



# Profit levels and aquaculture ownership structure before and during the covid-19 pandemic in Maninjau Lake, West Sumatra Province, Indonesia

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**Abstract.** This study aims to determine the profit level of business-scale fish cultivators and changes in the ownership structure of aquaculture businesses before and during the pandemic in Maninjau Lake. The method used is a survey method. Primary data collection was carried out by oral and telephone interviews with cultivators and key informants. The number of respondents was determined intentionally by considering the representativeness of the population, time, and research costs. The analytical approach uses the cost and income method as well as frequency, average, and percentage analysis. The results of the study show that the COVID-19 pandemic has caused a decrease in the level of profit for aquaculture businesses. In 2020, micro-scale fish cultivators experienced a greater decline in profit levels compared to other businesses. The same happened in 2021. This situation caused a decrease in the number of micro and small-scale fish cultivators, while medium and large-scale fish cultivators have not changed. However, the number of Floating Net Cage (FNC) plots for medium and large scale cultivators has increased. The increase in the number of FNC plots for medium and large scale fish cultivators has led to changes in the structure of business ownership. Before the pandemic, the percentage of small and micro-scale FNC business ownership was 79% and during the pandemic it was reduced to 71%. On the other hand, the ownership structure of medium and large-scale fish cultivators during the pandemic increased from 21% to 29%.

**Key Words:** business scale, cost, fish cultivator, FNC, income.

**Introduction.** Covid-19 is a virus that attacks the respiratory tract and can cause death. The virus is capable of spreading rapidly, as infected patients are highly contagious (Heymann et al 2020). This situation results in high mortality rates in various countries. This high mortality rate is caused by two factors, namely internal factors such as age and disease history and external factors such as environmental conditions and quality, as well as handling of covid-19 (Ilpaj & Nurwati 2020). According to WHO (2020), the COVID-19 pandemic was found in 223 countries, with many people infected, with a relatively high mortality rate. Moreover, in Indonesia there are many cases, also with an alarming death rate (Ministry of Health of the Republic of Indonesia 2021).

To suppress the high spike in the COVID-19 pandemic, the government has implemented a large-scale social restriction policy starting April 2020 for school activities, social restrictions in public places, transportation, and others. The business fields that are not limited are the fields of health, food, energy, communication and information technology. Furthermore, the Covid-19 outbreak continues to increase in Indonesia, so the government makes stricter policies in the form of restrictions on community emergency activities since early July 2021. These restrictions are stricter than before, such as blocking gates between cities and provinces, either by land, sea, or by sea. and air (Kompas Pedia 2021). As a result of these various restrictions, Indonesia's economic growth decreased by 2.07% in 2020 (BPS 2021). Also, The economy in other parts of the world also experienced a drastic decline in the first year of the pandemic. The IMF

estimates that the negative impact of the global economy will decrease by 3% (Iskandar et al 2020).

The economic impact of COVID-19 will halt the economic efforts of nearly 24 million people in East Asia and the Pacific, while nearly 35 million people will remain in poverty; the number of people living in extreme poverty will increase to 922 million worldwide (World Bank 2020). One of the sectors affected by COVID-19 in various parts of the world is the fisheries sector, including the aquaculture sector. According to FAO (2020a), the COVID-19 crisis has affected the aquaculture value chain and halved the demand for fish, thereby disrupting the aquaculture supply chain system in Bangladesh. Rafiquzzaman (2020) explained that the COVID-19 pandemic also had an impact on reducing consumption, cancelling export orders, falling prices, and delaying summer stocks in Bangladesh.

According to the European Commission (2021), fish are not harvested in EU countries and remain in the water due to reduced sales of certain species due to the COVID-19 pandemic. Ghana's fishing sector, which was developing well before COVID-19, also experienced a decline due to reduced demand for tilapia due to the closure of the tourism and hotel industries. This crisis has reduced the income of the aquaculture sector and led to a decline in production. Most fish cultivators surveyed are affected by disturbances in input and output markets (Ragasa et al 2021). Furthermore, in Malaysia, COVID-19 has resulted in reduced domestic and global demand for capture fisheries and aquaculture products (Waiho et al 2020). According to FAO (2020b), in 2018, global fisheries and aquaculture production reached an all-time high, with the aquaculture sector accounting for 46% of the world's fisheries, with a total production of 82.1 million tonnes.

