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Original Research

Urban Farming Aquaculture as an Alternative Business for Food and Economic Security During the COVID-19 Pandemic – Case Study in the Sub-Urban Area of Jakarta, Indonesia

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Abstract

The study of urban farming aquaculture, which was conducted in the sub-urban area of Jakarta (Jakarta, Bogor, Depok, Tangerang, and Bekasi) during 6 months from July to December 2022, is to find out the most prospective urban farming aquaculture business model for food and the economy security during the Covid 19 pandemic. The data was collected through direct survey from the field and the result from interviews with 200 respondents of fish farming groups of consumption and ornamental fish, as well as using the result from filling out the questionnaire on the Google form and secondary data from the Central Bureau of Statistics (CBS), The primary data was then analyze using quantitative descriptive methods and ANOVA, and the secondary data using graphs. Urban farming aquaculture can be developed to strengthen food and economic security during and after the Covid 19 pandemic. The result shows that to improve food security, Tilapia and Catfish business model of CF-3 and CF-2 of consumption fish and to improve the economy security, Manfish, Goldfish, Guppy and Siamese fighting fish Business Model of OF-1, OF-2, OF-4 and OF-5 of ornamental fish, can be applied to achieve the target. Urban farming aquaculture business in the sub-urban area of Jakarta are mainly carried out by the community with education ranging from elementary school to college. To solve the socio-economic problems of urban communities in sub-urban Jakarta, urban farming aquaculture, based on the observations result, has good prospects as an alternative business to improve food security

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and the economy.

Keywords: urban farming aquaculture, alternative business, COVID-19 pandemic, sub-urban area of Jakarta, Indonesia

Introduction

The world population in 2030 is estimated to reach 7.4 billion; in 2050, it will reach 8.5 billion. Then the people of Indonesia in 2035 will increase from 271,066,400 in 2020 to 305,652,400 in 2035, and in 2045, which is 100 years of independence, it is estimated to be 319 million [1, 2]. Meanwhile, Sub-Urban Jakarta, which includes the cities of Jakarta, Bogor, Depok, Tangerang, and Bekasi, is a megapolitan area in Indonesia with an area of 6,437.89 km^2 or only about 0.34% of the total area of Indonesia, which is 1,916,906.77. km^2. However, based on data released by the government through the Regulation of the Minister of Home Affairs Number 72 of 2019 concerning Amendments to the Regulation of the Minister of Home Affairs Number 137 of 2017 concerning the Code and Data of Government Administration Areas, the Sub-Urban Jakarta has a population of 29,116,662 people or about 11% of the Indonesian population. It is one of the most densely populated areas in Indonesia, so the average population density in Sub-Urban Jakarta is 4,523 people/km^2, with the highest population density in Central Jakarta City at 21,870 people/km^2.

The COVID-19 pandemic has caused serious worldwide health issues [3-5] by enforcing lockdown and movement restrictions [6, 7] which resulted in extensive socio-economic impacts [8, 9] and a politico-economic crisis [10, 11] as side effects. The COVID-19 pandemic has seriously affected the livelihood of farmers and fishers involved in aquaculture and fishing activities across the globe [12-18]. Fisheries-related activities were severely affected due to the COVID-19-related lockdown in India [19, 20]. The COVID-19 pandemic that occurred in Indonesia has brought many significant impacts on various aspects of people's lives in the form of negative effects on socio-economic life and an increase in unemployment due to the termination of employment (ToE). The impact of this is really felt in the city of Jakarta and its surroundings, which are sub-urban areas. Jakarta is a metropolitan city surrounded by a sub-urban area known as Jabodetabek which is an acronym for the Jakarta-Bogor-Depok-Tangerang-Bekasi area. This area covers the administrative areas of Jakarta Province, Tangerang Regency and Tangerang City (Banten Province), Depok City, Bogor City, Bogor Regency, Bekasi City and Bekasi Regency (West Java Province).

Moreover, the increasing population growth in the Sub-Urban Area of Jakarta and the decreasing in agricultural area due to increasing development, settlements, and industry have led to a reduction of agricultural production area, which will threaten the food security of urban communities. To increase economic resilience, anticipate food crises, and ensure food availability during a pandemic, people in urban areas have been encouraged to develop urban farming, one of which is urban farming aquaculture, by utilizing the narrow area in their settlements [21].

Urban farming is defined as growing, processing, and distributing food and other products through intensive cultivation of crops and livestock/fisheries in urban and surrounding areas [22-25]. Urban farming is utilizing unproductive open space, such as vacant land, as an alternative activity for urban community activities to improve the quality and quantity of open space in big cities [26, 27]. Urban farming has a worldwide presence in the diversity of agricultural systems. It has provided opportunities for increasing food supply, improving health conditions, enhancing local economies, social integration, and overall environmental sustainability [28-30].

Along with the increasing population growth in urban areas, the existence of urban farming aquaculture is expected to help improve the community's welfare, strengthen the national economy and solve the problem of the need for animal protein food from fish both during and after the COVID-19 pandemic. The COVID-19 pandemic that has occurred in Indonesia has had a significant impact on various aspects of people's lives. Policies during the pandemic, such as Work from Home (WFH) and Large-Scale Social Restrictions (LSSR), also negatively impact the community's socioeconomic life, including the most basic needs related to the problem of food supply. On the other hand, agricultural land continues to decrease for development purposes, and the age of farmers, who are on average old age with declining farming skills, also plays a role in the decline in food production. The food crisis threat is slowly starting to haunt the entire community. Based on data from Global Hunger Indonesia (GHI), the level of public hunger in Indonesia is in a severe category, although it has decreased from 24.9% (2010) to 20.1% in 2019. Information about the benefits of urban farming aquaculture as an alternative business that can help urban communities meet their food needs for animal protein and increase their income, especially during the COVID-19 pandemic in the Jabodetabek area, which is a sub-urban area of the city of Jakarta, is very limited. For this reason, this research is expected to be able to fill the information gap and provide an alternative business solution that urban communities can develop with limited land and capital resources, especially during the COVID-19 pandemic and other economic crises.

