THE USE AND ECONOMIC VALUATION OF MANGROVE RESOURCE IN TONGKE-TONGKE MANGROVE AREA, SINJAI DISTRICT, SOUTH SULAWESI PROVINCE, INDONESIA

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ABSTRACT

The research was The aim of the research was to carry out to the economic valuation and the use of mangrove resource Tongke-Tongke at the mangrove area Sinjai District, South Sulawesi, Indonesia. Survey research approach was used in this research and data were analyzed descriptively and quantitatively. The result showed that mangroves were utilized to capture fisheries and wood sources utilization. The economic value of mangrove was $USD 4,330.95 /ha/year. Capture fisheries are the largest contribution, up to 94,47 percent, while mangrove wood utilization 5,53 percent to be a most important income source for society in coast who live in the vicinity. Therefore, coastal management policy was required to be developed by considering the impact on the socioeconomics of mangrove utilization on the community at area coast, especially related to coastal utilization area change.

Keywords: valuation, socio-economics, mangrove, Tongke-Tongke, Sinjai

BACKGROUND

Mangrove resource has been long used by the community around the coast for many necessities. These include cloth, food, and shelter. Various usages are considered(Orchard, Stringer, & Quinn, 2016; Zulkarnaini & Mariana, 2016). The activity is not limited to the hunting or capturing, but also includes others which are suitable for mangrove areas such as embankment for milkfish or shrimp(Van et al., 2015). Using the mangrove resource will give great benefit to the community (Mohammad Abdullah, Stacey, Garnett, & Myers, 2016), defines the benefit as the effort to quantify the natural resource into the monetary value, regardless of its market or non-market values (de Rezende, Kahn, Passareli, & Vásquez, 2015). Direct benefit value is one reflecting the benefit obtained by the community directly from the existence of mangrove (Mukherjee et al., 2014; Everard, Jha, & Russell, 2014). The objective of the research is to understand the use of mangrove resource at the coast area of Mangrove Area Tongke-Tongke, Sinjai Regency, South Sulawesi Province and to calculate the benefit value directly perceived by the community. This research is important to fill in the information gap in the formulation of the mangrove resource management plan at the area of Mangrove Area Tongke-Tongke. In addition to government, information obtained by the research will be a source of information the immediate business to develop the mangrove area(Richards & Friess, 2016;.Ismi, 2014)

METHODS

Location And Timing Of Research

The research was conducted at Tongke-Tongke village and Panaikang villages which are located at the coastal area of East Sinjai sub-district, South Sulawesi, Indonesia. Research location is determined by considering the rather good condition of mangrove with the great usage by the community for various needs. The location remains at an ordinate point from 120°18'14.43" to 120°26'30.95" of East Longitude and from 5° 7'1.74" to 5°27'22.96" of South Latitude (Figure 1).

Data Collection

Two types of data were involved, primary data and secondary data. Primary data are collected from observation and interview with the community using mangrove resource(Stone, Bhat, Bhatta, & Mathews, 2008;Vo, Kuenzer, Vo, Moder, & Oppelt, 2012; Salem & Mercer, 2012).

The interview is closed using questionnaire adjusted to the objective of the research (Micheletti, Jost, & Berger, 2016). The community of respondent is those with the use of fishery and wood resources (Zulkarnaini & Mariana, 2016).The use of fishery resource is limited to the activity of

capturing fish, shrimp, mollusks, and crab around the mangrove area (Wahyuni et al, 2014; Hariey, 2009; Suharti, Darusman, Nugroho, & Sundawati, 2016). The use of the wood resource is using mangrove as the firewood or processing it into the capturing aids and for the material of boats(Indrayanti, Fahrudin, & Setiobudiandi, 2015; Walters, 2005). Secondary data are gained from the review of the previous result of study and from the statistic data of fishery either at district and sub-district. Data sources include Bappeda of Sinjai district, Statistic Office, The Official of Fishery and Marine of Sinjai District, and the related agencies in the East Sinjai Sub-districts. The observation is assisted by satellite image to estimate the mangrove width at Sinjai area(Rhyma, Norizah, Ismail, & Shamsudin, 2016; Abdul Aziz, Phinn, Dargusch, Omar, & Arjasakusuma, 2015).

