Economic Valuation of Mangrove Management in Kulon Progo Regency

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Abstract. Mangrove is a kind of plant with high ecological value. Mangroves are capable of retaining floods, preventing abrasion, and even serve as the largest carbon storage plants as compared to land forest plants. This study aimed to examine the economic and ecological values of mangroves. The research was conducted using a survey of basic data in the form of primary data obtained through field interviews with local people and stakeholders of mangrove forest management. The research data were analyzed descriptive-quantitatively and qualitatively to be visualized into tables, graphs, drawings, and maps. It was found that the economic value of mangrove forest in Jangkaran Village was IDR 1,773,561,240 82 percent of which was in the form of indirect use value. This suggests that mangrove forests have high intangible benefits (service and environmental values).

1. Introduction

Indonesia with its 95,181 km^2 coastline has mangrove forests of 3,489,140.68 hectares (2015), which is equivalent to 23 percent of the world's mangrove ecosystem (16,530,000 hectares). Of the total mangrove area in Indonesia, 1,671,140.75 hectares was in good condition while 1,817,999.93 hectares was in bad condition [1]. Mangrove forest in Kulon Progo Regency is one of the mangrove forests in Special Region of Yogyakarta (DIY) (one of them is in Baros Beach, Bantul Regency). The mangrove area in Kulon Progo Regency is 3.4 kilometers long.

Mangroves are intertidal plants which means that they grow on between land and sea area and are affected by tidal water. Mangrove forest has three functions: biological/ecological, physical, and economic/productive. Biologically/ecologically, mangrove forests serve as a spawning ground, nursery ground, and feeding ground for nearby organizations such as shrimps and crabs. The mangrove area with good condition in Indonesia contributes the US $ 1.5 billion from the fishery sector. Various studies show that mangroves are the largest carbon-zinc plants in comparison to forests in the mainland. This indicates that mangroves play a major role in warding off climate change. In the sustainable development goals (SDGs) environmental issues that specifically focus on climate change is the concern of all countries in the world. Indonesia with its existing mangrove forest areas can expectedly meet a quarter of the 26 percent emission reduction target by 2020 [2].

The physical potentials of mangrove forest are to maintain coastal stability, prevent sea erosion, serve as a trap of pollutants and waste, prevent salt intrusion into the land, and process organic waste [3]. Anatomical tissue of mangrove plants can absorb pollutants, for example, *Rhizophora mucronata* can absorb 300 ppm Mn, 20 ppm Zn, and 15 ppm Cu and on *Avicennia marina* there is an accumulation of 15 ppm Pb[3], 0.5 ppm Cd[3], 2.4 ppm Ni[3] [4]. In addition, physically, mangrove forest also serves as a breakwater which according to The Nature Conservancy (TNC)'s and Wetlands International's studies mangrove with a thickness of 100 meters landward can reduce the wave height of between 13 and 66 percent.

In addition to their ecological and physical functions, mangroves also has an economic function. The economic functions that have been developed in the mangrove reclamation business are derived from utilizing the seeds, leaves, and stems. In the mangrove ecosystem, other economies grow with the growth and development of animals such as fish, shrimp, and crabs all of which have economic value and will increase the income of people living around mangrove forest. Mangrove forest also has aesthetic value as a tourist destination. Many areas with mangrove forests have developed their mangrove forests as tourist destinations. This kind of nature tourism potential development leads to another multiplier effect in the form of a creative economy in the society. Based on the description of the ecological, physical, and economic benefits that can be obtained from mangrove plants, it was very for this present research to examine mangroves' benefits from the ecological side and the economic side.

2. Research Method

This present study was conducted using a quantitative research method. The determination of research location used a purposive method from which Pasir Kadilangu Sub-Village and Pasir Mendit Sub-Village in Jangkaran Village, Temon Subdistrict, Kulon Progo Regency which is located on Bogowonto River estuary were chosen as research locations (Figure 1). The primary data used in this study were obtained from interviews with community members who benefit from mangrove forests. Thirty respondents were selected using sampling quota.

The economic value of mangrove forests was calculated using the Total Economic Value (TEV) concept according to which TEV consists of *use value* and *non-use/intrinsic* value) [7, 8] Use value is divided into *direct use value*, *indirect use value,* and *option value*. Non-use value is in the form of *existence value*.

