non-Lake Ecosystem | Lake Ecosystem | Total |
|------------------------------|------|---------------------|----------------|-------|
| Villages                     | Unit | 9                   | 6              | 15    |
| Population                   | Person | 17,492 | 8,802 | 26,294 |
| Farmers                      | HH   | 3,153               | 1,719          | 4,872 |
| Agricultural land            | Ha   | 4,780               | 4,490          | 9,270 |
| Irrigated rice field         | Ha   | 2,188               | 2,802          | 4,990 |
| Non-Irrigated rice field     | Ha   | 521                 | 227            | 748   |
| Other agricultural lands     | Ha   | 1,852               | 1,331          | 3,183 |
| Non-cultivated area          | Ha   | 219                 | 130            | 349   |
| Housing and public utilities | Ha   | 2,787               | 1,213          | 4,000 |
| Total area                   | Ha   | 7,567               | 5,703          | 13,270|

Source: Sabbangparu Sub-district in Figure 2018, BPS Wajo District, 2019.

Table 1 shows that the area affected by the lake ecosystem is around 42.98 percent with 33.48 percent of the population, and 63.92 percent of the paddy field area. This data shows that the commodities cultivated in Sabbangparu District are strongly affected by the lake ecosystem, which is a source of water for irrigating rice fields.

The irrigation pumping system by extracting water from Lake Tempe began in 1990, which later changed and greatly influenced the farming system in the lake area. Since then, the irrigated paddy fields have developed by converting agricultural land with crops to rice fields. The adoption of irrigation technology using pumps and plastic pipes has led to the development of the adoption of rice production technology by the use of fertilizers, pesticides, and HYV (High Yielding Varieties) seeds. This progress then encouraged the formation of stronger capacities from farmer groups and partnership systems. Partners associated with rice farming as the principal subsystem included therein; pump irrigation companies, input production supply agents, and large companies.

Table 2. Assets acquisition and responsibilities in the partnership system between rice farmer and irrigation water enterprise

| Parties                  | Responsibilities/Asset acquisition | Farmers Responsibilities | Notes: Harvesting failure |
|--------------------------|------------------------------------|--------------------------|--------------------------|

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|--------------------------|------------------------------------|--------------------------|--------------------------|
3.2. Subsystem of Input

Production inputs that are commonly used in rice farming are seeds, fertilizers, and pesticides. Different from other regions, especially in the Tempe Lake area, water has become a factor of production, and its value varies, because it follows the value of the products produced. Water fees are paid for 20 percent of the production value. Water as a factor of production, must be used through a partnership system based on a benefit-risk share system. Production inputs that are widely used through cooperation systems are fertilizers. Fertilizer has a relatively higher value compared with other production inputs, and sometimes difficult to obtain, while the application time should not be delayed.

Table 3. Percentage of farmers using production inputs sourced from partners (N=70)

| Input Production          | Farmer | Percentage (%) |
|---------------------------|--------|----------------|
| Seed                      | 26     | 37.14          |
| Fertilizer                | 54     | 77.14          |
| Pesticide                 | 32     | 45.71          |
| Water irrigation          | 70     | 100.00         |

Table 3 shows that all farmers use irrigation through a collaboration system. Essentially, farmers can work alone, but they must bear the costs and risks of agriculture by themselves. Furthermore, additional time and work are needed to maintain the pump, especially the safety of the pump engine, which must be stored on a lake prone to theft. Fertilizers used by farmers must be paid in cash even in the form of subsidized fertilizers. This system makes farmers have to collaborate with irrigation pump operators or marketing institutions where they can handle early payments. Only farmers with sufficient capital can provide more seeds and fertilizer to meet their needs.
3.3. Subsystem of Production

Farming as a production subsystem is a principal subsystem unit in rice agribusiness. Both the upstream subsystem, as well as the downstream subsystem and supporting subsystems, all of which relate to farming as a production subsystem. Services from supporting subsystems can be seen on the level of application of technology. Rice farming, in general, has used HYV seeds. There are four types of varieties that are commonly used by farmers. The choice of varieties depends on the availability and planting schedule or the age of the plant. While the planting system depends on the ability to plant, provide wages and farmers' affordability. Age crops and cropping systems be a primary consideration, because of the threat of flooding that could happen any time, either at the beginning

