

# Exploring farming strategies in a metropolitan area: case study of inland aquaculture in Bogor Regency

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**Abstract.** Farming practices in a metropolitan area are often under pressure of forces and processes associated with urbanization. In those circumstances, “reconnection” between agriculture and the urban environment is required to preserve farming activities. This partnership is secured by strategies of sustainable intensification, sustainable valorization and sustainable diversification. Studies concerning farmer strategies have been done in the Netherlands, India and China, but are lacking in many other countries such as Indonesia. The objective of this study was to explore which strategies are being adopted by farmers in Indonesia to adapt to and benefit from the process of urbanization. The research included a case study of inland aquaculture, a dominant agricultural activity in Bogor Regency, Jakarta Metropolitan Area (JMA). Document study and in-depth interviews with farmers, government officers and a consumer organization were conducted. Pattern matching was chosen as technique for analyzing the collected data. The results show that intensification is the dominant farming strategy implemented by farmers of inland aquaculture in JMA. Farmers concentrate on intensive methods in order to reduce production costs and subsequently obtain enough revenues from their farming activities. However, the research also shows that fish farming in JMA is not sustainable, given concerns about animal welfare and financial robustness. Furthermore, the discharge of wastewater from fish ponds to the surface water is a potential issue of environmental concern. Local training programs also seem to be too generic in order to be effective to address these issues and making inland aquaculture more sustainable.

**Keywords:** *Metropolitan agriculture; inland aquaculture; farming strategies; socio-cultural boundaries; spatial planning*

## 1. Introduction

Farming practices situated in a metropolitan area offer many benefits besides supplying food for urban dwellers. The presence of agricultural activities in a metropolitan area can stimulate economic growth by intertwining diverse economic activities [1]. Moreover, it can reduce the geographical distance between food producers and consumers. Shorter links and direct contacts between farmers and consumers may increase trust concerning, for instance, food quality [1]. In addition, farming activities contribute to shaping a regional identity for metropolitan areas and being embedded in culture-historical, socio-cultural or landscape features [1].

However, farming practices situated in metropolitan areas typically suffer from economic problems because they cannot compete with other urban activities [2]. Furthermore, farming in metropolitan areas often meets distrust from society, typically rooted in poor performance of traditional agricultural practices concerning environmental issues and animal welfare [3,4]. In those circumstances, a



“reconnection” between agriculture and the urban environment is required to preserve farming activities, not only from economic perspective, but also social and environmental perspective, such as establishing a regional identity or closing the nutrient cycle [5]. New partnerships between farmers and various actors in the urban environment will also stimulate and inspire innovation in farming practices. Research in the Netherlands, India and China showed that farmers typically adopt three types of strategies, namely sustainable intensification, sustainable valorization and sustainable diversification [5,6]. Sustainable intensification focuses on collaboration with fellow food producers to provide intensive food production, sustainable valorization strengthens the relationship with chain partners to open up existing markets and sustainable diversification concentrates on creating new products and new markets. When implementing these strategies, farmers are often challenged by two types of boundaries, namely the natural resource boundary and the socio-cultural boundary, which determine the extent to which agricultural activities can survive in metropolitan areas [5]. Looking at the natural resource boundary, farmers have to deal with the availability of natural resources, such as arable land, water or nutrients. In the context of the socio-cultural boundary, they must be able to comply with government regulations, meet norms and values of local communities and the demands of consumers for agricultural commodities [5].

Studies concerning farmer strategies and related boundaries have been done in the Netherlands, India and China [5,6], but are lacking in many other countries such as Indonesia. Strategies adopted by farmers and related boundaries are typically context specific. Hence, the objective of this study was to explore which strategies are being adopted by farmers in Indonesia to adapt to and benefit from the process of urbanization as well as the boundaries they have to deal with. The research included a case study of inland aquaculture, a dominant agricultural activity in Bogor Regency, Jakarta Metropolitan Area (JMA).

## 2. Metropolitan Agriculture

### 2.1. Concept of Metropolitan Agriculture

Eweg [5] defines the concept of metropolitan agriculture as: “a deliberately designed system of intelligently connected [agricultural] production sites that use the available resources, conditions and infrastructure in metropolitan areas to sustainably produce food and related material and immaterial demands for the urban consumer”. Metropolitan agriculture fosters the potential synergy in collaboration between agricultural practice and the urban environment [5]. This collaboration, in turn, will stimulate additional benefits, such as a reduction in the costs of food production or closed nutrient cycles [5]. The concept can be implemented by means of three strategies, namely sustainable intensification, sustainable valorization and sustainable diversification [6].

