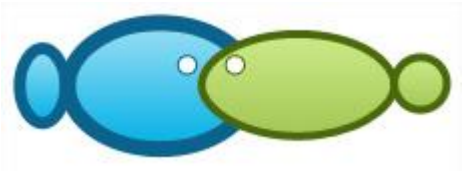

Profitability analysis of mariculture as well as its impact on farmers' incomes and poverty alleviation: Insights from Lampung and Bali Provinces, Indonesia

[1,2]Maulana Firdaus, [1]Katsumori Hatanaka, [1]Ramadhona Saville

[1] Department of Agribusiness Management, Graduate School of Agriculture, Tokyo University of Agriculture, Tokyo, Japan; [2] Research Centre for Marine and Fisheries Socio-Economic, Indonesia Ministry of Marine Affairs and Fisheries, Jakarta, Indonesia.
Corresponding author: M. Firdaus, 46719401@nodai.ac.jp

Abstract. Mariculture is an alternative vehicle for achieving development goals in several countries, including Indonesia. Mariculture, theoretically, can increase incomes, create jobs, and reduce poverty. However, the debate on empirical evidence against this statement continues to this day. This paper aims to provide empirical evidence that mariculture can increase income and reduce poverty or vice versa, especially for people who are directly involved in this enterprises. Research evidence shows that mariculture, particularly current finfish mariculture, is not always beneficial. Mariculture affects rising incomes because it is the primary source of income, especially for those directly involved in this business (workers and owners). However, the income received from mariculture has not been able to reduce poverty or improve the welfare of the majority laborers who involved in mariculture.
Key Words: mariculture, income, poverty, finfish mariculture, households.

Introduction. The target of aquaculture development is to increase the income and welfare of farmers. The Indonesian government has been promoting aquaculture development to reduce poverty and regional development since 2010 (Widjaja 2013). The development of aquaculture, especially mariculture, became one of Indonesia's government priority programs in the 2019-2024 period. Mariculture is one of the aquaculture activities defined as organic mariculture activities carried out at sea, not involving aquaculture activities carried out in coastal areas, such as ponds (Rimmer 2010). This definition also excludes stock enhancement or marine 'ranching'. Mariculture is also known as eco-friendly aquaculture (Neori et al 2004), which can provide economic benefits and food fulfillment. Indonesia has become one of the countries in Asia with such significant potential for mariculture, spread over an area of 12.1 million hectares but only using around 2.36% (Ministry of Marine and Fisheries Affairs 2018).

A few studies have analyzed aquaculture's contribution to household income and poverty reduction (Belton 2013; Mulokozi et al 2020). Theoretically, the development of aquaculture would have a direct impact on household income, job creation and export markets (Twomey 2017; Henriksson et al 2017; Hasimuna et al 2019). However, the statement is indeed doubtful because numerous studies indicate that there is still little empirical evidence to show that aquaculture activities can have a significant impact on poverty reduction, either directly or indirectly (Arthur et al 2013; Toufique & Belton 2014; Béné et al 2016; Kassam & Dorward 2017). Throughout conclusion, according to Belton (2013) or even Nguyen et al (2016), aquaculture has an impact on employment. However, it is not completely obvious whether it reduces the poverty of people and families. Perceptions about poverty have changed over the past decades to more multidimensional. Poverty can include food insecurity, social inferiority and exclusion, lack of assets and vulnerability, child outcome, a decent house, and living in a healthy environment (Burchi et al 2018; Gamboa et al 2020).

Research on mariculture in Southeast Asia is well documented in the literature, but according to Kassam (2014), aquaculture promotion for poverty alleviation has had a poor record in many developing countries. So, especially in the literature, it is very scarce that mariculture can have an impact on increasing household income for farmers and on reducing poverty, especially in the case of Indonesian mariculture farmers. Against this background, the aim of this paper is to analyze whether mariculture is a profitable enterprise currently and whether it can increase income for the farmers in target areas. This paper also contributes significantly to the empirical evidence of differences of opinion on aquaculture, which might reduce poverty or vice versa. Our research focuses on finfish mariculture in Lampung and Bali Provinces, Indonesia. Lampung Province is one of the mariculture centers in western Indonesia, and Bali Province is one of the mariculture centers in eastern Indonesia, which is dominated by groupers and Asian sea bass, with production contribution reaching 22% of total mariculture production (Ministry of Marine and Fisheries Affairs 2018).

Material and Method

Study design. This study was conducted in Lampung Bay, Lampung Province, and Penerusan Bay, Bali Province, Indonesia (Figure 1).