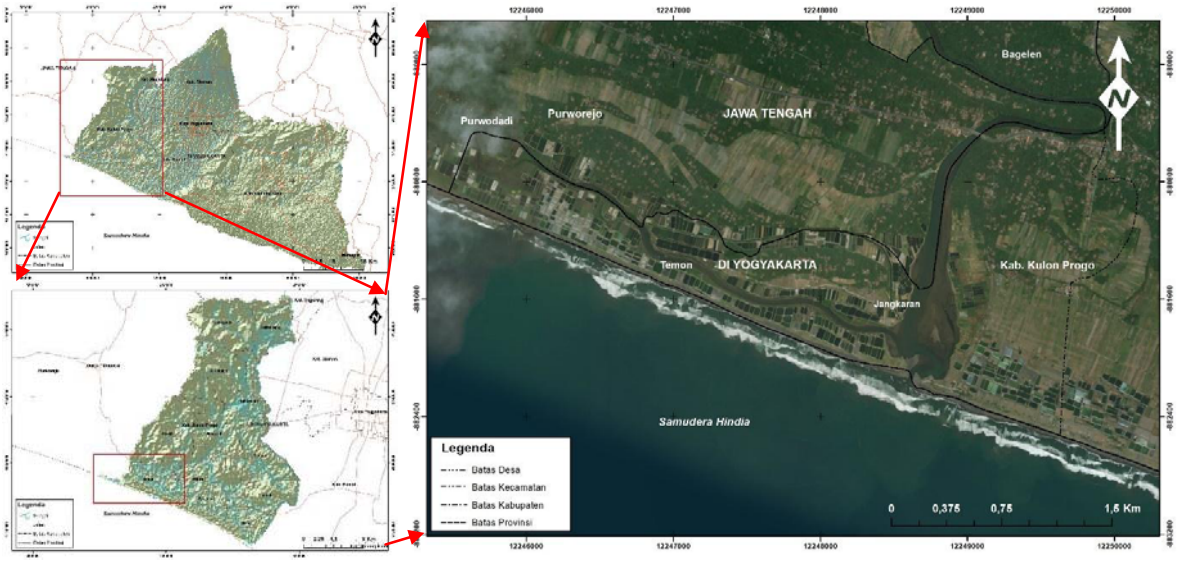

Figure 1. The Administrative Location Map of the Research Location

The total economic value of mangrove forest is formulated by the following equation:

$$TEV = DV + IV + OV + EV \quad (1)$$

Description:
TEV = *Total Economic Value*
DV = *Direct Use Value*
IV = *Indirect Use Value*
OV = *Option Value*
EV = *Existence Value*

Direct Use Value is the value which is directly generated from mangrove forests which in this present research included mangrove wood, fish, shrimp, and crabs. The direct use value of mangrove forest is calculated by the following equation:

$$DV = \sum_{i=1}^{4} DV_i \quad (2)$$

Description:
DV = *Direct use value*
DV 1 = Firewood's use value
DV 2 = Fish's use value
DV 3 = Shrimp's use value
DV 4 = Crabs' use value

Indirect use value is the value of mangrove that indirectly benefited the community. The indirect value of mangrove forests includes their functions as a feeding ground for marine biota and as breakwaters. The indirect use of mangrove forests was calculated by the following equation:

$$IV = \sum_{i=1}^{2} DV_i \quad (3)$$

Description:
IV = *Indirect use value*
IV 1 = Provider of natural feeding for the biota living in mangrove forest ecosystems.
IV 2 = *breakwater*

The method used in the *option value* equation is the benefits transfer method by transferring the benefit estimate from another place to obtain a rough estimate of the ecological benefit. This equation can be approximated by the value of biodiversity in the mangrove ecosystem [9]. The equation used to calculate the option value was:

$$OV = US\$\ 15\ per\ ha\ x\ luas\ hutan\ mangrove \quad (4)$$

The existence value of mangrove was calculated using the *willingness to pay* technique by the following equation:

$$EV = \sum_{i=1}^{30} (Mei)/n \quad (5)$$

Description:

Mei = The existence value obtained from respondent number 1 to n
n = Number of respondent

3. Results and Discussion

3.1. Characteristics of Respondents

The respondent characteristics based on their socio-demographic condition are shown in Table 1. The results of data processing showed that the majority of heads of household around Jangkaran Village's mangrove area are male (96.67 percent). This does not mean that that the population of males in Jangkaran Village is greater than that of females, however. The males, in particular, those who serve as the head of the family, are more regarded as the ultimate decision-makers and some of them work in the mangrove area as a side job.