- Sustainable intensification  
This strategy focuses on cooperation to establish efficient and intensive methods of food production. It is obvious that the growing urban population and living standards require much more food availability in the future. This situation calls for more efficient and intensive food production. Intensive food production typically applies technological measures to deal with economic, social and environmental issues.
- Sustainable valorization  
At present, the agricultural sector in many countries is dominated by food retailers, where food prices are the leading mechanism. As a consequence, food prices seem to be much more prominent compared to issues such as food quality or sustainability. Sustainable valorization aims at collaboration between food chain partners to open up markets, such as regional products or biological market niches.
- Sustainable diversification  
This strategy concentrates on creating new products or services. Farmers focus on delivering added value, such as other products or services besides their conventional agricultural

activities. By focusing on new products or services they will open up new markets, such as care farming, leisure activities or education.

### 2.2. Conditions for Metropolitan Agriculture

Eweg [5] frames the conditions for farming in metropolitan areas using two system boundaries, namely the natural resource and the socio-cultural boundary. Related to the natural resource boundary, farmers in metropolitan areas face the limitation of land, water and nutrient availability [7,8]. This limitation is an outcome of the competition for the use of natural resources among various activities, triggered by the process of urbanization [9].

Socio-cultural boundaries are determined by the government, consumers and society [5]. The government creates formal boundaries by issuing policies and regulations. Consumers and society are typically understood as a distinct force [10]. Consumers act based on self-interest, short-term orientation and are more interested in, for example, safe products with a low price or products which provide direct enjoyment. Society, on the other hand, has a long-term orientation and is concerned about social values, such as animal welfare and sustainability. Society is usually reflected in NGOs which pursue their ideas collectively instead of through individual action. The influences of consumer and society are present in each individual and both roles often produce a conflict when, for instance, an environmentally friendly product is less handy and more expensive [10]. Socio-cultural boundaries differ between areas and are determined by the context of local values and status of well-being of communities [5]. Farmers must obtain “permissions” from the government, consumers and society to practice their agricultural activities [10], and should therefore earn three types of socio-cultural licenses:

- License to produce  
Administrative and regulatory rules create formal links between farmers and the government. The government shapes policies and legal parameters for farming and consequently farmers should obtain a “license to produce” from the government.
- License to sell  
Farmers interact directly or indirectly with consumers in order to try to sell their agricultural products. If products meet the consumer’s expectations, the product will be bought by consumers. In this regard, consumers provide a “license to sell.”
- License to operate  
In a given societal context, farmers are confronted with social values concerning, for example, environmental and animal welfare issues. In this way, society provides a “license to operate.”

### 2.3. Analytical framework

The concepts of system boundaries and metropolitan agriculture were used to frame five aspects that were analyzed in the case study: (1) condition of natural resources, (2) governmental policies and regulations, (3) consumer demands, (4) societal demands and (5) measures taken by the farmers. For each aspect, more detailed indicators were identified based on the literatures, which were used for data collection (see next section). The relationships between the aspects, concepts and indicators are shown in Table 1.

**Table 1.** Components of the analytical framework

Aspects	Concepts	Indicators
1. Condition of natural resources	<i>Natural system boundaries</i> [5]	- Availability of land [7] - Availability of water [7] - Availability of nutrients [8]
2. Governmental policies and regulations	<i>Socio-cultural system boundaries</i> [10] • License to produce (granted by the government)	- Regulative instruments (including spatial planning) [6]

Aspects	Concepts	Indicators
		<ul style="list-style-type: none"> <li>- Financial instruments [5,6]</li> <li>- Capacity building instruments [6]</li> </ul>
3. Consumer demands	<ul style="list-style-type: none"> <li>• License to sell (granted by consumers)</li> </ul>	<ul style="list-style-type: none"> <li>- Consumer demand for food price [5]</li> <li>- Consumer demand for food quality [5]</li> </ul>
4. Societal demands	<ul style="list-style-type: none"> <li>• License to operate (granted by society)</li> </ul>	<ul style="list-style-type: none"> <li>- Societal demand for animal welfare [5]</li> <li>- Societal demand for environmental conservation [5]</li> </ul>
5. Measures taken by farmers	<p><i>Strategies for metropolitan agriculture</i></p> <ul style="list-style-type: none"> <li>• Sustainable intensification [5,6]</li> <li>• Sustainable valorization [5,6]</li> <li>• Sustainable diversification [5,6]</li> </ul>	<ul style="list-style-type: none"> <li>- Food production method [5,6]</li> <li>- Scale of food product transportation by farmers [6]</li> <li>- Collaboration in the process of food production [5,6]</li> <li>- Added value of food product [5,6]</li> <li>- Consumer segmentation [5,6]</li> <li>- Collaboration in the process of food product sales [5,6]</li> <li>- Bargaining position of farmers in the process of food product sales [5,6]</li> <li>- New types of products besides food [6]</li> <li>- New types of consumers [6]</li> <li>- Collaboration in creating new types of products in agricultural practices [6]</li> </ul>

Source: [5,6,7,8,10]

### 3. Materials and methods

#### 3.1. Research area

JMA is comprised of the urban core Jakarta and surrounding areas, including five municipalities (Bogor, Depok, Tangerang, Bekasi and South Tangerang) and three regencies (Bogor, Tangerang and Bekasi). JMA has transformed from a metropolitan area of 6 million people in 1961 to 27 million people in 2010 [11]. In 2010, it covered an area of 6,256 km<sup>2</sup> with a population density of 4,469 inhabitants/km<sup>2</sup> [11]. A study from Pribadi and Pauleit [12] shows the built-up area in JMA gradually rose from 1.4 percent in 1972 to 32.9 percent in 2012. In the same period, 179,509 ha of agricultural land was lost [12].

