Household welfare of mud crab fishermen in small outermost islands. Case study: Enggano Island, Bengkulu Province, Indonesia

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Abstract. Enggano Island is a small populated island designated as one of the 20 (twenty) locations for the Construction of Integrated Marine and Fisheries Centers in The Small Islands and Border Areas. The primary objective for the development of Enggano Island is to increase the income of coastal communities. Economic activities that can improve community welfare are economic activities based on the potential of Enggano and natural resources, one of which is mud crabs. This research is aimed to study the welfare of fisherman households on Enggano Island working as mud crabs catchers. Forty-two respondents were selected from 50 residents spread across 3 of the six villages on Enggano Island. Analysis of the data used scoring and indexing calculated based on seven indicators, namely the education level of the household heads, the number of household members who worked, housing conditions based on wall type, house floor area per capita, access to sanitation, primary lighting and the ownership of household goods. The results showed that the minimum achievement score for the welfare of mud crabs was 33%, the maximum achievement was 80%, and the average achievement was 59%. This finding means that mud crab fishermen on Enggano Island are in the category of moderately welfare. The number of mud crab fishermen included in the low welfare category was 2%, moderate welfare was 62%, and high welfare was 36%. Moderate and low welfare were distinguished by the floor area per capita, access to sanitation and the number of household goods owned. High and moderate welfare were distinguished by the education of the head of the household and the amount of ownership of household goods. High and low welfare was distinguished by the level of education of the household head, floor area per capita, access to sanitation and the ownership of household goods.
Key Words: mud crabs, small outermost islands, Enggano Island, coastal community, economic benefit.

Introduction. The development of Enggano Island is directed at the fisheries sub-sector, which is in line and strengthened by the enactment of Enggano Island as one of the 20 (twenty) locations for the Construction of The Integrated Marine and Fisheries Centers (SKPT) in Small Islands and Border Areas (Marine and Fisheries Ministry 2016a). This SKPT program leads to the optimization of fishing, fish-farming, salt-pond business, and processing and marketing of fish products so that the main actors and business actors in the maritime and fisheries sector will get high economic benefits (economic margins). In turn, it will improve the welfare of the main actors and maritime and fisheries business actors, especially on small islands and/or border areas (Marine and Fisheries Ministry 2015).

The primary objective for the development of Enggano Island, including as one of the SKPT, is to increase the income of coastal communities that lead to increased welfare. Developing Enggano Island also means developing community economies. One direction is the development of economic activities of coastal communities based on the management of available local resources. The development of economic activities of Coastal communities based on local resource management aims to improve the welfare

of coastal communities through developing economic activities and strengthening socio-economic institutions by utilizing fisheries and marine resources optimally and sustainably (Department of Marine and Fisheries 2003).

Welfare is something which is subjective, with everyone different guidelines, goals, and life styles towards the factors that determine the level of well-being. Household welfare is a condition of fulfilling the physical and non-physical needs of all household members (Statistics Indonesia & Faculty of Human Ecology 2015). Enggano Island, as the outermost island which is the most distant from the parent islands, and has limited access, requires economic activities that provide certainty of income in the long run. Economic activity that can be developed for the people's welfare in Enggano as one of the small outermost islands is fishing, and one of the potential commodities is mud crabs (Cahyadinata et al 2018). The species of mud crabs are *Scylla serrata* (80%), *Scylla tranquebarica* (11%) and *Scylla oceanica* (9%) (Suryani 2007). Enggano Island is the only sub-district producing mud crabs of the 19 sub-districts in the North Bengkulu Regency.

The economic value of mud crabs will provide incentives for crab fishermen, according to the number which can be marketed or able to be sold. In order to be sustainable, crab fishermen need to catch crabs of the right size, in accordance with the existing rules, namely the Indonesian Minister of Marine and Fisheries Regulation Number: 56/Pemen-KP/2016 concerning Prohibition of Catching and / or Expending shrimp (*Panulirus* spp.), mud crab (*Scylla* spp.), and swimming crab (*Portunus* spp.) from the Republic of Indonesia (Marine and Fisheries Ministry 2016b).