Material and Methods

Data Collection

To find out the performance, actors and characteristics of aquaculture urban farming in the Jakarta sub-urban area, a field survey was carried out to collect primary data from urban aquaculture business actors who are members of a business group known as POKDAKAN. Data collection was carried out for 6 months in July-December 2022 in the Jabodetabek area (Jakarta, Bogor, Depok, Tangerang and Bekasi) which is the Jakarta sub-urban area (Fig. 1). The method used in this research is a quantitative descriptive method. Primary data were obtained from filling out questionnaires with Google forms and direct interviews. The number of respondents who were interviewed and filled out the Google form was 200 respondents with the distribution as shown in Table 1. The Bogor City and Bogor Regency areas were combined into one Bogor area. Likewise, Tangerang City and Tangerang Regency were merged into one Tangerang area. Bekasi City and Bekasi Regency were merged into one Bekasi area. The reason for the merger is because the main target of urban farming aquaculture is urban (city) areas in the Jabodetabek, a sub-urban area of Jakarta. For this reason, only a few districts that have administrative areas representing urban (city) systems are taken for the data. The number of respondents for data collection is determined by the Slovin formula [31] as follows:

$$n = N/(1 + Ne^2)$$

Notes:
n: minimum number of respondents
N: number of respondents in the population
E: error tolerance limit (error)

Urban farming aquaculture data collected includes data on species of fish commodities, type of business, types of media, rearing period, size of fish product, fish production per cycle, selling prize of fish product, production costs per kg of consumption fish or per head of ornamental fish, total production cost per cycle and per unit, gross income per cycle and net income per cycle. These data are then grouped into consumption fish business models (CF Model) and ornamental fish business models (OF Model). To support this study, the education level of the fish farmer of the urban farming aquaculture, as well as the secondary data on the labor and socio-economic conditions both before and during the pandemic of COVID-19, data of poverty rates,

Fig 1. Map of Sub-Urban Areas of Jakarta (Jakarta, Bogor, Depok, Tangerang, Bekasi), Indonesia.

Table 1. Number of Respondents for Urban Farming Aquaculture in the Jabodetabek Sub-Urban Area of Jakarta.

No	Jabodetabek Region	Number of Urban Farming Aquaculture Groups		Number of Respondents Based on Slovin Magin error 5%	
		Consumption Fish	Ornamental fish	Consumption Fish	Ornamental fish
1	Jakarta	34	28	33	21
2	Bogor	22	10	21	10
3	Depok	21	19	20	18
4	Bekasi	46	32	24	13
5	Tangerang	23	14	22	14
	Amount	146	103	120	80

per capita income of Indonesian people, unemployment and layoffs were collected from the Central Bureau of Statistics (CBS) and various related sources. The data on the development of consumption fish and ornamental fish were collected from the Food Security Service and Fisheries Service in the sub-urban areas of Jakarta (Jakarta, Bogor, Depok, Tangerang, Bekasi).

Data Analysis

The primary and secondary data were then analyzed descriptively and quantitatively as needed to find an overview of the socio-economic conditions of urban communities in the Jabodetabek sub urban area of Jakarta (Jakarta, Bogor, Depok, Tangerang, Bekasi), both before and during the period of COVID-19 pandemic. Statistical analysis of the ANOVA [32] was applied to the primary data from direct interviews and google form, to find out the choices and differences of respondents to the urban farming business model of aquaculture and to understand the differences in the net income among the business activities of urban farming aquaculture on both consumption fish and ornamental fish in the Jabodetabek sub-urban area of Jakarta and to find out the choice of respondents to the urban farming aquaculture business model. From the results of this analysis, it is hoped that the most optimal type of business from urban farming aquaculture can be identified which can be developed in the future and become the best choice for fish farmers. This information can be used as the best choice for developing an aquaculture urban farming business in the future to strengthen food and economic security that can be widely applied at the national level, especially in overcoming socio-economic problems such as those that occurred during the COVID-19 pandemic. Meanwhile, the secondary data on poverty rates, poor population, labor conditions, and per capita income are graphically analyzed to understand socio-economic conditions due to the COVID-19 pandemic.

The hypothesis proposed in this study is:

– H0: There is no significant difference between the choice of respondents and net income
– H1: There is a significant difference between the choice of respondents and net income

Results and Discussion

Socio-Economic During the COVID-19 Pandemic

The COVID-19 pandemic not only impacts public health but also affects the Indonesian people's economic conditions and social life. This pandemic has caused several local governments to implement Large-Scale Social Restrictions (LSSR) policies which have implications for limiting community activities, including economic and other social activities. The decline in these activities impacts the community's socio-economic conditions, especially the vulnerable and poor. Therefore, the government, at the central and regional levels, has issued various policies to tackle the spread of COVID-19 and mitigate this pandemic's social and economic impacts.

COVID-19 is estimated to infect millions of people worldwide. The economic impact is expected to be large and could lead to a global recession. Millions of people will fall into poverty. The estimated impact of COVID-19 on poverty in Indonesia with a projection of 1.2 million people in Indonesia will be infected; the resulting economic impact is Indonesia's economic growth in 2020, which is estimated to grow by 5% due to COVID-19 will decline the range of numbers from 1% to 4%. The impact of COVID-19 on economic growth will increase the poverty rate from 9.2% in 2019 to 9.7% by the end of 2020. This means that 1.3 million people will fall into poverty with the poverty rate will increase to 12.4%, which means that there will be 8.5 million people who become poor [33]. This worst-case projection implies that Indonesia's progress in reducing poverty over the past decade will be in vain. The implication is that Indonesia needs to expand its social protection programs to help the new and existing poor.

In 2021, the Central Bureau of Statistics (CBS) released a report on the poverty rate in rural and urban areas, which shows that in 2021 it will be 20.99% or as many as 57.09 million Indonesians are poor. The poverty rate in 2021 is slightly lower than in 2020 but is still higher than the conditions before the pandemic in 2019 (Fig. 2). If viewed based on the number of poor people since 2019 (the lowest poverty Indonesia has ever achieved), the number of poor people has increased by 3.5 million individuals with the most significant increase occurring in urban areas by 2.72 million and in rural areas by 761,600 people (Fig. 3). The high poverty rate in urban areas is thought to be caused by the high unemployment. The COVID-19 pandemic has triggered a significant increase in urban poverty rates due to many employees being terminated. This condition is not so pronounced in rural areas, where the rate of growth in poverty is not as large as in urban areas. Economic conditions in rural areas are still relatively under control, with several alternative farming activities allowing rural communities to survive by relying on the potential of agricultural resources in rural areas. To overcome the unemployment problem due to the COVID-19 pandemic in urban communities such as in the Jakarta sub-urban area, it is necessary to introduce and socialize agricultural-based business activities, including aquaculture urban farming, which can be carried out in cooperation in one group. With a system like this, urban communities will significantly assist their economic life because they are carried out collectively at a cost that is not too large. Moreover, the government helps a lot in the capital through the Ministry of Maritime Affairs and Fisheries.