The COVID-19 pandemic in general has affected the Indonesian economy, as stated by Nasution et al (2020) and Hadiwardoyo (2020). One of the sectors affected by the COVID-19 pandemic is the fisheries sector, including the aquaculture sector. According to the KKP (2021), the COVID-19 pandemic has resulted in a decrease in demand for various fishery products. This situation resulted in a 20-30% decrease in fish and shrimp prices. Wahidin et al (2020) stated that the COVID-19 pandemic caused the price of tilapia to drop significantly by 15.79% in Lubuk Linggau City. One of the largest aquaculture centers in Indonesia is located in Maninjau Lake, West Sumatra Province in the form of a floating net cage (KJA) business (Sulaiman et al 2020). As is the case with various foreign and Indonesian regions, The aquaculture sector in this area is thought to have been affected by the COVID-19 pandemic. Based on this, this study will analyze the level of profit and ownership structure of aquaculture business in Maninjau Lake.

**Material and Method.** This research was carried out from March to July 2021 at Maninjau Lake which is administratively included in the Tanjung Mutiara District, Agam Regency, West Sumatra Province, Indonesia. The method used in this study is a survey method (Groves et al 2011). Survey research uses a sample of one population and uses a questionnaire as the main data collection tool.

Primary data was collected by conducting direct interviews with 30 respondents and telephone interviews with 35 respondents using a patterned questionnaire. Furthermore, data from key informants such as fish traders, feed sellers, village heads, farmer group leaders and other stakeholders were collected by telephone. Telephone interviews are used because they are very helpful during the COVID-19 pandemic and are relatively inexpensive.

To assess the impact of the COVID-19 pandemic on aquaculture businesses, FNCs are grouped into micro-scale businesses with a total of less than 10 plots, small-scale with a total of 10-20 plots, medium-scale with a number of 20-60 plots and large-scale with a number of more than 60 plots. The number of fish cultivator respondents was determined intentionally by considering population representation, time, and research costs. 25 people represented the respondents of micro and small scale fish FNC plots, 10 medium scale fish FNC plots, and 5 large scale fish FNC plots.

Collected data such as production inputs, costs, number of FNC plots, total production and others are tabulated and analyzed quantitatively and qualitatively.

Quantitative analysis was carried out on fish cultivators using the method of cost and income analysis (Beattie et al 2009). Quantitative analysis refers to the frequency, average and percentage of FNC production, revenue, profit and number of plots. Secondary data were collected from reports from the Agam Fisheries Service, reports from UPTD Agam, and reports from farmer group leaders in several villages.

## Results and Discussion

**General condition of Maninjau Lake.** Maninjau Lake is a volcanic lake with a water surface area of 9737.5 ha, with a water volume of 10.23 km<sup>3</sup>, and a maximum depth of 165 m; the circumference of the lake is 75 km (IIS 2007). The surrounding environment is connected to the lake by road with relatively good conditions, so that the accessibility of the community around Maninjau Lake is relatively good. In general, this lake has three functions, namely ecological, social and economic functions. Its ecological function is represented by its role as habitat for organisms, control of groundwater balance, and control of microclimate. Social functions include a place for people to bathe, wash clothes and provide a beautiful view. Economic functions include water sources for irrigation, fisheries, fish cultivation with floating net cages, and tourism; the largest economic function is as a power plant that produces an annual average of 205 MW of energy (Asnil et al 2013). In addition to fishing activities, Maninjau Lake is the largest aquaculture center in Indonesia through the floating net cage business (Sulaiman et al 2020).