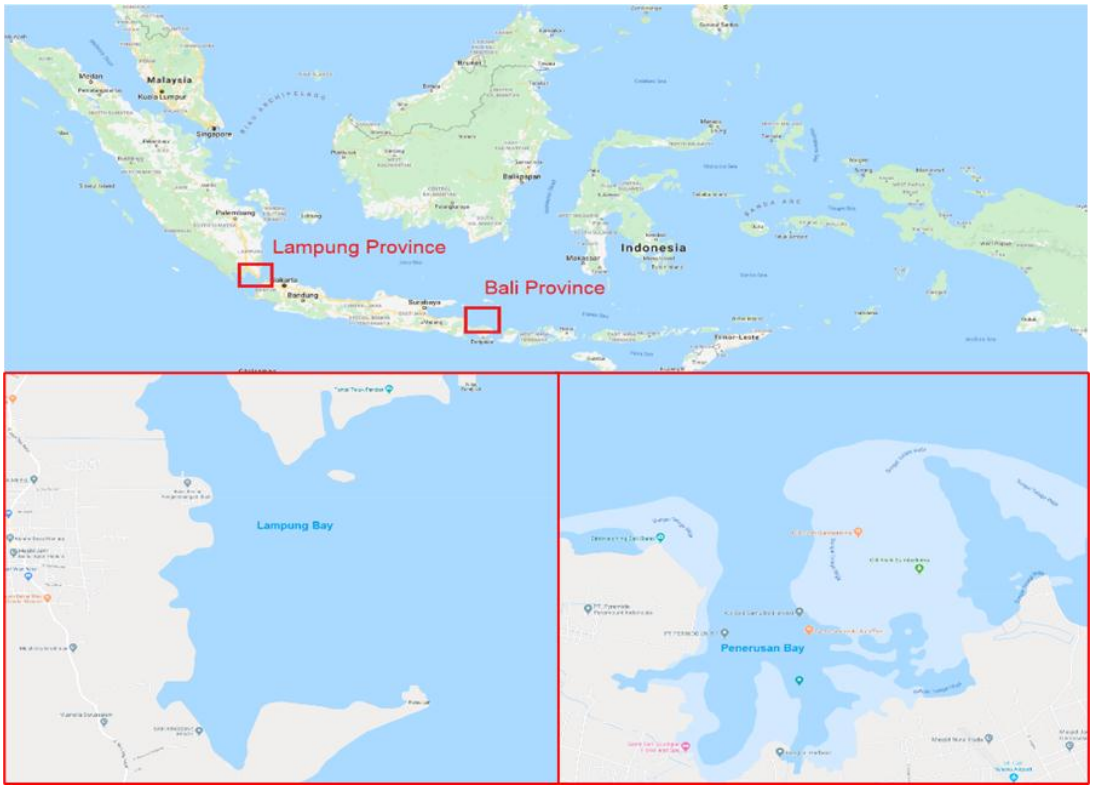

Figure 1. Study areas, Lampung Province and Bali Province, Indonesia (Source: Google map).

Indonesia is the fourth largest producer of finfish mariculture in the world (FAO 2015). Primary data collection was carried out through interviews with stakeholder groups in the mariculture enterprise using a questionnaire. Respondents in this study were divided into two: laborers and farm owners. Depending on the availability of the fish farm, our study used three types of sampling techniques, namely simple random, purposive and snowball sampling. Random sampling has been used in all study areas. Purposive sampling was used where the number of fish farmers was small. Where no lists were available, snowball sampling was used where fish farmers were asked to identify their fellow fish farmers who were then selected for the survey. Four owners and twelve workers were selected from four mariculture facilities in Lampung Bay, two owners and seven workers

were selected from two mariculture facilities in Penerusan Bay. Household incomes were divided into two categories, i.e. income from mariculture and other income from personal interviews over 12 months of the last one year (2019/2020) depending on the farmer's memory and notes — additional relevant information also obtained from field observations and in-depth interviews with key informants. This study uses secondary data, such as scientific journals or publications, articles and reports. Data were analyzed using the analysis of mixed methods using quantitative and qualitative methods.