Table 1. Respondents' socio-demographic characteristics

Variables	Number	Percentage (%)	Mean
Gender			Men
• Men	29	96.67	
• Women	1	3.33	
Age			49
• 30 – 34	2	6.67	
• 35 – 39	2	6.67	
• 40 – 44	6	20.00	
• 45 – 49	5	16.67	
• 50 – 54	2	6.67	
• 55 – 59	6	20.00	
• 60 – 64	5	16.67	
• 65 – 69	2	6.67	
Level of Education			Elementary
• Did not complete elementary school	1	3.33	
• Elementary school	9	30.00	
• Junior high school	8	26.67	
• Senior high school	8	26.67	
• College	4	13.33	
Occupations			Fishery
• Fishery	15	50.00	
• Agriculture	4	13.33	
• Private employee	1	3.33	
• Civil Servant/Police/Armed Forces/Retiree	4	13.33	
• Services/Entrepreneur	6	20.00	
Income			1,500,000
• 1,000,000 – 1,900,000	22	73.33	
• 2,000,000 – 2,900,000	5	16.67	
• 3,000,000 – 3,900,000	2	6.67	
• < 4,000,000	1	3.33	

Source: Primary data processing, 2018

The results of data processing showed that the age of people who work in mangrove forest vary, ranging from 32 to 68 years, while the average is within the productive age category (49 years). The data also show that most people have completed primary education as indicated by the proportions of those who completed elementary school (30 percent) or higher (66.67 percent). Only 3.33% did not finish primary education.

Figure 2. Shrimp farm in the village Jangkaran

The results also showed that most people work in the fishery sector (50 percent), i.e. coastal fish farming because their village is geographically located on a coastal area which is suitable for shrimp/fish farming. The results of data processing also showed that most people in this village have an income of more than IDR 1,000,000 with an average of IDR 1,500,000. The average income of the community around Jangkaran Village's mangrove forest is a bit higher than the 2018 regional minimum wage of Kulon Progo Regency, which is IDR 1,493,250.

3.2 The Economic Value of Mangroves in Jangkaran Village

Mangroves are plants growing along the coast or river estuaries that are still affected by tidal sea water. Mangroves in Jangkaran Village grow in Bogowonto River Estuary. Based on the results of interviews with local people in the study sites, there are various types of mangroves, including *Avicennia alba, Avicennia marina, Bruguiera sp, Rhizophora mucronata, Rhizophora sp,* and *Sonneratia alba*. Conservation of mangrove is needed to prevent damage to various types of mangroves. Among efforts to do this is by conducting economic valuation studies on mangrove ecosystems.

Figure 3. Avicennia (Left) and Rhizophora sp (Right)

The results of this present study showed that direct utilization of mangrove forest in Jangkaran Village includes the use of shrimp, crab, fish, and wood, and ecotourism. As for the indirect utilization is in the form of ecological services of mangrove forest enjoyed by the community, i.e. a a source of feeding for marine biotas like crab, fish, and shrimp and as seawater intrusion barrier. Another potential opportunity that may generate additional income for the community is the use of *Nipah*

(*Nypa fructicans*) leaves. People in Jangkaran Village have already used *Nipah* leaves as the basic material of roof (*woka*) of various facilities in tourist places such as stalls, gazebos, musholas and so on. However, woka is not yet traded because the number of *Nipah* plants available in the research location is relatively small. Still another potential ecological service of mangroves is to prevent water pollution by neutralizing substances or waste. The mangrove forest in Jangkaran village is used by the community either directly or indirectly. Based on interviews with respondents, the identified values of mangrove forest utilization are as follows.

3.2.1 Direct Use Value

The direct use value of mangrove forest is the benefit directly taken from natural resources [10]. Based on the results of this present study, the direct use value of mangrove forest for the surrounding community includes the utilization of crabs, fish, shrimp, and timber, and ecotourism as presented in **Table 2**.