Households whose main livelihood is fishing (capture fisheries or aquaculture) have the benefits of fishing businesses that can make an important contribution to household income. Households that have higher income will undoubtedly have a greater ability to fulfill the needs of all household members, both material and spiritual needs. In other words, households with large incomes have the opportunity to be more prosperous than those with low income (Statistics Indonesia & Faculty of Human Ecology 2015). Therefore, the formulation of the problem in this study is to assess the welfare of coastal communities on small outermost islands working as mud crab fishermen.

The business of mud crab fishing carried out by fishermen on Enggano Island is a business oriented to commercial businesses. The results of the sale of crabs are used by fishermen to meet household needs, like clothing, food, and shelter. This study aims to assess the welfare of fishing households on Enggano Island working as catchers of mud crabs.

Material and Method

Description of the study site. Enggano Island is administratively one of the sub-districts in North Bengkulu Regency consisting of 6 villages, namely Kaana Village, Kahyapu Village, Malakoni Village, Meok Village, Apoho Village, and Banjarsari Village. The capital of Enggano District is Apoho Village (Statistics of North Bengkulu Regency 2018a). Of the six villages that exist, the research location was in 3 villages, namely Kahyapu Village, Kaana Village, and Banjarsari Village because only these three villages undertake mud crab fishing and it is located between 102.05^{o} to 102.25^{o} (E) and 5.17^{o} to 5.31^{o} (S) (Kementerian Lingkungan Hidup 2005).

Data and data collection. The data in this study consist of primary data and secondary data. Secondary data were obtained from the available literature (from sources/agencies/related institutions), and primary data were obtained directly in the field through interviews with questionnaires. Questions on the questionnaire were adjusted to the seven welfare indicators used. The questionnaire was also supplemented with questions about the social and economic conditions of mud crab fishing households. This study was conducted for 4 months, from August to November 2018.

Sampling. The population of mud crab fishermen on Enggano Island is 50 people. The respondents in this study were 42 people (84% of the total population). The sampling

method used was the census (Nazir 2014), in which eight fishermen were not selected as samples because they were not on Enggano when the research took place.

Data analysis. The level of welfare was measured by the education approach of the household head, the proportion of the number of household members who work, the condition of the house based on the type of wall, house floor area per capita, access to sanitation, primary lighting and ownership of household goods. The welfare indicators, categories, and scores of each category used in this study are presented in Table 1 (Statistics Indonesia & Faculty of Human Ecology 2015).

Table 1

The welfare level indicators

No	Indicators		Score
1	Education level of household head	Higher education	5
		Senior High School	4
		Junior High School	3
		Elementary School (ES)	2
		Did not graduate from ES	1
		No schooling	0
2	Proportion of working family members	1	3
		$x < 1$; $x > 0.49$	2
		$x < 0.5$; $x > 0.25$	1
		$x < 0.25$	0
3	An appropriate house wall	Solid wall	3
		Wood	2
		Bamboo	1
		Others	0
4	Width of floor per capita (number of household members)	≥ 8 m^2	3
		< 8 m^2	0
5	Access to an appropriate sanitation	Toilet	1
		No toilet	0
6	Primary lightning	Electricity	1
		Others	0
7	Household contents	Bicycle, boat, radio, motorbike, television, refrigerator	Each 0.5
		Car/motorboat	1

Classification of welfare level was determined using the scoring method. The score was calculated by subtracting the highest score from the lowest number of scores from the seven welfare indicators that have been predetermined and the reduction results were divided by the number of classifications of welfare level which will be used, namely three classifications. The scores obtained were then indexed (0-100). Based on the indicator table (Table 1), the maximum score was 20, and the minimum score was 0. Mathematically, the determination of the index can be written in equation form as:

$$SK = \sum_{1}^{7} Xi$$

$$IK = \frac{SK}{SM} \times 100$$

where: SK - the number of welfare scores;
   IK - the index of welfare;
   Xi - indicator score to-i;
   SM - a maximum score;
   i - 1, 2, 3, 4, 5, 6, 7.