Data analysis. The profitability of mariculture was evaluated using the profitability analysis by calculating and comparing the benefits and costs (Nas 2016). The structure of household income and expenditure was derived from the respondents' responses and then calculated in units of one year. Data collected were organized into charts, tables, and graphs in Microsoft Excel. In this paper, the critical approaches to describe and assess poverty are from economic views, particularly income and expenditure (Little et al 2012). Economic and financial aspects are the simplest forms to define poverty and not to link it to the holistic well-being of the individual or household (Nguyen et al 2016). The impact on income and reducing poverty in this study is the direct impact received by farmer households. Farmers' household poverty was measured by using: (1) ratio income to regional minimum wages approach (RMW), when the ratio is <1 then the labor's income is under RMW (insufficient), when the ratio = 1 means that the labor's income is equal to RMW (borderline), and when the ratio is >1 means that the income is higher than RMW (more than sufficient) (Nababan et al 2020), and using Engel's coefficient, by calculating: Food consumption expenditure/Total consumption expenditure. Engel's coefficient is a standard indicator to analyze the living standards of people and poverty degrees in an area or region currently in the research field. Engel's coefficient values range between 0 and 1. The smaller the value indicates the more affluence (Jun & Jie 2011).

Results and Discussion

Mariculture overview and socio-economic conditions. Primary commodities of finfish mariculture in Indonesia are grouper and Asian sea bass or barramundi (Mayerle et al 2017). The number of mariculture households in Indonesia continues to decline, with an average value of a declining trend over the 2012-2017 period of -2.52% year^{-1} (MMAF 2018). In study areas similar conditions were experienced, the number of mariculture households continued to decline in the same period, where the declining number for Lampung Province (-24.47% year^{-1}) was higher than in Bali Province (-6.37% year^{-1}). A decline in household numbers in the industry may indicate that the sector does not provide benefits, which is why employers force them to turn to other livelihoods. Subsidies may change due to a number of reasons, such as difficulties in accessing land (resources), income security, unbalanced cost of production, and the ecosystem or environmental change (Buor & Konkor 2016; Majekodunmi et al 2017; Lauria et al 2018).

Finfish mariculture in Lampung Bay is categorized in the micro and small scale enterprise (Fisheries offices of Lampung Province 2019), while the finfish mariculture in Penerusan Bay is categorized in the small scale and industrial scale enterprise categories (BPS 2016). Referring to the Law of the Republic of Indonesia No. 20/2008 concerning micro, small and medium enterprise, the microscale is an enterprise that has a net asset value of at most IDR. 50,000,000.- (3,571 USD) excluding land and buildings for business premises or having an annual turnover of at most IDR. 300,000,000,- (21,429 USD). The small scale is a business that has the most net asset value IDR. 50,000,000.- (3,571 USD) up to IDR 500,000,000.- (35,714 USD) excluding land and buildings or businesses having an annual turnover of more than IDR. 300,000,000 (21,429 USD) up to a maximum of IDR. 2,500,000,000 (178,571 USD), as for the middle and big scale with the higher annual turnover.

The level of laborer education at these two different locations is also almost the same (11 and 12 years of education) and for the owner it is 14 years of education (Table 1). Twelve-year education is similar to a high school graduate, and 14-year education is

similar to a bachelor's degree. The 11-year level of education indicates that some of the workers have not completed their high school education. Education is one of the predictors of income inequality (Manna et al 2017), i.e. higher education leads to higher incomes and vice versa (Akpan et al 2016). The level of education was also positively linked to environmental awareness (Philippsen et al 2017). Parental education will also have an impact on the level of education of their children, where higher parental education tends to have higher participation in child education and vice versa (Wiyono et al 2018).

Table 1

Socio- economic characteristics of mariculture households in Lampung Bay and Penerusan Bay, 2020

Description	*Lampung Bay*		*Penerusan Bay*		*Average*	
	Laborer	*Owner*	*Laborer*	*Owner*	*Laborer*	*Owner*
Time spent in school or level of education (years)	11	14	12	14	11.5	14
Household members (individuals)	2.2	4	3.7	4	2.9	4
Experience in mariculture (years)	4	7	6	12	5	9.5

Mariculture activities and profitability of mariculture. Finfish mariculture in Lampung Bay and Penerusan Bay is performed in floating net cages. There are three types of floating net cages used in the two study areas, i.e. (1) a square with 3 x 3 m and 4 x 4 m with a depth of 3 to 5 meters, (2) a rectangle with a size of 3 x 4 m, 3 x 5 m and 4 x 6 m with a depth of 3 to 5 meters, and (3) Circles with a diameter of 4-10 m with a depth of 3 to 8 m. One unit of finfish mariculture consists of 6-9 cages. The construction of floating net cages is generally made of wood/bamboo and polyethylene or HDPE (Figure 2).