One of the reasons for the decline in household welfare (based on per capita expenditure) was a

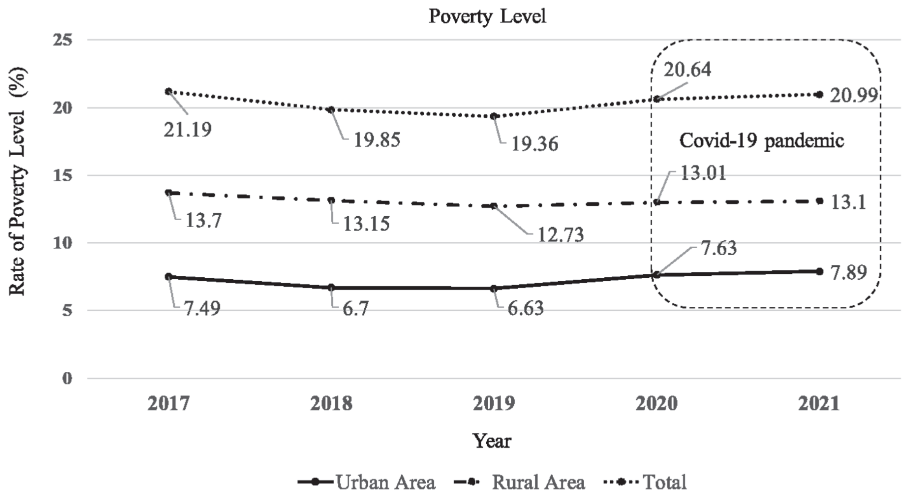

Fig. 2. National Poverty Rate of 2015-2021. Data sources: CBS (2015-2021)

decrease in household income. The results showed that 75% of households experienced a decline in income during the pandemic. As many as 66% of households owning a small business also experienced a decrease in the number of buyers and business turnover. In addition, in 2020, there will be an increase in the unemployment rate of 2.7 million people. At the same time, the average nominal wage for workers or laborers has decreased by -5.2% from the nominal wage before the pandemic [34]. Meanwhile, Indonesia's per capita income, as shown in Fig. 4, during the COVID-19 pandemic in 2020, there was a decline in per capita income of - 2.17 million or - 3.7%, and in 2021 there was an increase from 56.9 million in 2020, to 62.2 million or 9.3%. This shows that the COVID-19 pandemic has resulted in the impoverishment of the Indonesian people, which can be caused by various things, including a decrease in purchasing power due to Termination of Employment (ToE). However, in 2021, Indonesia's per capita income will increase due to improvements in the production sector, including the agricultural sector [35].

Labor Conditions Due to the COVID-19 Pandemic

The economic crisis triggered by the COVID-19 pandemic has had an impact on the employment situation in Indonesia. There are at least two implications that this crisis has on the employment sector, that is (i) an increase in the unemployment rate and (ii) a changing landscape of the labor market. In terms of the type of business field, construction, manufacturing, trading, and company services are the business fields that reduce the absorption of labor the most. Efforts to overcome the increase in the number of unemployed face significant challenges because the possibility of re-absorption

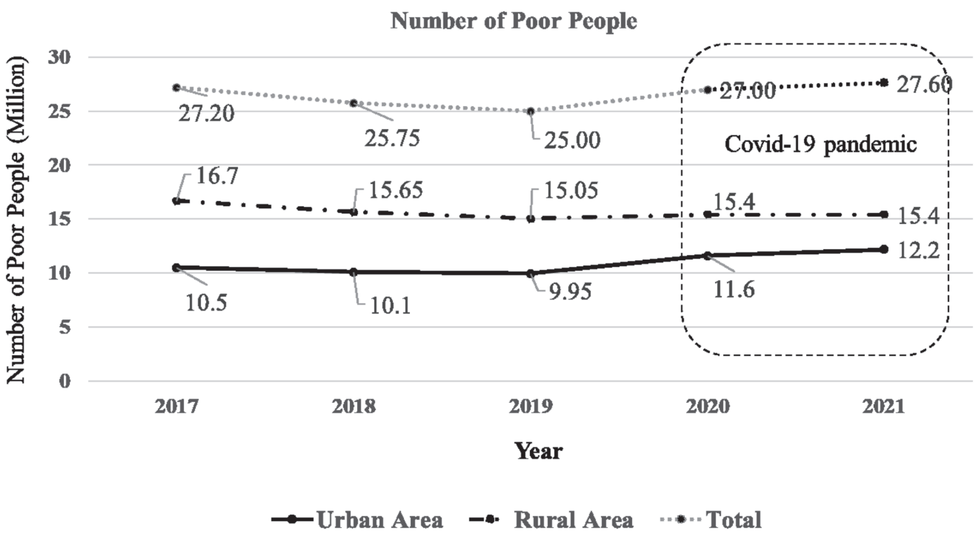

Fig. 3. Number of Indonesian Poor (Million). Data sources: CBS (2017-2021)

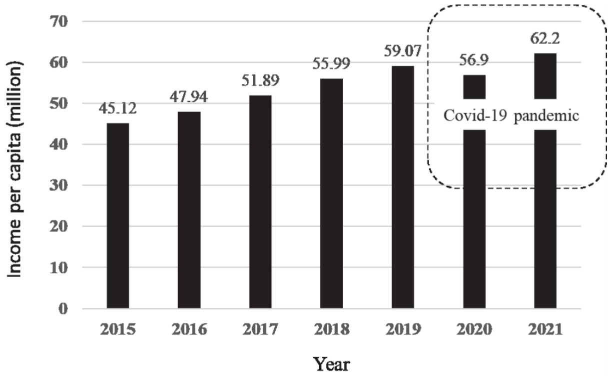

Fig. 4. Indonesia's per capita income 2015-2021. Data sources: CBS (2015-2021)

of workers will not be as significant as the number of workers affected by ToE. Another challenge is that the employment landscape in the future will require a workforce that has skills in information technology and demands a more flexible labor relations system. Therefore, a specific strategy is needed to address these employment challenges. The process in question is, among others, providing support for the relaxation of company operating costs, continuous training of workers, review of labor regulations to encourage flexibility in the labor market, and efforts to increase productivity in the informal sector.

The economic crisis triggered by the COVID-19 pandemic affected the employment situation in Indonesia. Some workers were forced to be Termination of Employment (ToE) due to the disruption of the company's operational activities affected by this crisis. Six business fields can be severely affected: accommodation and food and beverage providers; trading; transportation and warehousing; construction; processing industry; and other services. Based on the data of Sakernas and Susenas [36, 37], the six business fields are dominated by workers from the middle economic group, most of whom are senior high school (SHS) graduates. When viewed from the status of workers, the sector providing accommodation, food, and beverages; trading; and transportation and warehousing are dominated by informal workers. In addition, this crisis can potentially suppress women's work participation, especially in other service sectors, accommodation providers, and food and beverages. The labor situation in the six sectors described in this issue note can be used as basic information for policymakers in formulating effective strategies to cope with the impact of the COVID-19 pandemic on employment in Indonesia.

