The economic value of the resource utilization of wetlands: comparative study of beje fisheries in North Hulu Sungai Regency South Kalimantan, Indonesia

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The economic value of the resource utilization of wetlands: comparative study of *beje* fisheries in North Hulu Sungai Regency South Kalimantan, Indonesia

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Abstract. *Beje* fishery in wetlands is generally managed by fishermen only on the basis of their own capital and experience, so that land is cleared as far as possible without considering the financial feasibility aspects of the business and the conservation of wetlands. The aims of the study were to determine the volume and value of production, and the feasibility of *beje* fishery business based on the number of management units. The location of the study was determined purposively, namely Papuyu River Village, North Hulu Sungai Regency of South Kalimantan, and samples were taken by census of 20 fisherman *beje* households. The samples are grouped into 3 groups based on the number of managed *beje* units are small groups (1 - 5 units); middle group (6 - 10 units); and large groups (more than 10 units). Primary data were analyzed using descriptive analysis and business feasibility analysis through investment criteria approach. The results showed that the highest total *beje* production volume per unit is categorized as the moderate level with production reaching 100.91 kg year^{-1} with the highest production value per unit was approximately Rp 1,244,090 year^{-1}.The middle management group has better land use, capital and operational efficiency than small and large groups.

Key Words: inland fisheries, wetlands, conservation, feasibility studies, management

Introduction. Wetlands cover nearly 6% of the earth's surface, including swamp, fen, peat land or peat lands, either natural or artificial, permanent or transient, in the form of static or flowing freshwater, brackish or saline, including the area of sea water with receding depth not exceeding six meters (Stuip, et al, 2002). Wetland systems have benefited directly, or indirectly, to the world's population. A single wetland system may provide multiple types of ecosystem services depending on wetland conditions of type, location, condition, utilization, etc. (Whiteoak and Binney, 2012). Wetlands play an important role in slowing down and storing flood waters (Leschine et al., 1997), controlling pollution, contributing to local and national economies by producing resources and providing recreation (EPA, 2006; Früh, et al., 2013; Das, et al., 2015).

Fisheries and aquaculture in the mainland has contributed more than 40% of the world production of finned fish were reported from at least 0.01% of the total volume of water on earth. This fishery provides food for billions and livelihoods for millions of the world's population (Lynch, et al., 2016). Traditional fishing is an important livelihood for most households (especially the poor) in wetland areas, both as a source of household protein as well as investment resources, business and cash income (Kasthala, et al., 2008). Similarly aquaculture in wetlands is able to provide fish production (nutrient supply) and high economic benefits for farmers (Chandra et al. 2010; Olaoye, et al. 2014).

However, state development and development activities threaten the inland fisheries, the government does not make it a priority and one that produces, inland fisheries is considered low and exploited on a large scale (Cooke, et al. 2016). Competition of wetland use in various interests has the potential to threaten the availability of land and fishery resources in it. The Ramsar data show that in 1994 about 84% of registered wetlands have been or are threatened by ecological changes, such as drainage for agriculture, settlement and regional development, pollution and hunting (Stuip, et al, 2002).

One of the many traditional fisheries systems developed in several areas of Indonesia's wetlands (such as Sumatra and Kalimantan) is *beje*. *Beje* fishery has been developed by the people of South Kalimantan from generation to generation, especially in the freshwater swamp area of North Hulu Sungai Regency. *Beje* is a pond in a deliberately created swampland and serves as a natural fish trap when migrating fish seek protection when the water depth is in critical condition, it can also be used as a place to nourish and raise fish in the dry season (Najiyati, et al., 2005; Bijaksana, 2006; Herliwati and Rahman, 2011; Sumantriyadi, 2014). After the beje pond is prepared, then the fish entering the *beje* are allowed to grow naturally without any treatment. At the peak of the dry season the plains around beje dry, water and fish in beje isolated and trapped, then the fish can be harvested (Rupawan, 2004). Types of fish that are harvested are generally black fish groups that have habitat in the swamp marsh, such as common snakehead (*Channa striata*), giant snakehead (*C.micropeltis*), climbing perch (*Anabas testudineus*), snakeskin gourami (*Trichogaster pectoralis*), three spot gourami (*T. trichopterus*) and other swamp fish (Burnawi, 2009), and these fish belong to important economically valuable fish (Sofia, 2017). Some fish species with very high demand, and the specific fish produced only from local wetlands will lead to very high prices in the market, thus providing a significant effect on fisherman's income (Deka, et al., 2001). This indicates that *beje* has the potential to be further developed, where changes in natural ecosystems are relatively small, even able to maintain local fish species, and support food security and income sources for local communities.