Table 4. Percentage of farmers by type of technology used in rice cultivation production (N=70)

| Seed and planting technologies | Farmers | Percent (%) |
|-------------------------------|---------|-------------|
| **Seed varieties**            |         |             |
| Chigulis                      | 28      | 40.00       |
| Inpari                        | 14      | 20.00       |
| Mekongga                      | 12      | 16.67       |
| Ciherang                      | 16      | 23.33       |
| **Seed planting**             |         |             |
| Direct planting               | 34      | 48.57       |
| Transplanting                 | 28      | 40.00       |
| Spreading                     | 8       | 11.43       |
| **Planting Technology**       |         |             |
| Legowo*                       | 12      | 17.14       |
| Square                        | 58      | 82.86       |

*Jajar legowo system is technological engineering to get a plant population of more than square (160,000/ha)

Table 4 shows that direct planting and transplanting are the two cropping system technologies used. Both types of technologies are related to the amount of plant costs or the value of the seeds used. In addition, it relates to the ease of replanting in the event of disruption from flooding. Whereas technology planting is greatly influenced by farmers' preferences and habits. Farmers who use technology are those who dare to take risks to get higher production. The application of the legowo system has higher production, but the harvest and maintenance system is considered to be more intensive compared to other systems.

The planting season takes place twice a year. The first harvest season is January-April, and the second planting season is on July-October. Achievement of production in the second season is higher than the first season. However, there are fewer farmers who plant rice because of the peak flood cycle in the second season. The growing season takes place twice a year. The first harvest season is January-April, and the second planting season is July-October. Achievement of production in the second season is higher than the first season. However, there are fewer farmers who plant rice because of the peak flood cycle in the second season.

Rice fields planted with rice are located in areas with low risk of crop failure from flooding. In the second season, there was a dry season in the Wajo District, while rainy season occurs on the West coast, areas on the opposite of the Wajo District in South Sulawesi Province. Many rivers in the West Coast region flow into Lake Tempe, which causes flooding. Wajo district and Lake Tempe are located on the East coast of South Sulawesi with a rainy season in January-April.
Table 5. Financial analysis and benefit share to the party on a rice farm-based pump irrigation

| No. | Description                        | 1st Planting Season | 2nd Planting Season |
|-----|-----------------------------------|---------------------|---------------------|
| 1   | Production                        | Kg/ha               | 5,500               | 6,050               |
| 2   | Price                             | Rp/kg               | 4,500               | 4,800               |
| 3   | Total revenue                     | Rp/ha               | 24,750,000          | 29,040,000          |
| 4   | Tillage (Tractor fee)             | Rp/ha               | 1,300,000           | 1,300,000           |
| 5   | Seed                              | Rp/ha               | 450,000             | 480,000             |
| 6   | Fertilizer                        | Rp/ha               | 875,000             | 875,000             |
| 7   | Pesticide                         | Rp/ha               | 355,000             | 310,000             |
| 8   | Labor for cultivation             | Rp/ha               | 650,000             | 650,000             |
| 9   | Land tax (0.5xIDR 70,000/year)    | Rp/ha               | 35,000              | 35,000              |
| 10  | Depreciation of equipment         | Rp/year             | 335,000             | 335,000             |
| 11  | Harvesting fee (8.33 % of total revenue) | Rp/ha | 2,054,250          | 2,419,000          |
| 12  | Share for water (fee= 20% of total revenue) | IDR/ha | 4,950,000          | 5,808,000          |
| 13  | The total cost of production = 4+5+...+12 | IDR/ha | 11,004,250         | 12,583,006         |
| 14  | Net Revenue of farm = 3-13        | IDR/ha              | 13,745,750          | 16,456,994          |
| 15  | R/C-Ratio                         |                     | 2.25                | 2.31                |

Table 5 shows that the number of farmers receiving in the second crop season was higher than the season before at around IDR 2.7 million with an R / C-ratio of 2.31. The light intensity is also higher in the second planting season, and farmers who plant are exposed to the risk of high flooding.