The number of fingerlings used per planting season in each cage was not quite the same, in Lampung Bay, fingerlings ranged from 300 to 400 fish, with a stocking density of 30-40 fish m^{-3}. When the size of the fingerlings used is 500-600 g, the stocking density is 20-25 fish m^{-3}. However, when the size of the fingerlings is less than 200 g, the stocking density range is 30-50 fish m^{-3}. But for the Penerusan Bay, with an average of between 250 and 300 fish, the average fingerlings size was 200-300 g. If the size of the fingerlings used is more than 300 g (300-500 g), which is as much as 200 fish $cage^{-1}$, the use of larger seed sizes is the first choice for farmers as it has a higher survival rate (Cabaleiro et al 2018). First, the trash fish is cut according to the opening of the fish's mouth and given until it is full (no longer eaten). Fish trash feed is more wasted than pellet feed (Sim et al 2005; Afero 2012). However, the cost of trash fish feed was more significantly smaller, so that fish trash has been used more than pellets.

Figure 2. Left - Wood or bamboo floating net cages; Right - Polyethylene or HDPE floating net cages (original).

The average number of laborers in one unit of finfish mariculture in the study areas was between 3 and 8 persons $unit^{-1}$. Labor tasks are not clearly distinguished by the fact that each laborer must be able to do all the work, such as feeding, maintaining facilities,

replacing nets and operating machines. Every laborer must also be in a position to stock and seed and harvest. Wages received by laborers will vary for each mariculture facility, but work experience is the main determining factor. The types of fish cultivated at both locations differ; in Lampung Bay, the types of fish cultivated are more diverse, e.g. groupers, Asian sea bass, silver pomfret and golden trevally, whereas for the Penerusan Bay, there are only groupers and Asian sea bass. Farmers cultivating the grouper are made up of several types, i.e. hybrid groupers (*E. fuscoguttatus x E. macrodon*), bleached groupers (*E. lanceolatus x E. fuscoguttatus*), tiger groupers (*E. fuscoguttatus*) and Sunu groupers (*Plectropomus leopardus*).

The number of cages in finfish mariculture in Penerusan Bay is higher than in Lampung Bay, so that farm units in Penerusan Bay use more average inputs than in Lampung Bay. The number of fingerlings stored per cage for all types of fish in Lampung Bay ranged from 55 to 368 fish cage^{-1} with a density of 6 t0 40 fish m^{-3}, while the number of fingerlings stored per cage for all types of fish in the Penerusan Bay ranged from 160 to 233 fish cage^{-1} with a density of 17 to 25 fish m^{-3}. The number of feeds (fish trash) provided for finfish mariculture in Lampung Bay is an average of 0.76 tons year^{-1} and in the Penerusan Bay an average of 1.12 tons year^{-1}. Table 2 summarizes the input variables for finfish mariculture in Lampung Bay and Penerusan Bay.

Table 2

Summary of inputs for each finfish mariculture season on current conditions in Lampung Bay and Penerusan Bay, 2020

No	*Item*	*Lampung Bay*			*Penerusan Bay*		
		Min	*Max*	*Mean*	*Min*	*Max*	*Mean*
1	Cage number (Unit)	18	90	50	80	105	92.5
	Fingerlings (fish year^{-1})						
2	a. Grouper*	300	16,300	4,738	12,800	22,100	17,450
	b. Asian sea bass	300	5,000	1,500	0	2,400	1,200
	c. Silver pomfret	400	6,900	2,075			
	d. Golden trevally	0	5,000	1,325			
3	Fish trash feed (kg year^{-1})	9,900	90,000	38,025	64,800	144,000	104,40
4	Labor (person year^{-1})	2	4	3	3	8	5.5

* 4 types of grouper.