The welfare index obtained, and fisherman households are grouped into three categories, in the equation:

$$RK = \frac{IKmax - IK\,min}{JK}$$

where: RK - the range of welfare index classes;
  IKmax - maximum welfare index;
  IKmin - minimum welfare index;
  JK - the number of classes or welfare categories.

Welfare assessment is measured based on seven indicators used, in which the maximum welfare index of 100 will be obtained, the minimum index obtained is 0, and there are three classes. The class range for the welfare index is 33.33%, so the assessment of fishing household welfare uses categories are low welfare with an index of 0.00-33.33, medium welfare with an index of 33.34-66.66, and high welfare with an index of 66.67-100.

Results and Discussion

Welfare indicators. The welfare indicators that were measured consisted of 7 indicators, namely the education level of the head of the household, the proportion of the number of a household member working, house walls, house floor area per capita, access to sanitation, primary lighting and ownership of goods to fisherman households. Welfare can also be measured by putting indicators of household expenditure together (Armiento 2018). The result of measuring seven welfare indicators is presented in Table 2.

Table 2
The welfare indicator measurement of mud crab fishermen

No	Indicator	Category	Number (people)	Percentage (%)
1	Education level of household head	Higher education	0	0.00
		Senior High School	12	28.57
		Junior High School	10	23.81
		Elementary School (ES)	17	40.48
		Did not graduate from ES	3	7.14
		No schooling	0	0.00
2	Proportion of working family members	1	1	2.38
		$x < 1;\ x > 0.49$	9	21.43
		$x < 0.5;\ x > 0.25$	28	66.67
		$x < 0.25$	4	9.52
3	An appropriate house wall	Solid wall	11	26.83
		Wood	31	75.61
		Bamboo	0	0.00
		Others	0	0.00
4	Width of floor per capita (number of a household member)	$\geq 8\ m^2$	30	71.43
		$< 8\ m^2$	12	28.57
5	Access to an appropriate sanitation	Toilet	40	95.24
		No toilet	2	4.76
6	Main lightning	Electricity	41	97.62
		Others	1	2.38
7	Household goods owned	Bicycle	11	26.19
		Boat	17	40.48
		Radio	2	4.76
		Motorcycle	36	85.71
		Television	26	61.90
		Refrigerator	12	28.57
		Car	2	4.76
		Motorboat	12	28.57

Fishermen of mud crabs are generally the head of the household. The lowest level of education for the head of a fisherman household is four years schooling or equivalent to grade 4 of Primary School, and the highest is 12 years schooling or graduating from Senior High School (SLTA). The average education of the head of the family is eight years schooling or equivalent to grade 2 of Junior High School (SLTP).

The education level of fishermen using motorized boats, outboard motorized boats, or non-motorized boats in Indonesia is generally still very low. Most of the fishermen only passed elementary school (ES) or did not even complete elementary school, totalling more than 70%. There are many factors alleged to cause low levels of education for fisherman communities, some of which are the low income of fishermen, so they are unable to access higher education, location of junior high school / equivalent and senior high school / equivalent which is distant from the fishing settlements which are generally in rural-coastal areas, and low motivation of children to attend school or low awareness of parents to send their children to school (Statistics Indonesia & Faculty of Human Ecology 2015). The education level of farmers in Indonesia is high at 72.87% but includes those who did not graduate from elementary school and who graduated from elementary school (Statistics Indonesia 2014). This data shows that the average education level of fishermen on Enggano Island is higher than the average education of fishermen else where and farmers in Indonesia.

Educational facilities in Enggano consist of elementary schools, junior high schools, and high schools. The number of elementary schools is five units, in which there is one elementary school, except Malakoni. There are two units of junior high school education in Apoho Village and Village Kahyapu. While there is only one senior high school, that is in Malakoni Village (Statistics of North Bengkulu Regency 2018b). Especially for the study location villages, Kaana and Banjarsari villages have one primary school each, while Kahyapu Village has one elementary school and one junior high school.