The results showed a wave of Termination of Employment (ToE) and a decrease in workers' income during Indonesia's Large-Scale Social Restrictions (LSSR) period. The percentage of ToE of workers in Indonesia at the end of April 2020 was 15.6 percent, consisting of 1.8 percent of ToE with severance pay and 13.8 percent of ToE without severance pay [38]. Meanwhile, ToE in several areas of the suburban area of Jakarta, as shown in Table 2, shows a significant variation. Jakarta is the area most affected by the number of people who have been ToE, as many as 50,891 people or 0.43%, followed by the Tangerang area 20,972 people or 037%, Depok 14,137 or 0.08%, Bekasi 3,252 people or 0.06% and the lowest Bogor 1,629 people or 0.03% of the total population of each region. Likewise, for workers who were ToE, Jakarta is the highest area for workers who were ToE with a total of 27,233 people or 2.3%, followed by Tangerang 10,955 people or 0.19%, Bekasi 5,238 people or 0.1%, Depok 2,500 people or 0.01% and the lowest was Bogor 1,273 people or 0.02%. The high number of Termination of Employment (ToE) in Tangerang compared to other areas in the sub-urban area of Jakarta, outside the Jakarta area is suspected to be Tangerang, which is an industrial area, many workers have been laid off due to economic difficulties from the industry during the COVID-19 pandemic. Meanwhile, Depok city has the lowest area but is more densely populated than other areas outside Jakarta; more workers have been laid off than in other areas outside Jakarta and Tangerang.

Table 2. Termination of Employment (ToE) and Temporarily Dismissed of Employment in the sub-urban area of Jakarta in 2020.

Regions	Area (Km^2)	Total population (Person)	Termination of Employment (ToE)		Temporarily Dismissed of Employment (TDE)	
			(Person)	(%)	(Person)	(%)
Jakarta	781.3	11,846,940	50,891	0.43	272,333	2.30
Bogor	2829.1	5,614,896	1,629	0.03	1,273	0.02
Depok	200.2	18,844,932	14,137	0.08	2,500	0.01
Tangerang	1313.0	5,733,542	20,972	0.37	10,955	0.19
Bekasi	1425.5	5,077,147	3,252	0.06	5,283	0.10
Total	6549.1	47,117,457	90,881	0.96	292,344	2.63

Data sources: CBS (2020) and Results of Primary Data Analysis

Urban Farming Aquaculture as a Solution for Food and Economic Security During and Post-COVID-19 Pandemic

The COVID-19 pandemic in Indonesia has significantly impacted human life in various aspects of people's lives. Policies during the pandemic, such as Work From Home (WFH) and Large-Scale Social Restrictions (LSSR), also have a socioeconomic impact on the community, including the most basic need, namely food. On the other hand, agricultural land that continues to be eroded for development purposes and the average age of farmers whose ability to grow their crops is decreasing also contributed to the decline in food. The food crisis threat is slowly starting to haunt the entire community. Based on data from Global Hunger Indonesia (GHI), the level of public hunger in Indonesia is in a severe category, although it has decreased from 24.9% (2010) to 20.1% in 2019. However, Indonesia must remain vigilant against the threat of famine, which can trigger various big problems such as health, social, and security. In an effort to anticipate the food crisis during this pandemic, it has encouraged people living in urban areas through the urban farming movement to ensure food availability.

Urban farming aquaculture is the concept of fish cultivation on limited land. It is one of the efforts that can be applied to overcome the shortage of food based on animal protein originating from fish and help improve the community's economy during and after the COVID-19 pandemic. There are many benefits of urban farming aquaculture developed in residential areas urban communities, that is, (1) the ecological value to make the residential environment more environmentally friendly, (2) the economic value that may bring profits and income sustainability, and (3) the educational value which is a source of knowledge. People can fill their free time at home by remaining productive. The habits of the Indonesian people who like to gather can be used to form a community to promote urban farming aquaculture. Limited community land does not become an obstacle to building creativity to produce something worthwhile. The method of developing urban farming aquaculture, growing out and hatchery of consumption fish such as catfish and tilapia, as well as ornamental fish, can be carried out in limited land to produce fish-based animal protein food sources and increase people's income as an alternative business during and after the COVID-19 pandemic. The community gets the availability of fish as a source of nutrition, which makes the residential environment cleaner and helps reduce the impact of floods in several urban environments. In addition, it can strengthen a sense of togetherness and create a culture of mutual cooperation in the urban community. In addition to urban farming aquaculture activities, it can also be combined with agricultural activities of horticultural crops and ornamental plants by implementing the Integrated Urban Farming System (IUFS), which makes the residential environment greener and flood-free in several residential locations that are prone to flooding and can reduce global warming. IUFS is an integrated farming technique that is environmentally sound, economical, and sustainable. All the waste generated can be reused in an integrated urban farming system. Fishery liquid and solid waste can be used as fertilizer for horticultural agriculture or vegetables and ornamental plants that have economic value to increase people's income.

Based on the above, urban farming aquaculture is very supportive. It gives a positive appreciation because it has been proven to provide more benefits for the community amid the pandemic of COVID-19. A number of studies have stated that urban farming aquaculture can be an ideal urban farming aquaculture concept in the future. In addition to the considerable benefits of urban farming aquaculture, the main challenges in urban farming aquaculture are determining how to monitor, manage, and minimize environmental, economic, and socio-environmental risks and understanding how urban farming aquaculture can be sustainable in a global urban food system. Urban aquaculture can increase the value of locality of food and reduce the energy spent in the production process of consumption fish and ornamental fish. Therefore, the city government has a vital role in providing special regulations to support the implementation of sustainable urban farming aquaculture. The issue of urban farming aquaculture needs to get the main attention. Therefore, various stakeholders' support is required. Through the results of this study, it is hoped that it can provide a thought or policy recommendation to improve food security and economic resilience of urban communities during and after the COVID-19 pandemic.

Urban farming aquaculture is defined as the practice of aquaculture in urban areas or areas experiencing urbanization [39]. Urban aquaculture activities may include freshwater, brackish, and marine aquaculture activities. Urban fishery cultivation, or urban farming fisheries, was developed because it is believed to be helpful in supporting underprivileged communities' access to more affordable food. It can be used to overcome food insecurity and help improve the community's economy. Aquaculture activities in urban areas have increased in recent years as people continue to urbanize, and the demand for food in urban environments continues to grow. Based on the cultivation system, urban aquaculture can be in the form of an extensive aquaculture system characterized by dependence on natural food stocks; semi-intensive aquaculture uses fertilizers to increase raw food production and or the provision of additional feed, which is usually low in protein, Intensive system cultivation relies exclusively on external supplies of high protein feed (>20%).