Data analysis

Data are analysis descriptively and quantitatively. Descriptive analysis of data is used to explain the activity of the community in using mangrove resource (Yusof, Mustapha, Mohamad, & Bunian, 2012; Samodelov & Zurbriggen, 2017). Quantitative data analysis is used to quantify the use of mangrove resource as directly perceived by the community (Badola, Barthwal, & Hussain, 2012; Beitl, 2012; Feka, 2015). The direct benefit of mangrove resource by the community is described by Kuenzer & Tuan, (2013), as involving the firewood (wood, charcoal), building material (block, board), textile material, food, and drug(Nagelkerken et al., 2008). Direct benefit value is estimated by quantifying the direct extraction rate from natural resource and the value related to the market price (Richards & Friess, 2016) asserts that the commonly used market price is the local market price with the following formula:

The Use Rate of Mangrove Resource =

$$\sum(T_i \times H_i) - B_i$$

Description:

H_i = Resource price ($USD/ton)
T_i = Number of resource utilization (ton/tahun)
B_i = Operational cost of resource utilization ($USD/year)

Productivity approach is used to measure the resource benefit value either in form of goods or service during a certain time period(Komiyama, Ong, & Poungparn, 2008). A more specific approach is residual rent. Indeed, residual rent is looking at the contribution of the natural system or income factor to the total economic rate(Hussain & Badola, 2010). The mathematic formula for residual rent is written as follows(Sabah Forestry Department, 2014):

PV Residual Rent Model:

$$(\sum_{t=0}^{T}(Bt-Ct)/((1+r)t))/L$$

Description:

B = Benefit production
Ct = Costproduction
T = Total cost projection r = Level of discount rate
L = Resource area

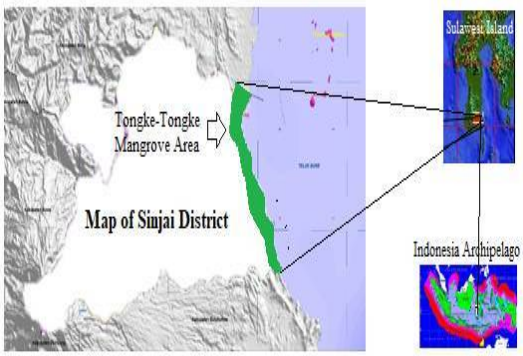

Figure 1.Map of the Tongke-Tongke mangrove area, in the coastal district of East SinjaiSinjai District, South Sulawesi Province

RESULT AND DISCUSSION

The general condition of Mangrove Area Tongke-Tongke

Along the coast of East, Sinjai sub-district is a place with the greater width of the mangrove area with various thicknesses. Mangrove grows thicker in the river downstream and should give greater benefit to the community. In the settlement area, mangrove thickness is less. Most coastal areas have been converted into the ponds, settlement, harbor, and others. The coastline ofSouth SinjaiSubdistrict reaches 10 km with a total area estimated at 173.5 ha, in two villages namely Tongke-Tongke and Panaikang villages. The coastline of the survey location is varied between 7,823 m and 2,171 m with the longest beach in the Tongke-Tongke Village. Mangrove thickness is also varied from 197. to 92 m. Village with greatest mangrove thickness is Tongke-Tongke Village. The estimation of mangrove width in the survey location is 75 ha. Village with greatest mangrove width is Tongke-Tongke village with 173.5 ha in Table 1.

Table 1 Coast line length, thickness and estimation of mangrove area at research location

No.	Village	Coast line length (m)	Thickness (Meter)	Location Estimation of mangrove area (m^2)	Percentace (%)
1	Tongke-Tongke	7,823.00	197.00	1,541,131.00	88.53
2	Panaikang	2,171.00	92.00	199,732.00	11.47
	Total/Average	9,994.00	Average = 144.50	1,740,863.00	100.00

Table 2. Fish catch value at mangrove waters area

No.	Village	Catch revenue (ton/year)	Price rates catch revenue($USD/kg)	Total operational cost ($USD)	Benefit fish catch value ($USD)
1	Tongke-Tongke	401,500.00	1.48	202,777.78	392,037.04
2	Panaikang	52.019	1.48	26,272.00	24,521.17
	Total			229,049.78	416,558.21

$USD 1 = Rp.13.500,00

Table 3. Shrimp catch value at mangrove waters area

No	Vill.age	dry season		rainy season		Benefit value of shrimp catching ($USD/year)
		Catch revenue (ton)	Price rates ($USD/kg)	Catch revenue (ton)	Price rates ($USD/kg)	
1	Tongke-Tongke	79,674.16	4.81	159,348.32	4.81	1,149,698.13
2	Panaikang	10,326.00	4.81	20,652.00	4.81	149,004.18
	Total					1,298,702.31