The number of household members of mud crab fishing ranges from 1 to 7 people with an average of 4 people per household. To meet household needs, each household has members of the household who work to make a living. The number of household members working in one household is between 1 and 3 people with an average of one person per household. This means that the proportion of household members who work ranges from 0.20 to 1.00 with an average proportion of 0.38.

The business households who fish at sea in Indonesia have an average number of household members of 4.50. Meanwhile, aquaculture households have an average number of members of 4.41 and household fishing businesses in public waters, namely as many as 4.07 people (Statistics Indonesia & Faculty of Human Ecology 2015). The average farmer household members in Indonesia are 3.85, and in Bengkulu Province, it is 3.94 (Statistics Indonesia 2014). Especially for Enggano Island, the number of household members is 3.65 people per household (Statistics of North Bengkulu Regency 2018b). Average members of the mud crab fisherman household are almost the same as the number of household members of general fishermen and farmers in Indonesia and communities on Enggano Island.

Houses owned by fishing households vary from one household to another. Fishermen who own their own homes are 90.48%. Those who rent houses are 4.76%, and those who live in someone else house without renting are 4.76%. In Indonesia, most of the buildings where fishing households live by the sea are owned by themselves, namely 93.21% in groups using motorized boats, 94.02% for those using outboard boats, and 95.33% for those using boats and do not motorbikes (Statistics Indonesia & Faculty of Human Ecology 2015). Semi-permanent houses are more numerous than permanent houses, so that the walls of fisherman houses are generally made of wood. People make houses with wooden or plank walls because Enggano Island is one of the earthquake-prone areas and there was a massive earthquake which occurred on June 4, 2000, with the power of 7.3 SR centered on Enggano Island (Mase 2015).

The floor area of mud crab fishermen's houses ranges from 18 to 120 m^2 with an average floor area of 46.52 m^2. For sea-based fishermen, the dominant category of fishing boats and outboard motors, houses are in the area of 51 to 100 m^2, which is

48.78% for motorbike fishermen and 46.35% for outboard motor fishermen. For these two categories, houses with a floor area of 25 to 50 m^2 are also quite large, which are 29.96% for motorized boat fishermen and 37.16% for outboard motor fishermen. For fishermen without a motorbike category, most fishermen (47.99%) own houses with a floor area of between 25 to 50 m^2, and those who have houses with a floor area of 51 to 100 m^2 are 37.07%. Meanwhile, for fishermen without boats, the majority (50.32%) of their house floor area is between 25 and 50 m^2, followed by an area of 50 to 100 m^2 (34.23%) (Statistics Indonesia & Faculty of Human Ecology 2015). With an average number of household members of 4 people, the floor area per capita of mud crab fishermen household members ranged from 4 to 40 m^2 with an average area of 13.5 m^2 per capita.

Fisherman houses with ceramic floors is 21%, tiled floors 2%, cement floors 38%, wooden floor or board is 33%, and earth flooring is 5%. For Indonesian fishermen, among the fishermen using motorbike boat, their houses mostly use wood/board floor (46.62%), followed by ceramics (28.58%), and cement (18.61%). For outboard motor fishermen, most houses use cement (33.00%), followed by ceramics (27.49%), and wood/boards (27.27%). Meanwhile, for motorized boat fishermen, the majority of houses with cement floors is 44.95%, followed by the wood/board at 29.13%, and ceramics at 8.88% (Statistics Indonesia & Faculty of Human Ecology 2015). Thus, houses for fishermen in Enggano are almost the same as general fishermen in Indonesia whose house floors are generally made of boards and cement.