Aquaculture activities in urban areas that are carried out extensively are mainly carried out in public waters (reservoirs and lakes) by stocking fish seeds (restocking) and aquaculture in floating net cages (KJA) such as

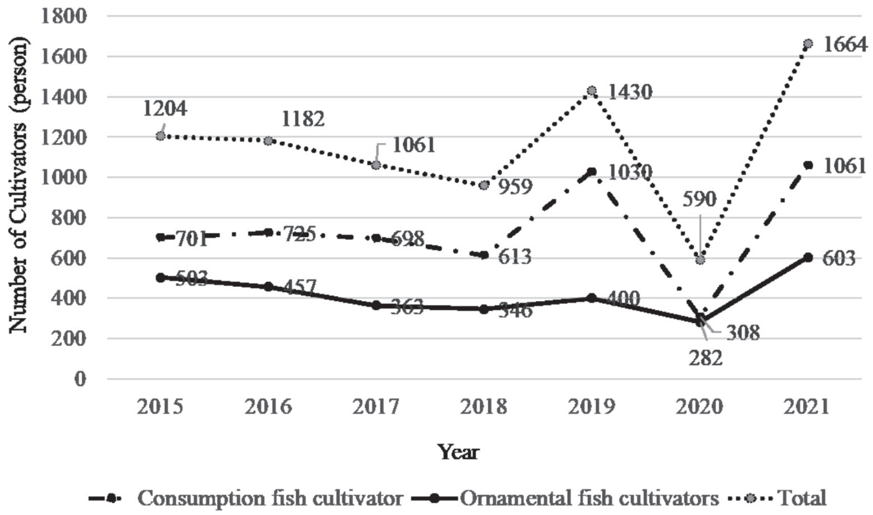

Fig. 5. Development of consumption fish and ornamental fish cultivators in the suburban area of Jakarta.

in Hanoi, Vietnam [40]; in the Saguling-Cirata-Jatiluhur reservoir downstream of Bandung, Indonesia [41] with carp and tilapia commodities. Semi-intensive aquaculture in urban areas is mainly done in open ponds.

Intensive urban aquaculture is being developed by entrepreneurs in several countries, such as North America and Europe, with limited land and higher production costs than semi-intensive aquaculture systems [42]. The advantage of intensive aquaculture is that it can be controlled water quality management, feed use, and stock management. However, because it requires significant capital, intensive aquaculture systems are geared toward producing high-value fish for specific markets. Intensive urban aquaculture systems in North America and Europe have been used to create high-value fish such as tilapia, snapper, and eel. In developing countries, intensive urban aquaculture systems are used primarily to produce export-quality ornamental fish, while local consumption fish have not been widely reported. Production systems used in intensive urban aquaculture systems in Europe and developed countries mostly use closed recirculation systems using tanks.

Based on the results of observations in several locations of urban farming aquaculture in the areas of Jakarta, Bogor, Depok, Tangerang, and Bekasi, it is known that during the COVID-19 Pandemic, as shown in Fig. 5, consumption of fish cultivators decreased from 1030 people in 2019 to 590 people in 2020. However, in 2021 it will increase again to 1061 people or an average of 456 (44.3%) per year. While ornamental fish cultivators even showed a decline in 2020, from 400 cultivators in 2019 to 282 cultivators. However, in 2021, ornamental fish cultivators will increase again to 603 cultivators or an average increase of 220

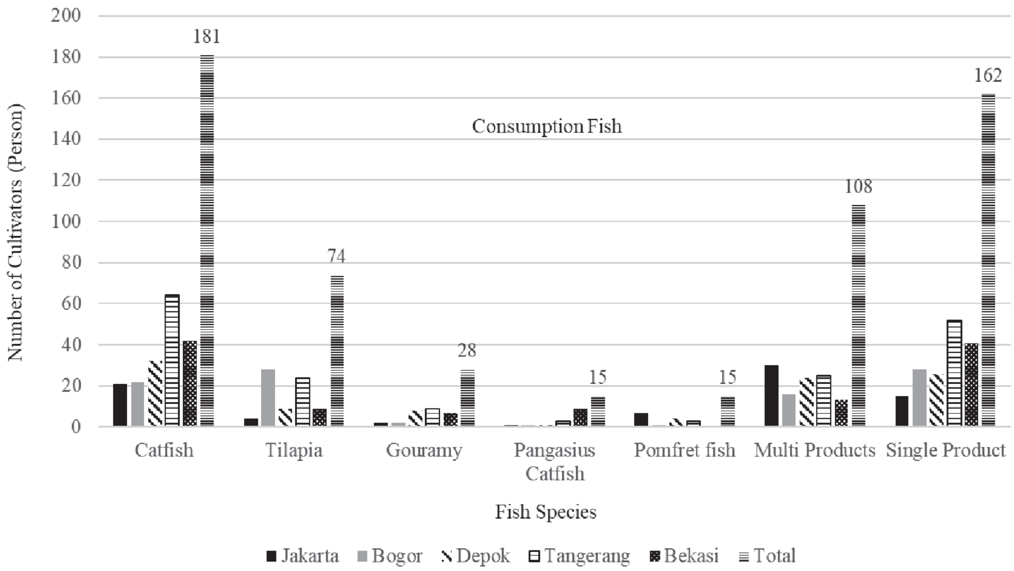

Fig. 6. Consumption fish commodities in the sub urban area of Jakarta.