However, the number of units and the size of *beje* managed by local fishermen is based solely on their own capital and experience, so that many wetlands are opened as widely as possible without considering financial feasibility aspects. While Barbier, et al, (1997) states that for the purpose of wetland conservation, policy is required that does not neglect the loss or degradation of further wetlands through sustainable use and research to measure the value of wetlands. Hence, the objective of the present study was to determine the volume and value of production, as well as the feasibility of *beje* fishery business based on the number of management units.

Material and Method

Description of the study sites. North Hulu Sungai is one of South Kalimantan region with an area of wetlands to ± 50,000 ha. Almost 98.82% of the marsh waters are periodically flooded (CBS North Hulu Sungai Regency, 2014) and swamplands will experience drought for some time during the dry season. Drought conditions are used by local communities to trap fish that are trying to find a source of water by making a well dug in the swamp land. This research was conducted in Sungai Papuyu Village Babirik District which is one of *beje* fishery development area in North Hulu Sungai Regency in January - April 2017 (Figure 1). Locations are deliberately chosen based on the number of fisherman households working on *beje* and the variety of fisherman-run units. The *beje* fishery in the study location is managed by 20 fisherman households with total *beje* of 145 units. The number of *beje* managed by each fisherman household varies between 5 - 15 units.

Populasi and sampel. The population in this research is fisherman households who work on fishery *beje* with the number of members as many as 20 households. The members of the population are all sampled. The sample will be divided into three groups based on the number of ownership of *beje* units cultivated. Group I as a small unit is a household that seeks 1 to 5 units; group II as middle unit is households that work on 6 to 10 units; and group III as large unit is households that work more than 10 units.

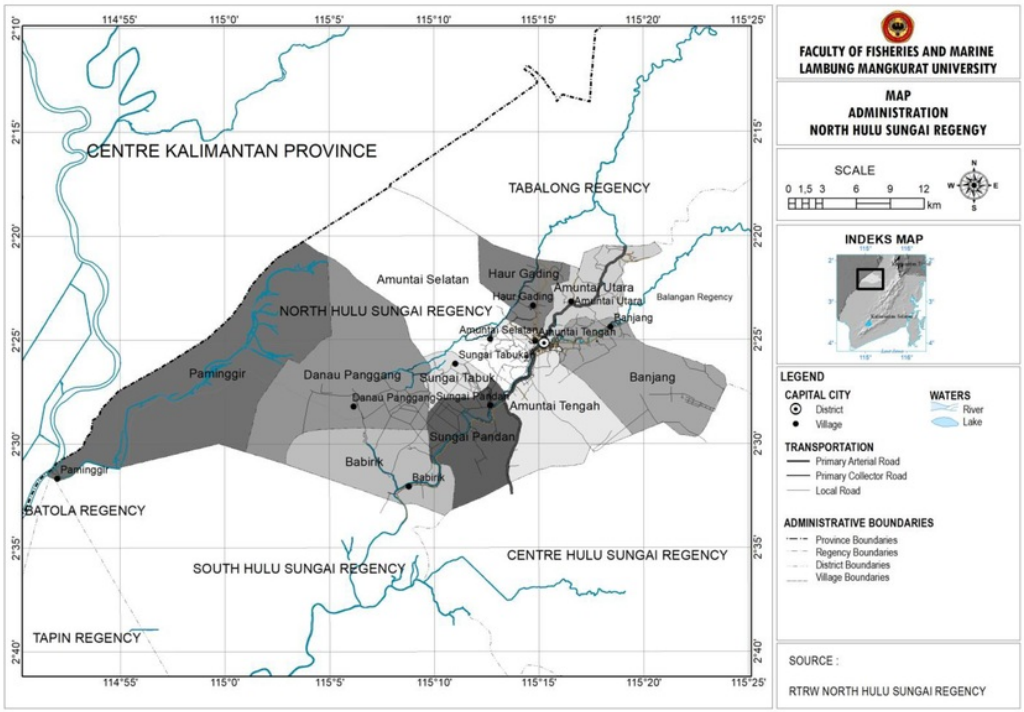

Figure 1. The location of *beje* at Babirik district, Hulu Sungai Utara, Indonesia.