The roof of the house also determines the quality of the house. For roofs, 10% of mud crab fishing houses have asbestos roofs, 88% have zinc roofs and only about 2% of fishermen's houses have roofs of leaves. For general fishermen in Indonesia, using all types of fishing gear, have mostly zinc roofs (52.93% motorboats, 47.42% outboard motorboats, and 63.02% motorized boats). Whereas, tile-roofed houses are also quite large, namely 21.09% for motorbike fishermen, 31.69% for outboard motor fishermen, and 9.79% for boat fishermen without motorcycles. Those who use asbestos roofs are still quite large, namely 16.64% for motorized boat fishermen, 10.73% for outboard motor fishermen, and 9.39% for boat fishermen without motorcycles. There are also marine fishermen using palm-fiber roofs, namely 4.86% for motorized boat fishermen, 6.95% for outboard motor fishermen, and 11.68% for motorized boat fishermen (Statistics Indonesia & Faculty of Human Ecology 2015). The type of house roof used by mud crab fishermen in Enggano is almost the same as that used by general fishermen in Indonesia.

Mud crab fishermen's houses on Enggano Island have a different shape and floor area, but in general, each fisherman's house still has a yard. As much as 88% of crab fishermen own an area of land but 12% do not. The land owned by the fishermen is between 0.001 and 1.7 hectares with an average area of 0.24 hectares. Some of the land areas are empty, and some are planted by several types of agricultural commodities, including chili, banana and coconut.

Access to household mud crab fishermen to sanitation is sufficient. Generally, fisherman houses have been equipped with toilets for bathing, washing, and latrines (MCK), except for only two houses or around 4.76% which did not have toilets. Fishermen who do not have toilets generally use the river for bathing, washing, and latrines.

The existence of PT. PLN - The State Electricity Company on Enggano Island began in August 2016. Even though it has been running for more than two years, not all residential locations have an electricity connection - the number of households in Enggano that are electricity customers of PT. PLN is 512 families from 881 households or around 58.16% (Statistics of North Bengkulu Regency 2018b). Of the 41 mud crab fishermen households that have access to electricity, 87.80% use the services of PT. PLN, 9.76% use PLTS services, and 2.44% use generators. PLTS was located in Enggano before electricity from PT. PLN. Electricity operation from PT. PLN starts at 05.00-12.00 WIB and 17.00-24.00 WIB. Energy consumption by the community can affect gross domestic product (Menegaki & Tugcu 2018).

Data shows that there are still mud fishermen households that do not have access to electricity. This can be caused by the ability to access or the absence of a nearly electricity network - households that do not have electricity use batteries as an alternative lighting source. For fishing households in Indonesia, most of the primary sources of electricity are PLN, being 73.06% for motorized fishing, 78.06% for motorized boat fishermen, and 60.95% for boat fishermen without motorcycles. Meanwhile, the main lighting source for those fishing in public waters is also dominated by PLN electricity (Statistics Indonesia & Faculty of Human Ecology 2015).

Goods owned by fishermen households vary based on eight types of ownership of goods, namely bicycles, boats, radios, motorbikes, televisions, refrigerators, cars and motorboats. There were no fisherman households with all eight types of goods. If there are households that already have television, then generally they no longer have radios. Of the 26 fishing households that have television, only about 3.85% of these households also own radios. However, if these households already own motorbikes, there are still some households that still have bicycles. Of the 36 fisherman households that own motorbikes, around 27.78% still have bicycles.

Ownership of goods in the form of motorboats or cars has the same value in evaluating the welfare of fishermen. If the household owns one motorboat or a car, then the value is 1.0. If the household owns a motorboat and car, the value is also 1.0. Of the two fishing households that own a car, there is only one household that also owns a motorboat. As for motorboats and boats, it is considered these two items of different types. This means that if one household owns a motorized boat, it does not mean that the household is considered to also have a boat.