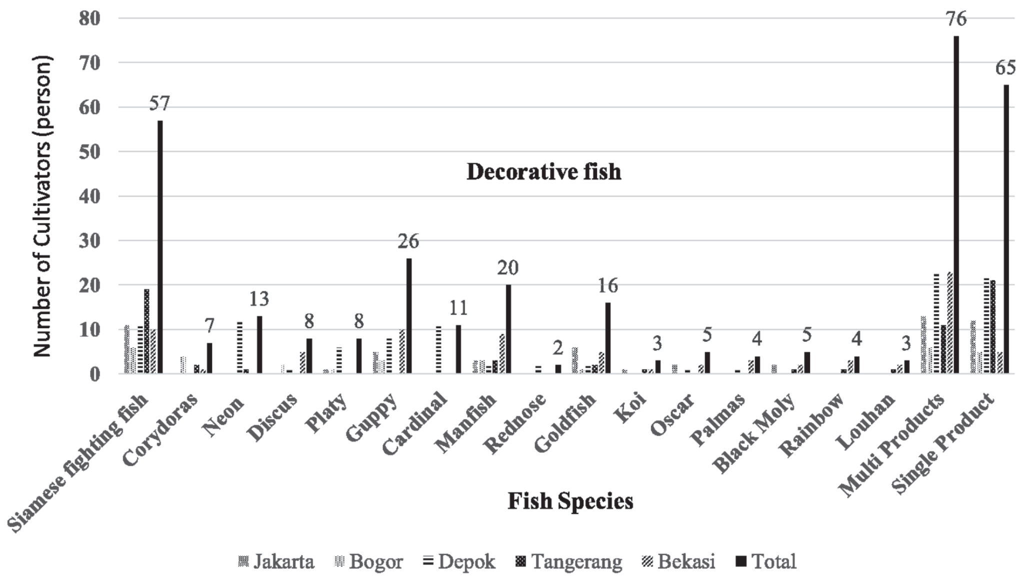

Fig.7. Ornamental fish commodities in the sub urban area of Jakarta.

cultivators (55%). This shows that ornamental fish is a more dominant additional business in urban areas than consumption fish. Because ornamental fish can be cultivated in narrow spaces such as in narrow alleys and settlements, they are more productive because the price is quite good in the market. The decline in cultivators in 2020 is thought to be because many workers were Termination of Employment (ToE).

The commodity of urban farming aquaculture for consumption fish is dominated by Catfish, followed by Tilapia, Gouramy, Carp, Pangasius Catfish, and Pomfret fish (Fig. 6). Catfish and tilapia are favorite commodities for fish culture because of their maintenance methods are more accessible, harvest time is not long and is widely liked by consumers. For ornamental fish, the aquaculture commodity is dominated by Siamese fighting fish, followed by Guppy, Manfish, Goldfish, Neon, Cardinal, Discus, Platy, Corydoras, and other ornamental fish (Fig. 7). Siamese fighting fish is an ornamental fish product that is cultivated, because, in addition to being liked by consumers, its maintenance does not require a large area of land, even in housing with narrow roads it can still be done and has become a home industry, especially in the Jakarta area.

In terms of human resources, aquaculture urban farming business activities in the suburban area of Jakarta, both consumption fish and ornamental fish, are dominated by people with senior high school (SHS) education who do not have a fishery background, as shown in Fig. 8. To improve their abilities, various pieces of training related to aquaculture activities for both consumption fish and ornamental fish are

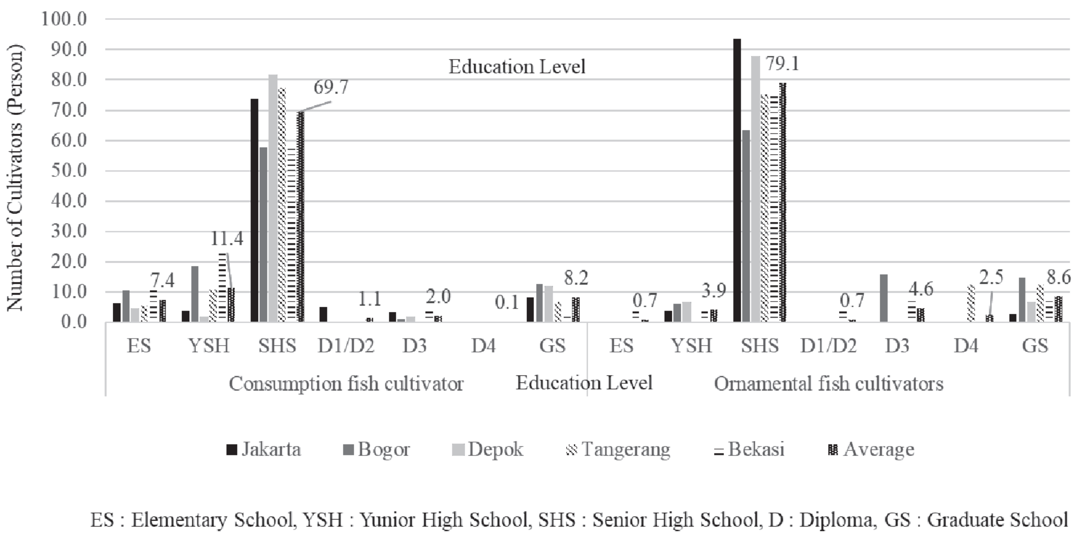

Fig. 8. Performance of aquaculture urban farming human resources in the sub urban area of Jakarta.

Table 3. Performance of the urban farming aquaculture business models for consumption and ornamental fish per unit production and types of fish in the Jabodetabek, sub-urban area of Jakarta.