According to Mustaruddin et al (2018), the high economic activity around Maninjau Lake has created new problems, making the lake a place for various wastes to be released. According to Nontji (2016), cultivation, settlement, and agriculture around the lake are sources of solid waste with the amount of discharge into Maninjau Lake reaching 393.22 tons year<sup>-1</sup>, 7.55 tons year<sup>-1</sup>, and 5.08 tons year<sup>-1</sup>, respectively. The Research Institute for Fish Resource Recovery (2016) stated that the decline in the quality of lake waters due to these various economic activities has caused mass fish deaths in recent years. One of the causes of mass death is pollution due to the uncontrolled growth in the number of FNCs (Billova & Mubarak 2020). According to the Agam District office report, The aquaculture business in this area was started in 1992 with a total of 12 lots. In 2019, it has reached 17417 lots (MAFS Agam 2020). The high growth rate of this FNC has exceeded its carrying capacity of only 6000 lots (LIPI 2014). This situation has led to several incidents of mass fish deaths in this lake. He further explained, although mass deaths continue to occur, the FNC business in this area continues to grow, because the aquaculture business in this area provides very large profits. According to Hendrik (2014), aquaculture business in Maninjau Lake provides greater profits, with an average food conversion ratio (FCR) of 1.29 when compared to the same business at the Koto Panjang PLTA Waduk Koto Panjang, with an average FCR of 1, 76. According to information from fish cultivators, after a period of mass mortality, the FCR of cultivation in the area was only 1.02, with larger profits received by farmers.

**Aquaculture business before the covid-19 pandemic.** The aquaculture business in Maninjau Lake is growing very rapidly. The growth of aquaculture business from 1999 to 2008 was 527% and was the highest growth compared to other lake aquaculture growth in Indonesia (Sulaiman et al 2020). Furthermore, from 2013 to 2019, aquaculture growth in this lake was 22%. In 2019, the number of FNCs reached 17569 lots (MAFS Agam 2020). The number of owners in the same year was 1606 people, with the number of plots per cultivator ranging from 4 to 210 lots. There were 768 micro-scale fish FNC plots, 786 small-scale fish FNC plots, 40 medium-scale fish FNC plots, and 12 large-scale fish FNC plots. The number of KKP for micro-scale fish farming is 3816 plots, the number of KKP for small-scale fish farming is 10133 plots, the number of MPAs for medium-scale fish farming is 1604 plots, and the number of MPAs for large-scale fish farming is 2016 plots (MAFS Agam 2020). Based on these data, it can be concluded that the percentage of micro and small scale FNC plots is 79%, while the number of medium and large scale plots is 21%. The division of the aquaculture business scale into these four groups is in accordance with the Regulation of the Minister of Marine Affairs and Fisheries of the

Republic of Indonesia Number Per.05/Men/2009 concerning Business Scale in the Fish Cultivation Sector.

The average FNC plot size is 5x5 m, with a depth of 4 m. The smallest FNC business unit has 4 plots. According to the cultivators, for each unit of FNC with 4 plots, the cost of manufacture ranges from 1724 to 2207 USD with an average cost of 1931 USD. The analysis of aquaculture business in this study uses cost and income analysis of one FNC plot as the unit of analysis. In the analysis of the FNC business, several assumptions are used, such as harvesting 2 times a year and the economic life of the FNC of 5 years. The wages of labor for each FNC plot are the same, so that the depreciation cost for each harvest is 48 USD. According to the fish cultivators, at each harvest, the average labor wage for one FNC plot is 166 USD. Use of other variable inputs such as seeds and other costs are the same for each scale of business. The price of 2-2.5 cm tilapia seed is 1 cent per head and the price of feed for each 50 kg sack is 32 USD on average. The average price of fish is 1.65 USD per kg. Based on this data, the costs and benefits of micro, small, medium and large scale aquaculture businesses are calculated before the pandemic (Table 1).