$USD 1 = Rp.13500,00

Table 4. Crab catch value at mangrove area

No	Village	Catch revenue (kg)	Price rates of catch revenue ($USD/kg)	Benefit value of crab catch ($USD/ton)
1	Tongke-Tongke	106,572.15	2.59	276,298.17
2	Panaikang	13,811.85	2.59	35,808.50
	Total	120,384.00		312,106.67

$USD 1 = Rp.13500,00

Table 5. Shell catch value at mangrove area

No	Village	Catch revenue (ton)	Price rates of catch revenue ($USD/kg)	Benefit value of crab catch ($USD/ton)
1	Tongke-Tongke	509,914.60	0.74	377,336.80
2	Panaikang	66,085.40	0.74	48,903.20
	Total	576,000.00		426,240.00

$USD 1 = Rp.13500,00

The use of the captured fishery resource

Fishery resource is affected by the existence of mangrove with some functions such as food supplier, enlargement site and spawning site. Therefore, mangrove condition indicates the fertility of waters for fishery resource (Bengen, 2001; Primavera JH. 1992;Robertson AI, Phillips MJ 1995; Primavera JH 1996). Fish capturing activity at Sinjai coast is using various capturing tools.The community often captures the fish with hooked-rod, net, and scoop. The average captured fish is 11 kg with an average price of $USD. 1.48 per kilogram. In the fish capture activity, operational cost expended is $USD.5.56 per trip. This cost is incurred for fuel and for ransom for two persons. In addition to sailing cost, there are also costs for machine repairing and capturing tools, with an average of $USD.33.33 per month in Table 2. Shrimp capturing season in the coastal waters is apparent during the rainy season, usually between October and April. The outcome of the captured shrimp is significantly increased during the rainy season. The capture average is 2,5 kg/day in dry season compared to 5 kg/day in therainy season. Shrimp price seems fluctuated with the quantity of the captured. In dry season when the shrimp supply is limited, the prawn price may reach $USD.5.93/kg while the white shrimp can cost for $USD.3.37/kg. During the rainy season, shrimp price reduces, from $USD.4.44 to $USD.3.70/kg for prawn, and from $USD.1.48 to $USD.1.11/kg for white shrimp. The production rate of the captured shrimp is shown in Table 3.

Crab is a commodity of mangrove resource with high economic value. The price per kilogram at fisher level is $USD.2.22. The capturing of crab is using a trap. The capture timing is usually afternoon. The crab type for capture is mostly mangrove crab (Scylla spp.) because it settles within mangrove mud. The average capture of fisher per day is only 2.5 kg. The lower capture rate seems evident because of the absence of a good marketing channel. It is less surprising that the crab is only for daily consumption. For the coast community, crab capture only represents a side job and is never becoming a main priority. Crab is captured daily by 15 persons from each village in Table 3.

Crab is a commodity of mangrove resource with high economic value. The price per kilogram at fisher level is $USD.3.59/kg. The capturing of crab is using a trap. The capture timing is usually afternoon. The crab type for capture is mostly mangrove crab (Scylla spp.) because it settles within mangrove

mud. The average capture of fisher per day is only 4.18 kg. The lower capture rate seems evident because of the absence of a good marketing channel. It is less surprising that the crab is only for daily consumption. For the coast community, crab capture only represents a side job and is never becoming a main priority. Crab is captured daily by 20 persons from each village in Table 4.

The muddy soil of mangrove is a very suitable place of life for any kinds of Mollusca(Gomes, Abrunhosa, Jesus, Simith, & Asp, 2013). The mostly found Mollusca type is Anadara spp. Mollusca is captured around the dark(Joshi & Ghose, 2014). The capture rate is affected by the ebb, especially the maximum ebb which is occurred at the beginning of the month and during a full moon. A result of Mollusca capture may attain 20 kg on average. It is only 25 percent of the capture to be sold, while the remaining is for consumption. The sale price of mollusk is $USD .0.74 per kg in Table 5. Mollusca capture is mostly carried out by the household mothers assisted by children, with a total of 40 persons per village on average

The use of the wood resource

The big mangrove tree is useful for the raw material of fishing boat and for construction material. The small mangrove tree has the slim stem, like Ceriops, and thus, it is useful to be used as the supporting pole for trap arm and main pouch installed along the coast. Dried mangrove woods may be used as firewood for daily cooking. When the use of mangrove wood is prohibited except for the dry and fallen wood, mangrove is not considered anymore for the material of construction and fisher boat. If such usages are allowed to continue, the standing rate of mangrove trees will decrease. In long term, it can suppress the existence of mangrove resource. The community inhabited in the coast is still using wood as the fuel for daily cooking. Every head of household takes in average 2 bundles of dry wood for the domestic needs in 2 or 3 days. A bundle consists of 15 stems with an average diameter of 5 cm, length of 100 cm, and price of $USD.0.37 in Table 6.