The most significant investment costs in the finfish mariculture in Lampung Bay and Penerusan Bay are for cages and net cages, which represent more than 90% of the total investment in existing assets. The feed is the highest cost for the two study areas, comparing the average feed cost to the total cost for Lampung Bay at 32.53% and Penerusan Bay 51.63%. The use of feed for finfish mariculture in Penerusan Bay is more significant than in Lampung Bay. The main contributing factors are the number of fingerlings stored even though the pool size is the same, and the price of trash fish feed is lower (0.37 USD kg^{-1}). Low feed prices allow farmers to buy feed at any time as needed. Whereas for Lampung Bay, the price of fish trash feed is 1.01 USD kg^{-1}. The total variable cost to the total cost for mariculture finfish in Lampung Bay averages 81.82% and in the Penerusan Bay 95%. Fixed costs for the "tax" at the Penerusan Bay were not included because, at the time of the study, there was no annual taxation related to the existing facilities by the local government. That is because, in the last two years, there has been no policy "plan zones of coastal areas and small islands (RZWP3K)" throughout the coastal areas of North Bali so that the local government does not yet have basic rules for collecting taxes. The type of fish distinguishes production because each type has a different price. The production calculated in this study is the production in the last year. Farmers harvest partly because fish growth varies, so farmers grade the fish to separate the size of the fish with the same size or weight in one cage. Generally, the length of maintenance of groupers grows out ranges from 6 to 12 months, Asian sea bass for 7-8 months and pomfret fish and golden trevally 5-6 months. The maintenance time for finfish mariculture in both locations is relatively the same, but needless to say, it

will be different for other territorial waters or countries. In Vietnam, grouper growth ranged from 9 to 11 months (Dennis et al 2020) and reached 7 to 12 months in Malaysia (Shapawi et al 2019).

The total investment cost for finfish mariculture in Lampung Bay averages 21,518 USD unit^{-1} or 430.36 USD cages^{-1}, while in Penerusan Bay 24,650 USD unit^{-1} or 266 USD cages^{-1}. The findings of the analysis indicate that cost investment in Penerusan Bay is lower than in Lampung Bay. This difference is due to the use of wood or bamboo for cages and the type of buoy used, such as plastic drums (more expensive) than styrofoam buoys (cheaper). Total costs incurred for finfish mariculture in Lampung Bay averaged 20,798 USD unit^{-1} year^{-1} and for finfish mariculture in Penerusan Bay 77,348 USD unit^{-1} year^{-1}. Minimum revenue for finfish mariculture in Lampung Bay is 2,884 USD unit^{-1} year^{-1}, and maximum revenue is 51,758 USD unit^{-1} year^{-1} with an average value of 14,342 USD unit^{-1} year^{-1}. Whereas revenue for finfish mariculture in Penerusan Bay is higher than in Lampung Bay, with a minimum revenue of 51,758 USD unit^{-1} year^{-1}, a maximum revenue of 123,983 USD unit^{-1} year^{-1} and an average revenue value of 87,870 USD unit^{-1} year^{-1}. This revenue is based on the total production of all types of fish harvested during the past year (Table 3). From the analysis results, it is known that mariculture enterprise (finfish) in Lampung Bay is not profitable, with an average loss of -5,586 USD unit^{-1} year^{-1} or -112 USD cage^{-1} year^{-1}. Whereas finfish in Penerusan Bay has an average annual profit of 10,521 USD unit^{-1} year^{-1} or 114 USD cage^{-1} year^{-1} (Table 4).

To achieve a break-even point (BEP) per unit (kg), the finfish mariculture in Lampung Bay must be capable of producing 3,318 kg unit^{-1} year^{-1} or each cage must be capable to produce 66.36 kg cage^{-1} year^{-1}, but in reality, in Lampung Bay can only produce an average of 49.32 kg cage^{-1} year^{-1}. The findings of the analysis indicate that finfish mariculture in Lampung Bay is not feasible because of its poor economic performance, which is indicated by the negative profit value and the revenue cost ratio of 0.73. Revenue value ratio <1 demonstrates that the enterprise is not feasible to be carried out (Elly et al 2019; Basuki et al 2019). This result can be one of the predictors of why the amount of finfish mariculture production in the Lampung Bay has decreased sharply by 89% in the period of 2017-2018, from 4,514.47 tons to 476 tons (MMAF 2019). Losing businesses will certainly force companies to stop trying or switch to other livelihoods so that they can continue to meet their living needs (Baird & Gray 2014; Rai 2018). Different results were shown by finfish mariculture in Penerusan Bay, with an average profit value of 9,920 USD unit^{-1} year^{-1} or 107.24 USD cage^{-1} year^{-1}, with an average revenue cost ratio of 1.14.

The results showed that the condition of finfish mariculture in Indonesia, especially in the current study area is not as good as a few years ago, as the results of the study of Sajriawati et al (2019), in 2016 about finfish mariculture in Selayar archipelago regency, Indonesia has a revenue cost ratio of 1.88 and the results of research by Afero et al (2010), in 2009 in four finfish mariculture centers in Indonesia (including Lampung and Bali) ranged from 1.25 to 1.33. When compared with finfish mariculture in other countries such as in India, it can reach 1.46 (Aswathy et al 2012).

