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Contributions of Enim Watershed in Production of Irrigation Rice Using Benefit and Cost Analysis

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***Abstract*—** Population growth impacts on accumulating basic need. Basic foodstuff of Indonesia people is rice. The rice is derived from paddy field. The availability of paddy land use need to be maintained due to the continuously of supporting aspects ie water, paddy field. Therefore, it is necessary to manage rice crops to yield more production. Irrigation is one way to increase rice production. Irrigation plays an important role in the success of rice production. An important role of this irrigation should be assessed economically. The economic value of irrigation for paddy production needs to be studied. An important role of the irrigation should be assessed econmically. The economic value of irrigation for paddy production needs to be studied. Study of economic value is important so that people know that the irrigation water is an important contribution in the production of rice in addition to seeds, fertilizer and labor. It is necessary for economic calculation.This study aimed to quantify the economic value of watersheds to irrigate rice fields. Economic value calculation is conducted using benefit and cost benefit analysis on use of irrigation watershed in Cahaya Alam village. Muara Enim regency in South Sumatera of province

***Keywords*—** Enim watershed, irrigation, benefits and costs analysis

I. INTRODUCTION

Population growth impacts on accumulating basic need, namely the need for food and shelter. Rice is the basic foodstuff of Indonesia people need a daily life. Rice as the base material, its availability need to be maintained so that it can meet the basic needs of Indonesia people. It agrees with the arguments raised by Malthus in his theory that the number of people following the geometric progression whereas the availability of the necessities of life to follow arithmetical, [1].

The supply of rice must be maintained so that it can meet the basic needs of Indonesia people. Therefore, it is necessary to manage rice crops with irrigation system. The water requirement for irrigated land areas of 7.6 million hectares, which is about 92.76 billion m^3, while the use of water for industrial and domestic respectively are 4.06 and 13.19 billion m^3 in 2000. The agricultural sector is water users that spread out,, ie 84.31% of the total water users in Indonesia ([2]-[5]).

Irrigation plays an important role in the success of rice production. According to the opinion ([6]-[8]), that the irrigation effects on rice production. Likewise, irrigation in the Cahaya Alam village is coming from Enim watersheds. Therefore, the availability of water for irrigation should be maintained. Water to irrigate the fields in the Cahaya Alam village is coming from watersheds Enim upstream. Water availability in Enim watershed needs to be done management in order to irrigate the rice fields that exist so that water availability keeps maintained.

Irrigation in this village are still using conventional irrigation system. The water from the watershed above the village, flows through the irrigation canal made public. Then, water of irrigation canal is flowed to the rice plots that distributed to several irrigation canals towards the rice plots. It is necessary for the calculation of how much the water with this conventional irrigation systems.

Enim watersheds give to a significant contribution to the irrigation of paddy fields in the village of Cahaya Alam. Water contributions of Enim watersheds need to be calculated economically. The calculation of the economic value of water in the Enim watershed, is expected to open the community insight about the value of water. In addition, to generate awareness about the importance of maintaining the supply of water in the watershed in order to remain to able to irrigate rice fields in the future. Therefore it is necessary for the calculation of the economic value of irrigation for rice production, especially water coming from upstream Enim watersheds. The results of cost-benefit analysis can provide information for decision makers in determining how water policy based on economic principles which have been tested. [9]. This paper aims to calculate the value of the contribution of Enim watershed economically for irrigation of rice fields.

II. METHODS AND MATERIALS

2. 1. Study Areas

The study was conducted in the village of Cahaya Alam, Semende Darat Ulu district of Muara Enim regency, South Sumatera, Indonesia. The location can be seen in Figure 1. This research was conducted in August-November, 2014. The used method and approach are quantitative. This type of research is exploratory research.

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2.2. Methods

This research began by exploring the concept of management and benefit of watershed and how state of society around Enim watersheds at Cahaya Alam village by means of survey. Used instruments are questionnaire and interview. Questionnaires were given to villagers chosen to sample and interview was conducted to head of sub-district, head and secretary of village and head of public facilities affairs. Number of respondents in this study was calculated using formula (1) in [10].

$$n = \frac{NZ^2S^2}{d^2N+Z^2S^2} \qquad (1)$$

Total population for this study was 217 respondents. Number of samples was calculated using the formula (1) obtained 18 respondents. However, researchers took a sample of respondents as many as 30 people by considering the minimum amount of good data for quantitative methods.

Data used in this study are primary and secondary data. Secondary data came from the central statistical agency and the village secretary. Secondary data is used to supplement primary data. Primary data used as the selling price of rice, the costs incurred in the production of rice, the purchase cost of fertilizers, medicines and seeds, labor costs cultivate paddy fields, land rental for people who do not have land and rental of agricultural equipment such as tractors for plowing fields.

Analysis of benefits and costs is an analysis that is used in the application of modern welfare economics and directed to improve the economic efficiency of resource allocation. Extended net present value or net present values are cost benefit analysis has been expanded from analysis of existing conventional benefits and costs before. This expansion has been done [10].