Welfare measurements. The assessment of the seven welfare indicators of mud crab fishermen households on Enggano Island resulted in a household welfare score and index. The welfare score for mud crab fishermen ranged from 7 to 16 with an average score of around 12. With a maximum welfare score of 20, minimum achievement welfare score is 33%, maximum achievement is 80%, and average achievement is 59%. The achievement of fisherman household welfare scores is a welfare index that describes the level of household welfare. In general, mud crab fishermen on Enggano Island belong to the medium welfare category (Figure 1). Increased welfare over time can reduce the level of poverty in a community (Borjas 2016). This can be achieved with sustainable fisheries management through training and supervision of fisherman activities (Quynh et al 2018).
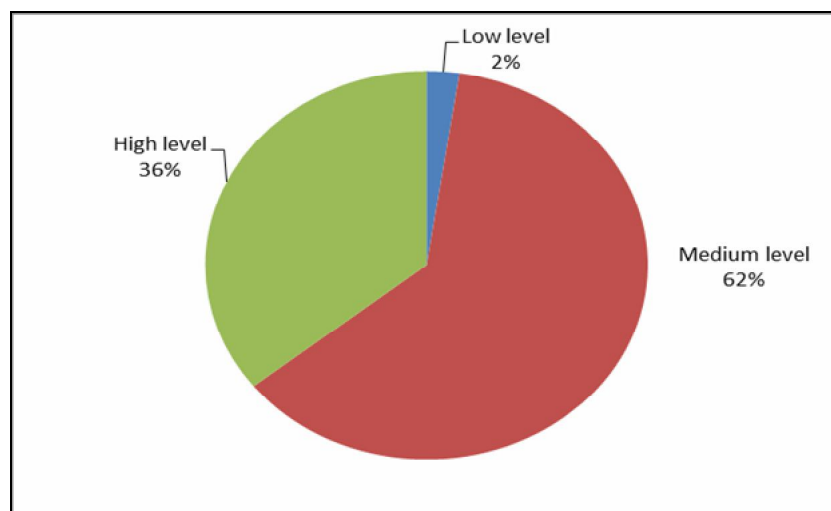

Figure 1. The distribution of mud crab fishermen's welfare level.

Mud crab fishermen who belong to the lower welfare make up 2%. The heads of households with low welfare have an elementary school level of education. The proportion of household members working is about 0.25-0.49. Their house walls are made of wood and hardboard. The floor width is < 8 m^2 per capita. They do not have

MCK facilities, but they do have electricity and at least one unit of household goods, such as a bicycle, boat, radio, motorbikes, television, and refrigerator. The welfare has a positive relationship with the level of income or wage obtained by the fishermen (Eden & Gaggl 2018). To survive, the fishermen with low welfare can use social modal to fulfill their needs (Islam et al 2011). In the long-term period, the welfare of fishermen can be improved by increasing the number and frequency of catches (James et al 2018).

Fishermen of mud crabs that belong to the category of moderate welfare make up 62%. The heads of fishermen with moderate welfare have an elementary school education level. The proportion of household members working is around 0.25-0.49. Their house walls are made of wood or board with a floor area per capita ≥ 8 m^2. They have MCK facilities, have electricity and generally have two units of household goods such as bicycles, boats, radios, motorbikes, televisions, and refrigerators. The difference between moderate and low welfare households lies in the floor area per capita, access to sanitation and the number of household goods owned (Table 3). Torch-fishermen in Bandar Lampung City are included in the medium criteria (Fadilah et al 2014). Welfare can be improved by coordinating the market for selling products produced by productive community groups (Kibler et al 2018), including fishermen. Wide market opportunities can help fishermen get the best prices (Wang 2016). Government financial policy can also be useful in improving welfare (Huang et al 2017). Welfare can also be undertaken by optimizing production costs (Huang & Kim 2018).

Table 3

The indicators and welfare level of mud crab fishermen

No	Indicator	Welfare		
		Low	Medium	High
1	Education level of household head	Elementary school	Elementary school	Junior high school
2	The proportion of working family members	0.25-0.49	0.25-0.49	0.25-0.49
3	Having an appropriate house wall	Wood	Wood	Wood
4	The floor width per capita	< 8 m^2	≥ 8 m^2	≥ 8 m^2
5	Having access to an appropriate sanitation	No	Yes	Yes
6	Main lightning	Electricity	Electricity	Electricity
7	Household goods owned	1 unit	2 unit	4 unit

Fishermen of mud crabs who make up the high welfare category comprise as much as 36% of the total. The welfare level of fishermen in the Minapolitan area in Jembrana Bali is categorized as high (Anggreni et al 2015). The heads of fishermen with a high welfare level have an education level of junior high school. The proportion of household work is around 0.25-0.49. Their house walls are made of wood or boards and their floor area is ≥ 8 m^2 per capita. They have MCK facilities, electricity and four units of household goods from several units of goods, such as bicycles, boats, radios, motorbikes, television, and refrigerators. The difference between households with high and medium welfare lies in the education of the head of the household and the ownership of household goods. The difference between high and low welfare households also lies in the education level of the head of household but also in the floor area per capita, access to sanitation and the level of ownership of household goods.