Data analysis. The long-term business feasibility of beje fishery is determined using the investment criteria approach (Gittinger, 1986), as follows:

(a) Net Present Value (NPV)

$$NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t}$$

where:

B_t = total benefit in year-t; C_t = total costs in year-t; n = the economic life of the project; i = discount rate

Decision criteria:

NPV > 0 : profitable business to be developed further

NPV = 0 : business is on break even

NPV < 0 : unprofitable business to be further developed

(b) Benefit Cost Ratio (BCR)

$$BCR = \frac{\sum_{t=1}^{n} B_t}{\sum_{t=1}^{n} C_t}$$

Decision criteria:

BCR < 1 : unprofitable business to run

BCR > 1 : profitable business to run

(c) Internal Rate of Return (IRR)

$$IRR = i' + \frac{NPV'}{NPV' - NPV''} (i'' - i')$$

where:

i_1 = the rate of discount rate that produces NPV_1 (the smallest positive)

i_2 = the rate of discount rate that produces NPV_2 (the smallest negative)
Decision criteria:
IRR < discount rate : unprofitable business to run
IRR > discount rate : profitable business to run

Results. *Beje* fishery generally has cultivated a local fisherman range 5-10 years (65%), and 35% *beje* has cultivated over 10 years. *Beje* which is managed by fishermen generally rectangular shape with area based on ownership group is small group around 57.80 - 462.40 m^2; the middle group ranges from 144.50 - 1,300.50 m^2; and large groups ranged from 9,392.5 - 10,837.50 m^2 (Tabel 1). Total production of *beje* per household ranges from 338.64 - 920 kg $year^{-1}$. Fish produced generally consists of snakeskin gourami as much as 103.57 - 345 kg; three spot gourami as much as 147.5 - 355 kg; common snakehead as much as 41.71 - 115.46 kg; and climbing perch as much as 45.86 - 110 kg. While production per unit *beje* ranged from 74 - 100.91 kg $year^{-1}$ (Tabel 2). The production value of *beje* catch depends on the amount and type of fish produced, as well as the price of the fish. The higher the number and price of the fish caught, the greater the income the fishermen will get. Table 3 shows that snakeskin gourami has the highest production value because its total production is highest, although the selling price is still below the price of common snakehead which is around Rp 15.000 - Rp 30.000 kg^{-1}. While the second highest production value is common snakehead with a value of Rp 1.131,140 - Rp 2,875,000; and the selling price per kg reaches Rp 20,000 - Rp 35,000.

Table 1

Size of *beje* by unit and household

Group	Size per unit (m^2)			Size per household (m^2)		
	Largest	Smallest	Average	Largest	Smallest	Average
Small	462.40	57.80	310.68	2,312.00	231.20	1,338.69
Middle	1,300.50	144.50	459.77	8,670.00	1,011.50	3,586.23
Large	722.50	-	722.50	10,837.50	9,392.50	10,115.00

Table 2

Average *beje* production by type of fish and business group (in a year)

Type of fish	Small		Middle		Large	
	vol.$unit^{-1}$ (kg)	total (kg)	vol.$unit^{-1}$ (kg)	total (kg)	vol.$unit^{-1}$ (kg)	total (kg)
Snakeskin gourami (*T. pectoralis*)	23.71	103.57	28.18	211.82	25	345
Three spot gourami (*T. trichopterus*)	29.57	147.5	45.00	333.18	27	355
Common snakehead (*Channa striata*)	9.86	41.71	15.00	115.46	8	110
Climbing perch (*Anabas testudineus*)	10.86	45.86	12.73	96.36	8	110
Total	74.00	338.64	100.91	756.82	68	920

Beje fishery business in each of the average management group requires investment capital of more than Rp 8 million. The highest total investment capital is large group Rp 19,760,000; and the lowest investment is the middle group only Rp 8,755,000. While the operational cost of *beje* in 5 years of highest management is small group Rp 21,577,000; and the lowest operational cost is the middle group Rp 15,428,000. The highest total

revenue and profits are large, while the lowest is the small group (Table 4). Table 4 shows the results of business feasibility analysis with the NPV criterion with a 9% factor discount indicating that in each group can generate profit, where the smallest profit in small group (Rp 3,782,000) and the biggest profit in large group (Rp 44,812,000). The result of NPV analysis with 12% discount factor also still give advantage to each management group. While the result of business feasibility analysis based on BCR criteria at 9% and 12% discount factor, the value of BCR in each group is above 1 which means that each group of management unit is feasible to be cultivated in long term. The lowest BCR value is in the small group and the highest is the large group. While the results of the analysis based on the IRR criteria indicate that the lowest IRR value is small group (16.04%) and the highest is the middle group (19.17%).