Table 1  
Average profit for micro, small, medium and large scale fish farming in 2019

Not	Information	Enterprise scale							
		Micro		Small		Intermediate		Big	
		Physique	USD	Physique	USD	Physique	USD	Physique	USD
1	Feed (sack)	26	825	30	952	34	1079	35	1110
2	Fry	10000	103	10000	103	10000	103	10000	103
3	Labor	20	166	20	166	20	166	20	166
4	Other costs		69		69		69		69
5	Depreciation		48		48		48		48
6	Total cost		1.211		1.338		1.465		1.497
7	Production (kg)	1040		1153		1259		1286	
8	Income		1721		1908		2084		2129
9	Profit		522		570		619		632
10	Number of plots	5		13		42		170	
11	Annual harvest	10		26		84		340	
12	Annual profit		5221		14833		51999		217639

Based on Table 1, it is known that the level of profit for each FNC plot is different between micro, small, medium and large enterprises, with larger business scales bringing higher profits for each plot. This is related to the amount of feed provided, where large-scale fish farms provide more feed than small-scale fish farms. According to Amalia et al (2018), feed is the biggest cost in fish maintenance, usually around 60-75% of the total production cost.

This aquaculture business has a fairly high cost, especially for the manufacture of FNC and the purchase of feed. 12% of micro-scale fish FNC plots cooperated with capital owners, while 40% of small-scale fish FNC plots collaborated with capital owners. 80% of the medium-scale fish FNC plots cooperate with the capital owners, while the large-scale fish FNC plots act as capital owners and as feed distributors in the area. The profit-sharing system provides 60% of profits for fish farming and 40% for owners of capital. According to respondents, the business is sufficient to meet their daily needs. Even medium and large scale fish farms can increase their investment from their FNC business.

**Aquaculture business during the covid-19 pandemic.** Aquaculture business during the pandemic is divided in this study into the period of 2020 and 2021. In 2020, the price of tilapia is 1.44 USD per kg and the price of feed is 32.75 USD per sack (50 kg). In 2021, the price of tilapia will increase to 1.58 USD per kg and feed price to 33.79 USD per sack. The price of seeds, labor costs, other costs, and depreciation are the same

before the pandemic as in 2020 and 2021 at 386 USD. In this study, the previous costs were the names of non-feed costs. Changes in fish prices and changes in feed prices cause changes in the level of profit for 2020 and 2021. The details of the profit level of fish farming in 2020 can be seen in Table 2.

Table 2

Average profit of micro, small, medium and large scale fish farming in 2020

Not	Information	Enterprise scale							
		Micro		Small		Intermediate		Big	
		Physique	USD	Physique	USD	Physique	USD	Physique	USD
1	Feed (sack)	23	753	28	917	32	1048	33	1081
2	Non-feed costs		386		386		386		386
3	Total cost		1140		1303		1434		1467
4	Production (kg)	920		1076		1185		1213	
5	Income		1332		1558		1716		1757
6	Profit		193		255		282		290
7	Number of plots	5		13		50		198	
8	Annual harvest	10		26		100		396	
9	Annual profit		1928		6627		28172		114649

In 2021, feed prices will increase again by 3.1% and fish prices will also increase by 9.5% compared to 2020. The high increase in fish prices compared to feed prices has led to an increase in farmers' profits compared to the previous year. (Table 3).

Based on Table 3, it is known that the profit level in 2021 is lower than before the pandemic (Table 1). In 2021, the profit rate of micro-scale fish farming will decrease by 50.34%, small-scale by 33.29%, medium-scale by 12.56%, and large-scale by 22.37% compared to the profit level before the pandemic. The decline in the profit rate of fish cultivators after the pandemic has led to a 20% reduction in micro-scale fish farming and by 4% in small-scale fish cultivators by 2020. By 2021, the number of micro-scale fish cultivators will decrease by 10% and small-scale fish cultivators by 4 % compared to 2020. According to micro-scale fish cultivators, this is because the profits from aquaculture are no longer sufficient to meet the needs of daily life, so there is no longer any funding for further cultivation. Micro-scale fish cultivators who carry out aquaculture activities obtain capital for operational costs partly from bank loans and partly from loans from other parties such as families. However, the number of FNC plots for micro and small-scale fish farming did not change compared to before the pandemic. On the other hand, the number of medium and large-scale fish FNC plots did not change before the pandemic, and during the pandemic the number of plots of ownership increased. The number of FNC plots for medium-scale fish farming increased 19% and for large-scale fish farming increased 16.5% in 2020.