The benefit value of mangrove resources

The greatest benefit value of mangrove resource is obtained from the usage of the captured fishery resource, which is counted to $USD.1,154,904.88 (27.76 %). The shrimp gives a great contribution by $USD.1,298,702.31 (31.22 %) of resource usage total. According to (Andi Gusti, 2012), mangrove waters may always be vicious

and may protect the juvenile of shrimp from the predator. Therefore, the mangrove ecosystem is an ideal natural environment for shrimp growth. It means that mangrove at East Sinjai Coast is relatively good, mainly in the mangrove area at research location. This condition is supported by the activity of planting new mangrove tree by the community, government, and Non-Government Organization.

The use of the wood resource for firewood does not show too great value, as shown for $USD.1,706,666.67 (41.02%) in Table 7. The prohibition of free logging against mangrove wood and the increased awareness ofthe community to conserve the mangrove trees will keep the usage rate greatly reduced. In the future, the use of mangrove wood needs further limitation, such as only for firewood. Such type of usage is expected to preserve the mangrove existence (Table 7). Based on the calculation of the benefit and cost, with an assumed discount factor of 11% for 10 years period, it is predicted that the use of mangrove resource at East Sinjai Coast will have the net benefit of $USD. 23,978.52/ha.

(Vaslet, Phillips, France, Feller, & Baldwin, 2012). The great usage rate of mangrove resource by community produces an understanding that the community of East SinjaiCoasthas a relatively greater dependence on mangrove resource. Therefore, the formula of coastal management and development at East Sinjai Coast must consider direct economic impact perceived by the community. Every change as the consequence of the policy at coastal area will influence the welfare rate of community.

The usage rate of the captured fish resource is $USD. 6,656.51/ha in Table 8. Such a condition may be achieved by assuming the absence of change on any usage rate during the predetermined period

Table 6. Benefit value of firewood

No	Village	Number of householder	Average utilization of firewood (Bunch/year/KK)	Price of firewood per bunch	Benefit value of firewood ($USD/year)
1	Tongke-Tongke	4,079,316.78	50,991.46	0.37	1,510,858.07
2	Panaikang	528,683.22	6,608.54	0.37	195,808.60
	Total	4,608,000.00			1,706,666.67

$USD 1 = Rp.13500,00

Table 7. Recapitulation of direct benefit value of mangrove resource in East Sinjai

No	Kind of utilization	Utilization value ($USD/year)		**Total ($USD/year)**
		Tongke-Tongke	Panaikang	
1	Capture			
	- Shrimp	1,149,698.13	149,004.18	1,298,702.31
	- Fish	392,037.04	24,521.17	416,558.21
	- Crab	276,298.17	276,298.17	552,596.34
2	- Shells	377,336.80	48,903.20	426,240.00
	Wood			
	- Utilization Firewood	1,510,858.07	195,808.60	1,706,666.67
Total				4,400,763.53

$USD 1 = Rp.13500,00

Table 8 Net benefit value of mangrove resources in East Sinjai coast

No	Net benefit value of resources	Value ($USD/ha/year)
1	Capture	
	- Shrimp	7,485.32
	- Fish	2,400.91
	- Crab	3,184.99
2	- Shell	2,456.71
	Wood	
	- Utilization Firewood	9,836.70
Total		25,364.63

$USD 1 = Rp.13500,00

Conclusion

The usage types of mangrove resource at East Sinjai Coast involve the use of fishery and wood resources. The value total of mangrove resource at East Sinjai Coast is $USD.4,400,763.53 with net benefit of $USD. 25,364.63/ha/year. The greatest usage rate of mangrove resource is the captured fishery resource which is 97.8% of the total value of mangrove usage rate. The usage of wood resource for firewood does not show a great rate, which is only 1.88%. However, if the user is allowed for a longer period, it can suppress the existence of mangrove resource.

Suggestion

For further research, the simulation of coastal management may give an estimation of optimum benefit based on

the existing economic potential of mangrove resource. A more advanced research will be important to see the possibility of social impact from the usage and its solution against this issue, and also to look at the change as the consequence of policymaking. Therefore, a policy may run well and be accepted by the community.

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Conflict of interest

None.

Ethical standards

This research project was approved by the Chairperson of the Institute for Research, Development and Community Service at the Bosowa University (File number 05/LP3M/ Unibos/I/ 2018) and conforms to the protocols therein.

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