Table 2 The Direct Use of Jangkaran Village's Mangrove Forest

No.	Type of Direct Use Value	IDR per annum	%
1.	Crabs	40,182,000	12.65
2.	Fish	13,430,000	4.23
3.	Shrimp	58,920,000	18.55
4.	Wood	4,753,000	1.49
5.	Ecotourism	200,400,000	63.08
	Jumlah	317,685,000	100

Source: Primary data processing, 2018

Figure 4 Crabs in Mangrove Area

The value of crab fishing is IDR 40,182,000 per year. This value is obtained from the total crab catch of 1,086 kg per year multiplied by the selling price of IDR 37,000 per kg. Another catch is fish, i.e. IDR 13,430,000 per year. This value is obtained from the total fish catch of 1,343 kg per year multiplied by the selling price of IDR 10,000 per kg. Still, another catch is shrimp, i.e. IDR 58,920,000 per year. This value is obtained from the shrimp catch of 982 kg per year multiplied by the selling price of IDR 60.000, - per kg.

The direct use value of firewood taken by the community is derived from the branches they get around the mangrove forest. People can get around 679 bundles of firewood per year. The market price of firewood at the study location is Rp 7,000 per bundle. So the total direct use value of firewood for a year is IDR 4,753,000.

Figure 5. A Sample Ticket of Jangkaran Village's Mangrove Ecotourism Object

The direct use value of mangrove forest as ecotourism object is estimated based on visitor charge multiplied by the average number of visiting tourists per year. The annual direct use value derived from mangrove is IDR Rp 200,400,000. The retribution of mangrove tourism entrance for Jangkaran Village is set in the Jangkaran Village Regulation Jangkaran No. 07 the Year 2017, i.e. IDR 5,000/visitor. This village regulation regulates the distribution of mangrove ecotourism income because the location of the mangrove forest in the bordering area of Kulon Progo Regency (DIY) and Purworejo Regency (Central Java) may lead to social conflicts and conflicts of interest. It is mentioned in this village regulation that 20 percent of revenues received through retribution will become the incomes for local governments of Kulon Progo Regency and Purworejo Regency, while the remaining 80 percent will be returned to the ecotourism manager for maintenance cost, operational cost, and so forth.

Thus, the total direct use value of mangrove forest in Jangkaran Village is IDR 317,685,000 per year. It can be seen from Table 2 that the direct use value of ecotourism from a mangrove forest in Jangkaran Village is the biggest, which is 63.08 percent, compared to that of crab, fish, shrimp, and wood. The above description suggests that mangrove forest is very rich in natural resources that are useful and can be utilized to increase people's income.

3.2.2 Indirect Use Value

Indirect use value is a value which benefit is not directly felt nature, [10]. Based on the result of this present study, the indirect use value of Jangkaran Village's mangrove forest shown in **Table 3** below.

Table 3. The Indirect Use Value of Jangkaran Village's Mangrove Forest

No	Type of Indirect Use Value	IDR per annum	%
1.	Penyedia pakan alami biota laut	746,060,000	51.30
2.	Peredam gelombang	708,225,834	48.70
	Jumlah	1,454,285,834	100

Sumber: Pengolahan data primer, 2018

The indirect use value of mangrove forests as a natural food provider for marine biota is estimated by a calculation which was based on fish feed price prevailing in the study sites. This present study found that the amount of feed needed in the pond with the size of 1000 m^2 is 4 kilograms per day with the price of feed of IDR 14,000 per kilogram. Based on these, the indirect use value of mangrove forests as a natural feed provider for marine biota is IDR 746,060,000 per year.

The indirect use value of mangrove forest as wave absorber is estimated by the replacement cost of resources which included all costs incurred for the construction of coastal embankments. It was assumed that the cost of making a coastal embankment of 1,000 meters long with durability of approximately 50 years is IDR 10,415,085,800. This value is divided by 50 to get an annual value. Thus, the indirect use of mangrove forest as wave absorber is IDR 708,225,834 per year.

3.2.3 Option Value

Option value is the potential value that can be utilized in the future [10]. The option value of Jangkaran Village's mangrove forest was estimated by a *benefit transfer* method, i.e. ie by assessing the benefit estimate from another place (where resources are available) then the benefit is transferred to obtain a rough estimates of the environmental benefits. In this present study, the option value of Jangkaran Village's mangrove forest was estimated using biodiversity value in the mangrove area. According to Ruiteenbeek [9], the biodiversity value of mangrove forest in Indonesia is the US $ 15 per hectare per year. The option value was obtained from the multiplication of biodiversity value with a mangrove forest area of 3.65 Ha. Based on Bank Indonesia's exchange rate (2018) according to which 1 US $ is valued at IDR 14,254, the resulting option value was IDR 780,406 per year.