Table 3

Average *beje* production value by type of fish and business group (in a year)

Type of fish	Small		Middle		Large	
	per unit (Rp 000)	total (Rp 000)	per unit (Rp 000)	total (Rp 000)	per unit (Rp 000)	total (Rp 000)
Snakeskin gourami (*T. pectoralis*)	554.21	2,416.43	430.45	3,243.64	405	5,565
Three spot gourami (*T. trichopterus*)	147.86	632.14	225.00	1,665.91	135	1,775
Common snakehead (*Channa striata*)	272.00	1,131.14	329.55	2,481.82	205	2,875
Climbing perch (*Anabas testudineus*)	220.43	925.14	259.09	1,940.91	160	2,200
Total	1,194.50	5,104.86	1,244.09	9,332.27	905	12,415

Table 4

Beje's business feasibility analysis by business group within 5 years of management

Business feasibility criteria	Small	Middle	Large
Investment cost (Rp 000)	9,918	8,755	19,760
Total cost (Rp 000)	21,577	15,428	15,917
Total revenue (Rp 000)	25,529	46,650	62,150
Profit (Rp 000)	3,952	31,222	46,233
NPV 9% (Rp 000)	3,782	30,280	44,812
NPV 12% (Rp 000)	2,171	21,348	31,387
BCR 9%	1.18	3.00	3.86
BCR 12%	1.13	2.74	3.34
IRR (%)	16.04	19.17	19.01

Discussion. *Beje* is a traditional fishery activity in the inland water swamp where fishing activities are continued with fish polyculture activities. Usually *beje* ponds that have been built by fishermen are left without any treatment until a number of fish from various types of swamp fish are trapped. *Beje* productivity is highly dependent on natural conditions and aquatic fertility, there is no special treatment in management to further encourage fish production, for example an increase in stocking density, feeding, or protection from predators. Therefore, the fish rearing period until harvesting generally takes some time, at least one year. The experience of fishermen shows that the age of *beje* is enough to determine the amount of fish production that can be produced. *Beje*

which is old (more than 10 years) allows a lot of fish seeds embedded in it. Adult fish will be harvested immediately, while seeds or young fish are deliberately left and raised to be harvested in the next season.

The results of the study indicate that *beje* business with different size and number of management units can still provide income for fishermen who develop it. The result of business feasibility analysis based on cost and revenue in 5 years of management shows that the three management groups are able to generate profit with ratio between cost and revenue more than 1, so that the three management groups are feasible to be developed further. Similarly, the IRR analysis shows that the IRR of each management group is more than the interest rate for small business loans (12%). Therefore, if the business development uses loan funds with standard bank interest rates, then each level of management still provides benefits for the managers.

However, the highest level of management with productivity per unit was the middle group reaching 100.91 kg year^{-1} (Table 2). Similarly, the production value per unit of *beje* shows that the economic value of middle group unit (6 - 10 units) is higher than the other group which is Rp 1,244,090 year^{-1}. While the capital needed for the supply of *beje* units in the middle group is the smallest (Rp 8,755,000). While in large groups (> 10 units) both volume and production value per unit is the lowest at only 68 kg year^{-1} with production value of Rp 905,000 year^{-1}, but the required total capital is higher is Rp 19,760,000.

Thus, the middle management group has better land use efficiency, capital and operational costs than small and large groups. In line with the results of Sarkar et al (2015) study, the best annual production level in a dredged pond type culture can be achieved with good management practices, and it comes from small and medium scale cultivation because it is economically more feasible than other scales. Ownership of waters that are not too extensive requires fish farmers to intensify their efforts so that they lead to high productivity (Bairagya, 2011). Small-scale polyculture fisheries are feasible (Olawumi et al, 2010) with a positive NPV and an IRR of 19% -24% (Bigwa, 2013). Efforts to increase the productivity of *beje* can be done by developing middle group management unit and more intensifying *beje* maintenance as a fishery cultivation business. Chandra et al. (2010) indicate that semi-intensive aquaculture type ponds in floodplain areas are able to provide fish production and high economic benefits for farmers. In addition, in the cultivation of ponds found that the factors that positively affect the production is the extent of the pond area, fish seed, feed, labor and other costs (Tajerin, 2007: Onumah and Acquah, 2010; Olawumi et al., 2010; Adewuyi, et al., 2010), fish size (Sikiru , et al., 2009), location and level of water circulation (World Bank, 2006), and management capabilities (Ahmed, 2007).

Conclusions. The highest total *beje* production volume per unit is the middle group with production reaching 100.91 kg/yr. The highest production value per unit is in the middle group of Rp 1,244,090/yr. The middle management group has better land use, capital and operational efficiency than small and large groups. The results of the study suggest that to increase the productivity of beje fisheries can be done by developing beje business in the middle group, and supported the application of semi-intensive production technology.

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