3.4. Subsystems of Processing and Marketing

Processing and marketing subsystems in rice agribusiness tend to be united, marketing institutions that work with farmers also carry out processing activities. Some of these marketing institutions operate RMU (Rice Milling Unit). There are two models in the downstream subsystem, namely a marketing institution that has an RMU, a truck, and a harvesting machine. On the other side, marketing institutions only have RMU and buy grain through collectors. This marketing agent performs the marketing function and also acts as a supporting subsystem. This merger was conducted to improve business efficiency and competitiveness.

The partnership system in rice marketing is still limited, this is because the rice market situation is very dynamic, so farmers who partner with marketing institutions require production inputs at market prices, but grain production must be sold to partners at the current price. Not all products produced by farmers are sold, farmers also store stock for household needs, and some farmers even store their production to meet their household needs for up to one year to anticipate subsequent crop failures due to flooding.

Table 6. Number of farmers based on the number of product sold and partnership system (N=70)

| Description         | Number of farmers | Percent (%) |
|---------------------|-------------------|-------------|
| Selling of production |                   |             |
| >90 %               | 21                | 30.00       |
| 70.1-90.0%          | 34                | 48.57       |
Table 6 shows that around 78 percent of farmers sell their products at around 70 or more of the total production received, even some farmers keep rice stocks around 50 percent or more to anticipate crop failure in the next planting season. This data shows that the precautionary motive for family food security is a top priority. The main goal of most farmers in Indonesia is to produce food to meet their family’s basic needs [25]. Farmers who sell their products, not through a partnership system, are 63 percent. Farmers are encouraged to partner with marketing institutions to obtain production inputs at current prices. On the other hand, farmers who partner with irrigation pump operators with the motive for payment of production inputs can be postponed at the next harvest if there is a crop failure.

3.5. Subsystem of Supporting

Supporting subsystem analysis includes activities carried out with the production subsystem. Farming is a subsystem that utilizes many of the service products provided by supporting subsystems, such as land management services, crop services, fertilizer and pesticide application services, and transportation of production from farming to sales or storage.

The industrialization of rice has begun to develop. An indication of this development can be seen from all the work on rice cultivation can be done using external or paid labor. All farmers have used harvesting and transportation services. Harvesting services using modern machines are used by farmers because they are very efficient, inexpensive, and fast. While transportation services are used to transport crops to the point of sale, service providers usually stay on the edge of the highway or close to the farmer's house and fields. Thus making farmers sell their products immediately after harvesting to avoid drying, storing, shrinking, and other risks.

| Support services             | Outsourcing | Percent (%) |
|------------------------------|-------------|-------------|
| Land preparation (Tractor services) | 46          | 65.71       |
| Nursery                      | 14          | 20.00       |
| Planting                     | 28          | 40.00       |
| Fertilizer application       | 19          | 29.14       |
| Pesticide application        | 45          | 64.29       |
| Harvesting                   | 70          | 100.00      |
| Transportation               | 70          | 100.00      |

Table 7 shows that there are already about seven services used by farmers in rice farming. The service that is mostly used by farmers besides harvesting and transportation is land preparation, then followed by pesticide application services and planting services. All of these types of work require immediate time in order to be able to participate in simultaneous planting for all farmers. The purpose of using supporting services is to speed up the completion of work and to maintain the nature of mutual assistance and kinship among the village community or farmers for various jobs. Farmers who
use supporting services are farmers who obtained large cultivated land, while those who use tractor services are those who do not have tractors.

4. Conclusion and Policy Recommendation

Partnerships in rice farming can develop because they are based on the availability of irrigation services and the risk of crop failure due to flooding. Water and production inputs in farming are two basic needs that can be met through a partnership system. In addition, the ease, efficiency, and risk-sharing of rice farming management can be realized, capital constraints and frequent flood problems can be overcome through a partnership system. The partnership model on various food commodities can be developed to improve the welfare of farmers and increase the income of the agricultural sector and region.

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