Business Models	Commodities	Type of Business	Media	Volume	Unit	Rearing Period	Unit	Product Size of fish	Unit	Fish Production per cycle	Unit	Selling Prize of fish product (IDR)	Production Cost/kg or per head of fish (IDR)	Total Production Cost per Cycle and per Unit (IDR)	Gross Income per Cycle (IDR)	Net Income per Cycle(IDR)
Consumtion Fish																
CF-1	Catfish	Growing Out	Bucket	90,00 ± 0.32	Liter	2.50 ± 0.16	months	8.00 ± 0.56	tails/kg	6.00 ± 0.56	kg	17,000.00 ± 0.22	9,800.00 ± 0.89	58,800.00 ± 0.45	102,000.00 ± 0.67	43,200.00 ± 0.45
CF-2	Catfish	Growing Out	Plastic Pond	12,500.00 ± 0.72	Liter	2.50 ± 0.03	months	9.00 ± 0.46	tails/kg	150.00 ± 0.56	kg	17,000.00 ± 0.45	9,800.00 ± 0.45	1.470,000.00 ± 0.22	2,550,000.00 ± 0.67	1,080,000.00 ± 0.49
CF-3	Tilapia	Growing Out	Plastic Pond	12,500.00 ± 0.72	Liter	5.00 ± 0.56	months	9.00 ± 0.56	tails/kg	150.00 ± 0.32	kg	27,000.00 ± 0.89	17,000.00 ± 0.22	2,550,000.00 ± 0.22	4,050,000.00 ± 0.67	1,500,000.00 ± 0.67
CF-4	Catfish	Growing Out	Plastic Barel	200.00 ± 0.22	Liter	3.50 ± 0.06	months	8.00 ± 0.32	tails/kg	120.00 ± 0.65	kg	17,000.00 ± 0.67	9,800.00 ± 0.89	1,176,000.00 ± 0.67	2040,000.00 ± 0.67	864,000.00 ± 0.45
CF-5	Catfish	Seeds Production	Ground Pond	3,150.00 ± 0.39	Liter	1.50 ± 0.05	months	3.50 ± 0.06	cm	20,000 ± 0.41	tails	175.00 ± 0.22	140.00 ± 0.31	2,800,000.00 ± 0.24	3500,000.00 ± 0.24	700,000.00 ± 0.67
CF-6	Pangasius	Seeds Production	Concrete Pond	1,280.00 ± 0.391	Liter	20.00 ± 0.47	days	0.75 ± 0.02	inch	14,000 ± 0.50	tails	80.00 ± 0.31	40.00 ± 0.42	560,000.00 ± 0.31	1,120,000.00 ± 0.94	560,000.00 ± 0.94
Ornamental Fish																
OF-1	Manfish	Growing Out	Aquarium	175.00 ± 0.24	Liter	2.00 ± 0.02	months	2.00 ± 0.33	cm	800.00 ± 0.43	tails	15,000.00 ± 0.73	5,000.00 ± 0.73	4,000,000.00 ± 0.24	12,000,000.00 ± 0.45	8,000,000.00 ± 0.94
OF-2	Gold fish	Growing Out	Concrete Pond	1,000.00 ± 0.33	Liter	2.00 ± 0.02	months	10.00 ± 0.43	cm	200.00 ± 0.96	tails	50,000.00 ± 0.97	20,000.00 ± 0.48	4,000,000.00 ± 0.48	10,000,000.00 ± 0.97	6,000,000.00 ± 0.97
OF-3	Platis	Growing Out	Concrete Pond	600.00 ± 0.72	Liter	2.00 ± 0.02	months	2.00 ± 0.48	cm	250.00 ± 0.97	tails	3,500.00 ± 0.31	1.000.00 ± 0.94	250,000.00 ± 0.33	875,000.00 ± 0.99	625,000.00 ± 0.99
OF-4	Guppy	Growing Out	Concrete Pond	600.00 ± 0.72	Liter	2.00 ± 0.02	months	2.00 ± 0.48	cm	250.00 ± 0.97	tails	25,000.00 ± 0.63	5,000.00 ± 0.63	1,250,000.00 ± 0.66	6,250,000.00 ± 0.34	5,000,000.00 ± 0.66
OF-5	Siamese fighting fish	Growing Out	Concrete Pond	600.00 ± 0.72	Liter	2.00 ± 0.02	months	2.00 ± 0.48	cm	250.00 ± 0.97	tails	15,000.00 ± 0.94	5,000.00 ± 0.31	1,250,000.00 ± 0.89	3,750,000.00 ± 0.33	2,000,000.00 ± 0.33

needed so that their business activities can develop better.

The performance of urban farming aquaculture business models for the consumption and ornamental fish in the sub urban area of Jakarta is shown in Table 3. The data shows that all urban farming aquaculture business models generate quite good net income per cycle and per production unit, and vary according to the business model. For the consumption fish business model, the largest net income is obtained from the urban farming business model for Tilapia enlargement aquaculture with media using Plastic Pond (CF-3). High net income also occurs in the growing out business model Catfish using the same media (CF-2), followed by growing out business model Catfish using Plastic Barrels (CF-4), Catfish seeding in Ground Pond (CF-5) , Pangasius seeding in Concrete Pond (CF-6) and Catfish growing out in Buckets (CF-1). For the ornamental fish business model, almost all business models show a better net income than the consumption fish business model. The highest net income was obtained from the Manfish (OF-1) business, followed by Goldfish (OF-2), Guppy (OF-4), Siamese fighting fish (OF-5) and Platis (OF-3) businesses.

As is well known, the average minimum wage in the Jabodetabek area (Jakarta, Bogor, Depok, Tangerang, Bekasi) as a sub-urban area of Jakarta, ranges from IDR 4,169,806 – 4,791,843 per month [43]. Based on the net income data for the aquaculture urban farming business as shown in Table 4. It seems that the aquaculture urban farming business for all models, both for consumption and ornamental fish businesses, has provided monthly profits to entrepreneurs as a farmer of the urban farming aquaculture. However, for consumption fish, it seems that urban farming aquaculture business activities per production unit are sufficient to meet the needs for food sourced from fish for business actors as an effort to increase community food security. Meanwhile, to obtain more net income as a substitute for income due to termination of employment (ToE) during the COVID-19 pandemic, the business scale needs to be enlarged by adding production units up to 10 units. This has been done by urban farming aquaculture farmers in the Jabodetabek area (Jakarta, Bogor, Depok, Tangerang, Bekasi), sub-urban Jakarta. In contrast, for the urban farming of ornamental fish aquaculture, it seems more prospective to be used as a substitute for income due to layoffs during the COVID-19 pandemic. The net income earned by urban farming ornamental fish aquaculture per unit and per month as shown in Table 4, is greater than consumption fish and if the business is enlarged to 5 units as done by the entrepreneurs as a farmer of the urban farming aquaculture, the net income obtained will be more than enough to replace the lost income due to termination of employment (ToE) during the COVID-19 pandemic, except for the Platis fish business. This is quite encouraging, because the urban farming business of ornamental fish aquaculture can be relied upon to

Table 4. Performance of Net Income Per month Per Unit, 5 Unit and 10 of Production Unit urban farming aquaculture business model in the Jabodetabek, sub-urban area of Jakarta.

Business Models	Commodities	Type of Business	Net Income permonth per unit production (IDR)	Net Income per Cycle Per 5 Unit Production (IDR)	Net Income per Cycle Per 5 Unit Production (IDR)
Consumtion Fish					
CF-1	Catfish	Growing Out	17,280.00	86,400.00	172,800.00
CF-2	Catfish	Growing Out	432,000.00	2,160,000.00	4,320,000.00
CF-3	Tilapia	Growing Out	300,000.00	1,500,000.00	3,000,000.00
CF-4	Catfish	Growing Out	246,857.14	1,234,285.71	2,468,571.43
CF-5	Catfish	Seeds Production	466,666.67	2,333,333.33	4,666,666.67
CF-6	Pangasius	Seeds Production	800,000.00	4,000,000.00	8,000,000.00
Ornamental Fish					
OF-1	Manfish	Growing Out	4,000,000.00	20,000,000.00	40,000,000.00
OF-2	Gold fish	Growing Out	3,000,000.00	15,000,000.00	30,000,000.00
OF-3	Platis	Growing Out	312,500.00	1,562,500.00	3,125,000.00
OF-4	Guppy	Growing Out	2,500,000.00	12,500,000.00	25,000,000.00
OF-5	Siamese fighting fish	Growing Out	1,000,000.00	5,000,000.00	10,000,000.00

increase the economic resilience of urban communities and serve as a promising business alternative.