3.2.4 Existence Value

Existence value is the value of an individual's concern for the existence of a natural resource [10]. The existence value of Jangkaran Village's mangrove forest was obtained from the respondents' willingness to pay for the existence of mangrove forest in their area. Based on interview results, it was found that 83,3 percent of respondents are willing to put aside some of their income for mangrove forest conservation program, while 16.67 percent are not willing. People who are not willing to pay for the existence of this mangrove forest could be considered as free riders in that they enjoy and use the resources (mangroves) but are not willing to make sacrifices. These free riders said that they are not willing to pay for the existence of mangrove forest because the mangrove forest management costs should have been covered by the retribution paid by the visiting tourists so that people no longer need to pay for that. The results of data processing showed that 16.67 percent of people are willing to pay IDR 20,000 and 13.33 percent are willing to pay IDR 10,000. These people are willing to pay because their knowledge of the importance of mangrove forests is quite high. The existence value of mangrove forest is Rp 8,100,000 per year as presented in **Table 4**.

Table 4. The Existence Value of Jangkaran Village's Mangrove Forest

WTPi (IDR per year)	Respondent	WTP (IDR per year)	%
0	5	0	16.67
5,000	1	5,000	3.33
10,000	4	40,000	13.33
15,000	1	15,000	3.33
20,000	5	100,000	16.67
25,000	2	50,000	6.67
30,000	2	60,000	6.67
35,000	2	70,000	6.67
40,000	2	80,000	6.67
45,000	2	90,000	6.67
50,000	2	100,000	6.67
100,000	2	200,000	6.67
Total	30	810,000	100
Rwp		32,400	
%r		0.83	
Respondent		25	
Twp = Rwp x Responden		8,100,000	
Tnp = %r x Twp		720,900	
Ts = Twp - Tnp		89,100	

Source: Primary data processing, 2018

The calculation results showed that there is a consumer surplus from people's willingness to pay for the existence of mangrove forest amounting to IDR 89.100 per year

3.2.5 The Total Economic Value or Jangkaran Village's Mangrove Forest

Total economic value includes the values contained in the natural resources. It is the sum of direct use value, indirect use value, option value, and existence value. Based on the TEV formula, the total economic value of mangrove forest of Jangkaran Village, Temon District, Kulon Progo Regency is IDR 1,780,851,240 as presented in **Table 5** below:

Table 5. Total Economic Value of Mangrove Forest

No	Types of value	IDR per annum	%
1.	Direct use value	317,685,000	17.84
2.	Indirect use value	1,454,285,834	81.66
3.	Option value	780,406	0.04
4.	Existence value	8,100,000	0.45
	Total	1,780,851,240	100

Source: Primary data processing, 2018

The economic value of Rp 1,780,851,240 of Jangkaran Village's mangrove forest 82 percent of which is in the form of indirect use value indicates that mangrove forest in this particular area has important benefits and serves as a source of economic and ecological resources for the life of the surrounding communities. The amount of the indirect use value of mangrove forest also shows that mangrove forest has the high intangible benefit (service and ecological values) and the estimation of its economic value in rupiah would enable the society to know the ecological value of mangrove forest.

3.3Factors that Affect People's Willingness To Be Involved in the Mangrove Forest Management
Factors that affect people's willingness to be involved in the mangrove forest management were identified through a multiple regression analysis.

Table 6. Regression Analysis Results

Variables	Sig	Description
Age	0,091	The influence is not significant
Level of education	0,395	The influence is not significant
Income	**0,004**	**The influence is significant**

Source: Primary data processing, 2018

Table 6 shows that of the 3 variables tested, only one has a significant effect on the willingness to manage mangrove forest, i.e. the variable of income. Income affects the willingness of managing mangroves because with high-income people will have more funds to spend on other costs, in this case, the cost for managing mangrove forest.

4. Conclusions

The results showed that the total economic value of Jangkaran Village's mangrove village is IDR 1,780,851,240 which includes direct use value of IDR 317,685,000 (17.84 percent), indirect use value of IDR 1,454,258,834 (81.66 percent), and choice value of IDR 780,406 (0.04) percent and existence value of IDR 8,100,000 (0.45 percent). This indicates that the indirect use value (81.66%) has the greatest contribution. It shows that mangrove forest has the high intangible benefit (service and ecological values) so that it needs a community awareness in managing the mangrove forest. The analysis shows that only 83.33 percent of the respondents are willing to manage the mangrove forest. Community willingness is influenced by income factor (significance coefficient = 0.004).

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