Table 3

Harvested yields of finfish mariculture (kg unit^{-1} year^{-1}) in Lampung Bay and Penerusan Bay, 2020

Commodity	*Unit*	*Lampung Bay*			*Penerusan Bay*		
		Min	*Max*	*Mean*	*Min*	*Max*	*Mean*
Hybrid grouper-Kerapu Cantik (*E. fuscoguttatus x E. macrodon*)	kg	-	1,186	297	1,056	1,440	1,248
Hybrid grouper/Kerapu Cantang (*E. lanceolatus x E. fuscoguttatus*)	kg	262	1,884	849	7,258	17,600	12,429
Grouper/Kerapu macan (*Epinephelus fuscoguttatus*)	kg	-	-	-	-	-	-
Asian sea bass/barramundi (*Lates calcarifer*)	kg	93	1,989	603	-	1,488	744
Grouper/kerapu sunu (*Plectropomus leopardus*)	kg	-	-	-	-	1,005	503
Silver pomfret/bawal Bintang (*Pampus argenteus*)	kg	96	1,936	584	-	-	-
Golden trevally/simba (*Gnathanodon specious*)	kg	-	464	133	-	-	-

Table 4

Profitability of finfish mariculture in Lampung Bay and Penerusan Bay, 2020

No	Item	Lampung Bay (USD year^{-1})			Penerusan Bay (USD year^{-1})		
		Min	Max	Mean	Min	Max	Mean
1	Assets*						
	a. Cage	32,140	235,712	120,540	140,004	200,252	170,128
	b. Net	24,301	138,604	81,230	45,717	82,852	64,290
	c. Boat	3,925	10,713	6,343	4,200	5,357	4,773
	d. Others	4,826	10,056	7,223	5,410	9,557	7,489
	Total Assets	65,202	388,455	215,325	196,487	296,862	246,669
2	Variable Cost*						
	a. Seed	1,15 (1.3)	13,727 (32.4)	3,601 (17)	16,342 (34)	28,665 (27)	22,503 (28)
	b. Feed	2,121 (24)	13,757 (32.6)	6,766 (33)	24,728 (52)	55,143 (52)	39,936 (52)
	c. Labor	4,629 (53)	7,303 (17)	5,812 (28)	4,886 (10)	16,153 (15)	10,519 (14)
	d. Others	544 (6)	1,195 (3)	837 (4)	477 (1)	592 (0.6)	535 (0.7)
	Total Variable Cost	7,409 (85)	35,983 (85)	17,016 (82)	46,434 (97)	100,553 (94.6)	73,493 (94.7)
4	Fix Cost*						
	a. Tax	65 (0.7)	429 (1)	204 (1)	-	-	-
	b. Maintenance Cost	161 (3)	629 (1.5)	417 (1.5)	429 (0.9)	996 (0.9)	713 (0.9)
	c. Depreciation cost	1,085 (12)	5,166 (12)	3,058 (15)	629 (1.1)	3,871 (4)	2,942 (4)
	d. Others	42 (0.5)	172 (0.5)	104 (0.5)	-	400 (0.5)	200 (0.3)
	Total Fix Cost	1,353 (15)	6,395 (15)	3,783 (18)	1,058 (2)	5,266 (5)	3,856 (5.3)
5	Total Cost*	8,763 (100)	42,378 (100)	20,798 (100)	47,491 (100)	105,819 (100)	77,348 (100)
6	Production[a]	451	7,459	2,466	8,698	21,149	14,923
7	Average Price[b]	6.07	6.62	6.35	5.87	5.95	5.91
8	Revenue*	2,884	45,287	15,213	51,758	123,983	87,870
9	Profit*	-5,878	2,910	-5,586	4,266	18,164	10,521
10	R/C Ratio	0.33	1.07	0.73	1.09	1.17	1.14
11	Break Event Point[c]	1,705	6,736	3,318	8,213	18,051	13,132

1 USD = IDR 14,000; Values in brackets represents percentages of cost; [a] The unit is kg year^{-1}; [b] The unit is USD kg^{-1}; [c] The unit is kg; * The unit is USD year^{-1}.

Impact of mariculture on households: direct impact on income. The household income structure consists of (1) income of respondents and family members derived from finfish mariculture and other income derived from non-mariculture activities. Laborers income consists of regular monthly income, consisting of basic salaries, food allowance incentives, and harvest bonuses, which may vary depending on the amount of fish harvested, ranging from USD 7 to USD 14 ton^{-1} person^{-1}. The average household labor income in Lampung Bay is lower than in Penerusan Bay (Table 5).