If we look at the Tables of 5 and 7 regarding the distribution of urban farming aquaculture business models based on the distribution of respondents in the Table 1, it can be seen that the distribution of urban farming aquaculture business actors from 200 respondents who filled out questionnaires either through the Google form or through direct interviews, spread to several urban farming aquaculture business models of consumption fish (6 models) and ornamental fish (5 models). Out of 120 respondents from the urban farming business aquaculture for consumption fish, the most business actors are the CF-2 business model followed by CF-3, CF-5, CF-1 and CF-6. As for ornamental fish, out of 80 business actors, most are in the OF-1 business model, then the OF-2, OF-4, OF-5 and OF-3 business models. The results of the ANOVA analysis at $\alpha = 0.05$ as shown in Table 6 for consumption fish and Table 8 for ornamental fish show F count>F Table which states that there are differences in respondents' choices of urban farming aquaculture business models related to income. Thus it can be said that respondents are more likely to choose a business model that is more profitable financially which is adjusted to the ability of capital and the availability of resources they have.

Based on the results of the analysis above, the urban farming aquaculture business is quite prospective for the development of urban communities for both food security and economic security. In the future, it is hoped that the urban farming aquaculture business model can continue to be developed by incorporating various innovations and technologies to increase business efficiency.

Table 5. The Distribution of consumption fish farmers in urban farming aquaculture in the Jabodetabek area (Jakarta, Bogor, Depok, Tangerang, Bekasi) in the Jakarta sub-urban area, based on the consumption fish business model (CF).

Area	Business Models of Consumption Fish (CF)						
	CF-1	CF-2	CF-3	CF-4	CF-5	CF-6	Total
Jakarta	7	14	9	1	1	1	33
Bogor	1	8	5	1	5	1	21
Depok	1	6	5	4	3	1	20
Bekasi	1	8	6		7	2	24
Tangerang	1	8	6	1	5	1	22
Total	11	44	31	7	21	6	120

Table 6. Statistical analysis of the ANOVA and mean average of the urban farming aquaculture business models for consumption fish (CF).

DESCRIPTION								
Groups	Count	Sum	Mean	Variance	SS	Std Err	Lower	Upper
Model CF-1	5	11	2.20	7.20	28.80	1.08	0.787	5.18698
Model CF-2	5	44	8.80	9.20	36.80	1.08	5.81302	11.787
Model CF-3	5	31	6.20	2.70	10.80	1.08	3.21302	9.18698
Model CF-4	4	7	1.75	2.25	40.89	1.20	2.0779	5.57789
Model CF-5	5	21	4.20	5.20	20.80	1.08	1.21302	7.18698
Model CF-6	5	6	1.20	0.20	0.80	1.08	1.787	4.18698

ANOVA						
Sources	SS	df	MS	F	P value	F crit
Between Groups	180.56	5	36.11	6.24013	0.0012631	0.17335
Within Groups	138.89	24	5.79			
Total	319.45	29	11.02			

Significantly different among the models ($p<0.05$)

Table 7. The Distribution of ornamental fish farmers in urban farming aquaculture in the Jabodetabek area (Jakarta, Bogor, Depok, Tangerang, Bekasi) in the Jakarta sub-urban area, based on the ornamental fish business model (OF).

Area	Business Models of Ornamental Fish (OF)					
	OF-1	OF-2	OF-3	OF-4	OF-5	TOTAL
Jakarta	8	6	3	5	3	25
Bogor	4	2	1	2	1	10
Depok	6	5	1	4	2	18
Bekasi	4	3	1	3	2	13
Tangerang	4	4	1	3	2	14
Total	26	20	7	17	10	80

Table 8. Statistical analysis of the ANOVA and mean average of the urban farming aquaculture business models for ornamental fish (OF).

DESCRIPTION								
Groups	Count	Sum	Mean	Variance	SS	Std Err	Lower	Upper
Model OF-1	5	26	5.20	3.20	12.80	0.57	3.62744	6.77256
Model OF-2	5	20	4.00	2.50	10.00	0.57	2.42744	5.57256
Model OF-3	5	7	1.40	0.80	3.20	0.57	0.1726	2.97256
Model OF-4	5	17	3.40	1.30	12.10	0.57	1.82744	4.97256
Model OF-5	5	10	2.00	0.50	2.00	0.57	0.42744	3.57256

ANOVA						
Sources	SS	df	MS	F	P value	F crit
Between Groups	39.90	4	9.98	6.2188	0.00129	0.17335
Within Groups	40.10	25	1.60			
Total	80.00	29	2.76			

Significantly different among the models ($p<0.05$)

Conclusions

The COVID-19 pandemic has had a negative impact on socio-economic life, both at the global and national levels in Indonesia, including in the Jabodetabek area (Jakarta, Bogor, Depok, Tangerang, Bekasi) which are the suburban areas around Jakarta. During the COVID-19 pandemic, there were many layoffs (PHK), and many employees were sent home due to the economic difficulties experienced by companies in various small, medium and industrial scales. To maintain the life of urban communities during the COVID-19 pandemic, it is necessary to look for alternative businesses that can replace lost income due to termination of employment (ToE) or to meet food needs. One alternative business that can be developed independently is urban farming aquaculture which is mostly practiced by urban communities in Jabodetabek (Jakarta, Bogor, Depok, Tangerang, Bekasi) in various business models and various types of commodities, both consumption fish and ornamental fish.

The urban farming business model for consumption fish aquaculture and ornamental fish which is mostly carried out by urban communities with a Senior High School educational and no fisheries education background has shown good performance in providing net income to business practitioners during the COVID-19 Pandemic. The size of the net income earned depends on the business model being carried out, the type of fish commodity and the size of the scale. business. The net income obtained from the urban farming business of ornamental fish aquaculture is greater than consumption fish. For food security, urban farming aquaculture consumption fish such as Tilapia (business model CF-3) and Catfish (business model CF-2) have become the choice of many urban communities, while for economic security, ornamental fish business models such as Manfish (business model OF- 1), Goldfish (business model OF-2), guppy (business model OF-4), and Siamese fighting fish (business model OF-5) are mostly practiced by urban communities, because they are export commodities and have a fairly wide market. The aquaculture urban farming business model, both consumption fish and ornamental fish, is recommended to be developed respectively for food security and national economic security in overcoming various pandemics, such as the COVID-19 pandemic. Government support is urgently needed in helping the community improve their business capabilities both in the form of training, facilities and infrastructure assistance, access to capital, expansion of marketing and business development.

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Conflict of Interest

The authors declare no conflict of interest.

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