The COVID-19 pandemic resulted in a decrease in the number of floating net cages (KJA) in Maninjau Lake by 5.59% in 2020 and 5.23% in 2021. The decrease in the number of cages was relatively small when compared to similar businesses in other areas. The decrease in the number of floating net cages in the PLTA Koto Panjang Reservoir in the same year was 13.37% (Hendrik et al 2021). This relatively small reduction in the number of FNCs illustrates that the demand for fish in Maninjau Lake is still relatively high when compared to the demand for fish from the PLTA Koto Panjang reservoir. According to traders, fish from this area has a better taste than fish from other regions, so the demand is relatively constant during the pandemic. 50% of Maninjau Lake fish are marketed to Riau Province, 40% are marketed to West Sumatra Province, and the rest to other areas. Based on the marketing area, it can be said that the demand for tilapia in West Sumatra and Riau during the pandemic, especially from Maninjau Lake was relatively constant. This is presumably because the impact of the pandemic on the

economy of the two regions is relatively small. In addition, the high demand for fish is also influenced by the income of the people in the area. Community income can be seen from its GRDP, where for the Province of West Sumatra the agricultural sector is the largest contributor, relatively stable during the pandemic (Taifur 2020).

Table 3

Average net income of micro, small, medium and large scale FNC fish farming in 2021

Not	Information	<i>enterprise scale</i>							
		<i>Micro</i>		<i>Small</i>		<i>intermediate</i>		<i>Big</i>	
		<i>Physique</i>	<i>USD</i>	<i>Physique</i>	<i>USD</i>	<i>Physique</i>	<i>USD</i>	<i>Physique</i>	<i>USD</i>
1	Feed (sack)	20	676	25	845	30	1014	32	1081
2	Non-feed costs		386		386		386		386
3	Total cost		1062		1231		1400		1468
4	Production (kg)	833		1016		1153		1174	
5	Income		1321		1612		1829		1862
6	Profit		259		381		429		395
7	Number of plots	5		13		53		214	
8	Annual harvest	10		26		106		428	
9	Annual profit		2592		9894		45463		168898

Likewise with Riau Province, according to BPS Riau (2021), the agricultural sector is the second contributor to GRDP after the processing industry. This sector continues to grow amidst the pandemic. especially from Maninjau Lake is relatively constant. This is presumably because the impact of the pandemic on the economy of the two regions is relatively small. In addition, the high demand for fish is also influenced by the income of the people in the area. Community income can be seen from its GRDP, where for the Province of West Sumatra the agricultural sector is the largest contributor, relatively stable during the pandemic (Taifur 2020). Likewise with Riau Province, according to BPS Riau (2021), the agricultural sector is the second contributor to GRDP after the processing industry. This sector continues to grow amidst the pandemic. especially from Maninjau Lake is relatively constant. This is presumably because the impact of the pandemic on the economy of the two regions is relatively small. In addition, the high demand for fish is also influenced by the income of the people in the area. Community income can be seen from its GRDP, where for the Province of West Sumatra the agricultural sector is the largest contributor, relatively stable during the pandemic (Taifur 2020). Likewise with Riau Province, according to BPS Riau (2021), the agricultural sector is the second contributor to GRDP after the processing industry. This sector continues to grow amidst the pandemic. Community income can be seen from its GRDP, where for the Province of West Sumatra the agricultural sector is the largest contributor, relatively stable during the pandemic (Taifur 2020). Likewise with Riau Province, according to BPS Riau (2021), the agricultural sector is the second contributor to GRDP after the processing industry. This sector continues to grow amidst the pandemic. Community income can be seen from its GRDP, where for the Province of West Sumatra the agricultural sector is the largest contributor, relatively stable during the pandemic (Taifur 2020). Likewise with Riau Province, according to BPS Riau (2021), the agricultural sector is the second contributor to GRDP after the processing industry. This sector continues to grow amidst the pandemic.