Table 5

Household income for laborers and owners in Lampung Bay and Penerusan Bay, 2020

Specification	*Lampung Bay*		*Penerusan Bay*	
	Laborer	*Owner*	*Laborer*	*Owner*
I. Income (USD year^{-1})				
a. Finfish mariculture	1,655 (88)	7,174 (86)	1,947 (94)	13,433 (98)
b. Other income	233 (12)	1,142 (14)	124 (6)	285 (2)
Total income	1,888(100)	8,316 (100)	2,071 (100)	13,718 (100)

The values in brackets represents percentages.

From the total value of income of farm household owners, the same thing also occurred, that the total income of farm household owners in Lampung Bay was lower than in Penerusan Bay. The results showed that the primary source of income for laborers and owners came from finfish mariculture. It indicates that the two households in both locations are highly dependent on finfish mariculture. Sources of household income from non-mariculture come from other household members, such as working wives, children's remittances, and other sources of work, such as motorcycle taxis, agricultural sales, and trading.

The previous section's discussion showed that finfish mariculture in Penerusan Bay was more cost effective than in Lampung Bay. Income for owners and laborers was also higher than of the households in Lampung Bay. The total household income of finfish mariculture laborer in Lampung Bay during the year is, on average, 1,888 USD or 157 USD month^{-1}, while laborers in Penerusan Bay achieve 2,072 USD year^{-1} or 173 USD month^{-1}. Some research findings indicate that large profits will have a positive impact on income and vice versa (Safina et al 2018; Kernalis et al 2019; Mulokozi et al 2020). Finfish mariculture in both study areas contributes a significant income (average of more than 80%) to total household income, making all household members highly dependent on finfish mariculture.

Impact of mariculture on households: direct impact on poverty. The household income will be spent for food, transport services, education for children, renting houses and buying vehicles. Somebody's expenditure is directly proportional to his income, and if his income is higher, the expenditure is also more significant or vice versa (Bunn et al 2018). Thus, the level of consumption is dramatically determined by the size of one's income. The composition of household food expenditure at both locations is higher than that of non-food expenditure, which ranges from 60 to 65% year^{-1}. Meanwhile, for household owners, food expenditure is lower than non-food expenditure, which is 42 to 46% year^{-1} (Table 6). It is also consistent with Engel's proposition, when income is low, the share of total food expenditure is higher (Paulin 2008; Yusof & Duasa 2010). The pattern of food and non-food expenditure is influenced by the size of the revenue (Kirkpatrick & Tarasuk 2003; Haq et al 2009). Food and non-food expenditure patterns are indicators of household welfare; households with higher expenditure on non-food consumption than on food can be said to have wealthier households (Paul et al 2014; Jovanovic 2016).

Table 6

Household expenditure for laborers and owners and Engel's coefficient in Lampung Bay and Penerusan Bay

Specification	*Lampung Bay*		*Penerusan Bay*	
	Labor	*Owner*	*Labor*	*Owner*
I. Expenditure (USD year^{-1})				
a. Food	833 (65%)	2,602 (46%)	1,314 (60%)	4711 (42%)
b. Non Food	444 (35%)	3,079 (54%)	849 (40%)	6,436 (58%)
c. Total Expenditure	1,277 (100%)	5,681 (100%)	2,163 (100%)	11,147 (100%)
II. Engel's Coefficient*	65.23%	45.79%	60.77%	42.26%

*According to the United Nations Food and Agriculture Organization (FAO) proposed standards, Engel's coefficient of more than 59% in poverty, 50-59% for food and clothing, 40-50% for a well-off, 30-40% for rich and less than 30% for the most affluent.

Based on the standard Engel's coefficient, according to the FAO, labor households in both study areas are in the category of "poverty" or poor with Engel's coefficient of both more than 59%. However, this is the status obtained using the household expenditure approach. To strengthen empirical evidence of the impact of mariculture on poverty, it is also carried out using the income approach. The household income of finfish mariculture labor is compared to the regional minimum wages (RMW) value. RMW is the minimum income received by every individual and as a benchmark for citizens' prosperity. RMW in Indonesia is determined based on the Ministry of Manpower Number circular B-M/308/HI.01.00/X/2019. RMW rates in thirty-four provinces in Indonesia concluded by the Governor in each Province and applied to all formal sectors. RMW can also be a benchmark to find out whether working on finfish mariculture is better than in other occupations (Nababan et al 2020). Total laborers household income in the both study areas is lower than the RMW value prevailing in the region (Figure 3). The ratio of mariculture labor income to RMW is presented in Table 7.