Fishermen's welfare can be improved by increasing the number of boats or fishing gear so that the range of fishing becomes more extensive, but they are also required to preserv the environment, such as maintaining mangrove ecosystems (Riyanda & Haadi 2018). Financial indicators need to be considered in carrying out a fishing business, such as capital, production, revenue and business costs (Yafiz et al 2009). Increasing boat numbers and fishing gear is expected to increase fishing productivity which produces better welfare (Wossen et al 2017). The results of welfare measurements can change from time to time, and the results also depend on the methods used (Ozbilgin 2017).

Conclusions. The welfare of mud crabs fishermen on the small outermost islands lies in the moderate welfare category, with a welfare index of between 33 and 80% and an average of 59%. Fishermen with low welfare make up 2%. Those having moderate welfare comprise 62%, and those enjoying high welfare at 36%. The difference between moderate and low welfare is determined by the floor area per capita, access to sanitation and the level of household goods ownership. The high and moderate welfare is distinguished by the education of household heads and the goods held by the household. High and low level of welfare is distinguished by the level of education of the household head, the floor width per capita, access to sanitation and total ownership of household goods.

The proportion of household members who work, the standard of house walls and the main source of lighting for mud crab fishermen households show the same tendency for households of low, medium and high welfare categories. For this reason, the status of houses and electricity sources need to be considered as one of the indicators to measure the level of welfare. The walls of houses that are either made of wood or boards can have a different status of house ownership, such owner-occupied or rental. They have different sources of electricity, such as PT. PLN, solar power plants, and generators that provide different qualities of lighting.

References

Anggreni K., Suparta N., Astiti N. W. S., 2015 [The role of the Baruna Cooperative as the economic institute for coastal development (LEPP) in improving fishermen welfare at Pengambengan Minapolitan Area, Jembrana]. Manajemen Agribisnis 3(1):14-21. [in Indonesian]

Armiento M., 2018 The sustainable welfare index: towards a threshold effect for Italy. Ecological Economics 152:296-309.

Borjas G. J., 2016 Does welfare reduce poverty? Research in Economics 70:143-157.

Cahyadinata I., Fahrudin A., Sulistiono, Kurnia R., 2018 [Potency of catch fisheries development in a small outer island (Case study: Enggano Island Bengkulu Province)]. Agrisep 17(2):151-162. [in Indonesian]

Department of Marine and Fisheries of the Republic of Indonesia, 2003 [General guidelines for economic empowerment of coastal communities in Indonesia]. pp. 1-64. [in Indonesian]

Eden M., Gaggl P., 2018 On the welfare implications of automation. Review of Economic Dynamics 29:15-43.

Fadilah, Abidin Z., Kalsum U., 2014 [Household income and welfare of torch fisherman in Bandar Lampung City]. Jurnal Ilmu-Ilmu Agribisnis 2(1):71-76. [in Indonesian]

Huang C. Y., Yang Y., Cheng C. C., 2017 The growth and welfare analysis of patent and monetary policies in a Schumpeterian economy. International Review of Economics and Finance 52:409-426.

Huang Z., Kim A., 2018 Welfare maximization with production costs: a primal-dual approach. Games Economic Behavior. https://doi.org/10.1016/j.geb.2018.03.003.

Islam G. M. N., Yew T. S., Abdullah N. M. R., Viswanathan K. K., 2011 Social capital, community-based management, and fishers' livelihood in Bangladesh. Ocean and Coastal Management 54:173-180.