Although the demand for fish from Maninjau Lake is relatively constant, the profits obtained by farmers have actually decreased post-pandemic. The largest percentage decrease in profits was experienced by micro-scale fish FNCs. As many as 28% of micro-scale fish FNC respondents stopped their business during the pandemic because their profits were reduced by 50.34%. This situation caused a lack of funds to invest and continue the business. According to Edwards (2000), micro and small scale fish FNC plots have difficulty increasing their productivity due to limited capital, technology, market information, and low capacity and ability to gain access to finance. During the pandemic,

the government lowers interest rates and makes lending easier (Regulation of the Coordinating Minister for the Economy of the Republic of Indonesia 2020). This opportunity is only utilized by 20% of micro-scale fish cultivators and 30% of small-scale fish cultivators. On the other hand, about 60% of medium and large scale fish cultivators take advantage of this opportunity. According to the medium and large-scale fish FNC plots, their investment in additional FNC comes from profits and capital loans from the government at low interest rates. It was further explained that investment in the aquaculture sector was more profitable than investment in other sectors, so the number of FNC plots continued to grow during the pandemic.

The decrease in the number of micro and small-scale fish FNC plots and the increase in the number of medium and large-scale FNC plots have resulted in changes in the ownership structure of aquaculture businesses in Maninjau Lake. In 2019, 1,554 micro and small scale fish cultivators controlled 79% of the total FNC plots, while 52 medium and large scale fish cultivators controlled 21% of the total FNC plots. In 2021, the number of micro and small-scale fish cultivators decreased to 1276 people who controlled 71% of FNC plots and medium and large-scale fish cultivators did not experience a change in the number of cultivators but the number of FNC plots increased to 29%. Based on this, it can be interpreted that the COVID-19 pandemic, in addition to reducing the profit level of fish cultivators, also changed the ownership structure of FNC plots.

To address the problem of inequality, the government and various stakeholders must make clearer rules regarding the maximum number of medium and large business units that can be owned, with stricter supervision. The Government of Agam Regency has issued Agam Regency Regional Regulation Number 5 of 2014 concerning Management of the Sustainability of the Maninjau Lake Area, which is related to the carrying capacity and capacity of the number of floating net cages that can be cultivated. However, this regulation has not yet been implemented by the government, presumably because it relates to various interests such as owners of capital, entrepreneurs, and the community in relatively large numbers. According to Ardieansyah et al (2020), the government must involve religious leaders, traditional leaders, and community leaders in carrying out activities,

**Conclusions.** This study concludes that the covid-19 pandemic has caused a decrease in the profits of micro, small, medium and large scale aquaculture businesses in Maninjau Lake. The highest profit reduction was experienced by micro-scale fish FNC plots and the lowest percentage profit was experienced by large-scale fish FNC plots. The profit of aquaculture business in 2020 is smaller than the profit in 2021. This decrease in profit has caused a decrease in the number of micro and small-scale fish cultivators, but the number of FNC plots they own has not changed. The number of medium and large-scale fish cultivators did not change, but the number of FNC plots owned by each increased during the pandemic.

**Acknowledgements.** The authors would like to thank the Faculty of Fisheries and Marine Affairs, University of Riau and the Department of Fisheries and Marine Affairs, Agam Regency, West Sumatra Province for supporting this research.

**Conflict of Interest.** The authors declare that there is no conflict of interest.

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Received: 18 November 2021. Accepted: 03 March 2022. Published online: 16 July 2022.

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How to cite this article:

Hendrik, Hendri R., Syahrul, Yulinda E., 2022 Profit levels and aquaculture ownership structure before and during the covid-19 pandemic in Maninjau Lake, West Sumatra Province, Indonesia. *AAFL Bioflux* 15(4):1703-1711.