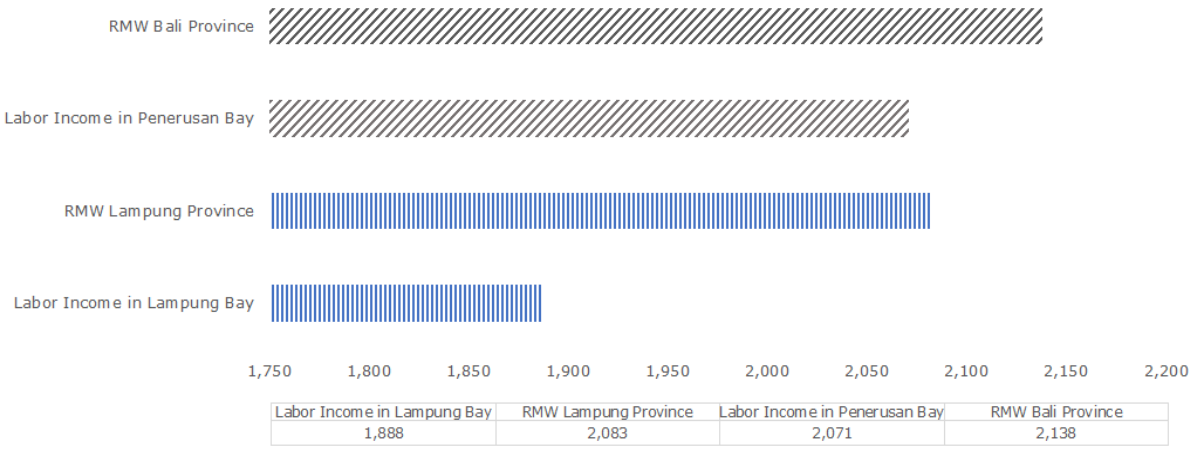

Figure 3. Mariculture laborer income and regional minimum wages (USD year^{-1}) in study areas, 2020.

Table 7

The ratio of laborer income to regional minimum wages (RMW), 2020

Variables	*Lampung RMW 2,083 USD year^{-1}*	*Bali PMW 2,138 USD year^{-1}*
Income from finfish mariculture	0.79	0.91
Income from finfish mariculture and other activities	0.91	0.97

The results of this analysis indicate that the comparison of labor income in the both study areas with RMW has a ratio of less than one (<1). This value reflected that labor income at finfish mariculture is insufficient to meet the needs of a decent life (prosperity). Being mariculture labor in the study areas does not have an impact on improving welfare, because both are still in the category of "poor" or the income received is still not sufficient for a decent living (lower than the regional minimum wages).

Conclusions. The current condition of finfish mariculture may not always be profitable for the owner. It is shown by an analysis of the profitability of finfish mariculture in Lampung Bay, Lampung Province, which has suffered losses. Thus, profitable mariculture enterprise is vital to provide better income for owners and laborers since there is high dependency on mariculture. However, the results of the analysis have shown that mariculture in both study areas has not yet had an impact on reducing poverty or improving household welfare in terms of the economy (income and expenditure). One reason for this is the low income earned as finfish farm workers. Income as mariculture labor is generally still below the regional minimum wage value. The Indonesian government should be particularly concerned about imposing minimum wage rules on mariculture in all its regions. Low income may be one reason why it is not essential to work in mariculture. In the future, it could be a challenge to achieve the priority objectives of mariculture development programs in Indonesia due to a lack of attractive community work in the mariculture sector.

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Authors:
Maulana Firdaus, Tokyo University of Agriculture, Graduate School of Agriculture, Department of Agribusiness Management, Japan, Tokyo; Indonesian Ministry of Marine Affairs and Fisheries, Research Centre for Marine and Fisheries Socio-Economic, Indonesia, Jakarta, e-mail: 46719401@nodai.ac.jp
Katsumori Hatanaka, Tokyo University of Agriculture, Graduate School of Agriculture, Department of Agribusiness Management, Japan, Tokyo, e-mail: k3hatana@nodai.ac.jp
Ramadhona Saville, Tokyo University of Agriculture, Graduate School of Agriculture, Department of Agribusiness Management, Japan, Tokyo, e-mail: sr203424@nodai.ac.jp

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