The analysis used in this study is an analysis of benefits and costs. The purpose of this analysis is to evaluate the use of resources to be used efficiently and economically. Natural resources are utilized to provide or improve social welfare. In this study is water of Enim watershed used to irrigate rice fields.

Fig. 1. Location of Cahaya Alam Village (Sources: Geogle Earth)

III. Results and Discussion

Cahaya Alam village is located on Semende Darat Ulu district, Muara Enim regency, South Sumatera province, Indonesia. The village is located at an altitude of 800-1000 meters above sea level and coordinates 103.290^0 East Longitude and -4.17^0 South Latitude. The village is in the upstream of Enim watershed. The population of this village is 1,999 inhabitants in 2012, and the area of the village is 45 km^2.

Livelihoods of villagers of Cahaya Alam are farmer and planter in general. There are also workers as teachers, civil servants, health workers, merchants, and others. Cahaya Alam village has extensive irrigated rice fields about 407 ha of rice field areas. Irrigation in paddy fields aims to increase crop production and avoid crop failure due to lack of water. This is in accordance with the opinion ([6]-[8]). If production increases, the welfare of the community was achieved. It is also evident from the survey of research field that villages in the upstream of Enim watershed are still dawn, beautiful and natural. These villages are still not affected major industries. There is no industry that stands in the district of Semende Darat Ulu.

The areas of irrigated rice field in the village of Cahaya Alam produce 510 tons of dried paddy. Average of rice crop yield for rice field areas of 1.5 hectare produces 2.5 tons of rice or dry grain. The used seedlings for planting rice are the seedlings taken from previous year's rice harvest that are separated of best paddy. The rice field areas of 1.5 hectares needs 6 quintals of rice seedlings. Fertilizer is used for this rice crops is the type of SP36 fertilizer. The price of SP36 ranges from IDR 130,000 to IDR 145,000 per bag. A fertilizer bag is 50 kg in weight. Rice field area of 1.5 hectares requires fertilizer about 200-300 kg.

The results of calculation of the contribution of watershed water for irrigation of rice fields can be seen in Table 1.

Table 1.
The contribution of water from the Enim watershed for Rice Irrigation at Cahaya Alam Village

No	Remarks	The price of a unit	The total economic value
1	The selling price of rice	7,630,000,000	7,630,000,000
2	Total Production Cost of Rice	6,721,507,000	6,721,507,000
3	The direct costs of Rice Agriculture	6,056,620,000	
	a. seedling	976,800,000	
	b. Fertilizers & Drugs	349,070,000	
	c. Worker wage	305,250,000	
	d. Land lease	3,815,000,000	
	e. Agricultural equipment rental	610,500,000	
4	Business profits (15% of the cost of rice Agriculture)		908,493,000
5	Indirect costs (Value of Watershed)		664,887,000

Source: Result of calculating researcher (2016)

Based on Table 1 it can be seen that the result of the production of rice in the village of Cahaya Alam in 2014 is IDR 7,630,000,000. The total cost for rice production is IDR 6,721,507,000. The indirect cost is IDR 664,887,000. The amount of indirect costs is the value of water in the Enim watershed village of Cahaya Alam is used to irrigate the fields. It means that the value of the contribution of water or water services for the value of irrigated fields of Cahaya Alam village in 2014 is IDR 664,887,000 or 664 million rupiahs.

If seen for the two (2) years, namely 2014 and 2015, the production of rice produced in the village of Cahaya Alam is not too different and with the same assumptions for rice field areas of 1 ha yield about 1.5-2 tons of paddy and condition of irrigation water is assumed stable as in 2014 and rice production every year is not necessarily. it sometimes goes up or down production. The predictive value of the contribution of water for irrigation in 2030 is IDR 803,985,530 by assuming the same land areas and same production quantities as in 2014.

But, if the reduced water availability and rice production decreases (25-30)%, the economic value of water is reduced such as when the dry season is longer. Cahaya Alam village uses conventional irrigation system as shown in Figure 2, where the water of irrigation is from the watershed on upper village.

Figure 2. Conventional irrigation canal on upper Cahaya Alam village (Source: Researcher document, 2015)

The value of water for irrigation of rice fields not only increases rice production and increases people's income, but also provides indirect value of water. This indirect value is water contribution. This value is known in the economic environment with a value of watershed water. A value of watershed water in the Cahaya Alam village is IDR 664,887,000 per year from an area of 407 ha of rice fields irrigated.

If the irrigation system in the village can be upgraded from the conventional system becomes a technical irrigation system or other non-conventional irrigation systems, the production of rice can be improved in the villages upstream or located at an altitude of more than 1000 m above the sea surface. Irrigation is essential for this area as it can produce rice once a year. This is because the temperature of this area is low.

IV. CONCLUSION

Enim watershed management utilized for irrigation of paddy fields in the village of Cahaya Alam has given benefits. The benefits was obtained by the increase of rice production and people's incomes. The water value of Enim watershed was used to irrigate the fields has same meaning to water contribution value or the value of water services for irrigation of paddy fields in the village of Cahaya Alam is IDR 664,887,000 or 664 million in 2014. The irrigation system in Cahaya Alam village needs to be improved so that rice production also increase.

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