James P. A. S., Tidd A., Kaitu L. P., 2018 The impact of industrial tuna fishing on small-scale fishers and economies in the Pacific. Marine Policy 95:189-198.

Kibler E., Salmivaara V., Stenholmc P., Terjesend S., 2018 The evaluative legitimacy of social entrepreneurship in capitalist welfare systems. World Business 53:944–957

Marine and Fisheries Ministry, 2015 [The Indonesian Ministry of Marine and Fisheries Regulation Number: 48/Permen-KP/2015 concerning general guidelines for the establishment of integrated marine and fisheries centers in small islands and border areas]. pp. 1-29. [in Indonesian]

Marine and Fisheries Ministry, 2016a [The Indonesian Ministry of Marine and Fisheries Regulation Number: 51/Kepmen-KP/2016 concerning the location of integrated marine and fisheries centers on small islands and border áreas]. pp. 1-3. [in Indonesian]

Marine and Fisheries Ministry, 2016b [The Indonesian Ministry of Marine and Fisheries Regulation Number: 56/Pemen-KP/2016 concerning prohibition of catching and/or expending Shrimp (*Panulirus* spp.), Mud crab (*Scylla* spp.), and Swimming crab (*Portunus* spp.) from The Republic of Indonesia]: 1-8. [in Indonesian]

Mase L. Z., 2015 [Earthquake characteristics in the Bengkulu City]. Teknosia 2(15):25-34. [in Indonesian]

Menegaki A. N., Tugcu C. T., 2018 Two versions of the Index of Sustainable Economic Welfare (ISEW) in the energy-growth nexus for selected Asian countries. Sustainable Production and Consumption 14:21-35.

Nazir M., 2014 [Research methods]. Ghalia, Indonesia, 544 pp. [in Indonesian]

Ozbilgin H. M., 2017 Welfare implications when closing small open economy models. Journal of International Money and Finance 70(C):471-493.

Quynh C. N. T., Schilizzi S., Hailua A., Iftekhar S., 2018 Fishers' preference heterogeneity and trade-offs between design options for more effective monitoring of fisheries. Ecological Economics 151:22-33.

Riyanda R., Haadi F. A., 2018 [Strategy of Batam fisheries service in optimizing fishermen's community welfare]. Dialektika Publik 3(1):31-38. [in Indonesian]

Statistics Indonesia, 2014 [Socio-economic analysis of farmers in Indonesia]. Jakarta, pp. 1-172. [in Indonesian]

Statistics Indonesia, Faculty of Human Ecology Bogor Agricultural University, 2015 [Analysis of fisheries household welfare in Indonesia]. Jakarta, pp. 1-135. [in Indonesian]

Statistics of North Bengkulu Regency, 2018a [Enggano Subdistrict in figures 2018]. Argamakmur, pp. 1-83. [in Indonesian]

Statistics of North Bengkulu Regency, 2018b [North Bengkulu Regency in figures 2018]. Argamakmur, pp. 1-299. [in Indonesian]

Suryani M., 2007 [Ecology of mud crab in mangrove ecosystem in Enggano Island, Bengkulu Province]. University of Diponegoro Semarang, Indonesia, pp. 1-91. [in Indonesian]

Wang L., 2016 Endogenous search, price dispersion, and welfare. Journal of Economic Dynamics and Control 73:94-117.

Wossen T., Abdoulaye T., Alene A., Feleke S., Gilbert J. R., Manyong V., Awotide B. A., 2017 Productivity and welfare effects of Nigeria's e-voucher-based input subsidy program. World Development 97:251-265.

Yafiz M., Sondita M. F. A., Soemakaryo S., Monintja D. R., 2009 [Financial analysis of fishing effort in a model of fishermen prosperity improvement at the regency of Rokan Hilir Riau Province]. Jurnal Perikanan dan Kelautan 14(1):81-92. [in Indonesian]

*** Kementerian Lingkungan Hidup, 2005 Studi daya dukung lingkungan Pulau Enggano Provinsi Bengkulu, Indonesia. pp. 1-104. [in Indonesian]

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