Despite the high pressure on agricultural land, inland aquaculture and lowland horticulture remain important agricultural activities in JMA, while other types of farming did not survive and moved to other areas [12]. In this research, inland aquaculture, which is concentrated in Bogor Regency, was selected as case. Data from the Office of Animal Husbandry and Fisheries of Bogor Regency [13] shows that the fish production in Bogor Regency increased gradually from 23.1 to 112.8 million ton between 2006 and 2015 with an annual growth rate of 20.3 percent. In the last five years of that period, the fish market was dominated by catfish, goldfish, Nile tilapia, gourami and iridescent shark fish. The largest growth was seen in the production of catfish between 2011 and 2015 with an average annual growth of more than 25 percent, followed by gourami fish with an average annual growth rate of 24.7 percent. The proportion of catfish in the total of fish production in Bogor Regency rose from 60.0 percent in 2011 to 73.3 percent in 2015. Moreover, data from the Central Bureau of Statistics of Bogor Regency [14] shows that the contribution of the fisheries sector to the Regional Gross Domestic Income rose continuously between 2011 and 2015.

### 3.2. Interviews

The methods for data collection about the system boundaries and farmer strategies of inland aquaculture in Bogor Regency included interviews and document study. Interviews and document study are well-known methods in case study research [15]. The interviews aimed to collect data about opinions and motives of relevant stakeholders in inland aquaculture. Semi-structured interviews were used to arrange the interview questions along the five aspects and related indicators of the theoretical framework, but still allowed some improvisation and adjustment during the interviews. A total of 15 interviews were held between December 2016 and January 2017 among five different categories of interviewees: farmer associations, individual farmers, the local and regional government and the Indonesia consumer organization (Table 2). The total number of interviews was sufficient to establish data saturation, in other words no new information was obtained in the last couple of interviews [15].

**Table 2.** Interviewees

Category of interviewees	Interviewees
Community-based farmer associations	1. Farmer association of "Mina Makmur" 2. Farmer association of "Bina Karya Mandiri" 3. Farmer association of "Mitra Usaha"
Individual farmers	4. Farmer of gourami fish 5. Farmer of catfish 6. Farmer of catfish
Local Government (Bogor Regency)	7. Office of Animal Husbandry and Fisheries 8. Development Planning Agency of Bogor Regency 9. Office of Trade and Industry, Cooperatives Small and Medium Enterprises
Regional Government (Development Coordinating Board of JMA)	10. Head of Development Coordinating Board of JMA 11. Development Division 12. Social Welfare and Governance Division
Indonesia Consumer Organization	13. Executive Board 14. Consumer Complaints and Law Division 15. Research Division

### 3.3. Document study

Document study was used in addition to the interviews in order to collect data about the emphasis on agriculture and inland aquaculture in spatial planning documents at regional level (JMA) and local level (Bogor Regency) (Table 3). To analyze the documents, content analysis was applied [16]. The analysis concentrated on identifying the overall emphasis on agriculture in these documents as compared to other main sectors as well as the emphasis on aquaculture as compared to three other main agricultural activities in JMA and Bogor Regency. A set of keywords was used (Table 4) to count the word frequencies in the documents. A basic assumption was that words used more often would indicate issues of bigger concern. Next to the word counts, the type and content of policies and regulations in the documents were studied and compared with the results of the interviews.

**Table 3.** Types of Spatial Planning Document

Types of document	Name of documents	Document publishers
1. Spatial Planning Document about JMA (Regional level)	Spatial Planning of National Strategic Areas of JMA [17]	National Development Planning Agency
2. Spatial Planning Documents about Bogor Regency (Local level)	- Spatial Planning of Bogor Regency 2005-2025 [18]	Development Planning Agency of Bogor Regency
	- Spatial Planning of Bogor Regency 2016-2036 [19]	Development Planning Agency of Bogor Regency

**Table 4.** Keywords for Content Analysis of Overall Development Sector and Agricultural Sector

Overall development sector	Keywords	Agricultural sector	Keywords
1. Agriculture	Pertanian	1. Food crops	Tanaman pangan
2. Education	Pendidikan	2. Aquaculture	Perikanan
3. Health	Kesehatan	3. Horticulture	Perkebunan
4. Economic	Ekonomi	4. Livestock	Peternakan
5. Industry	Industri		
6. Trade	Perdagangan		
7. Tourism	Pariwisata		
8. Transportation	Transportasi		
9. Infrastructure	Sarana		
10. Settlement	Perumahan		

### 3.4. Data analysis

Pattern matching was chosen as technique for analyzing the collected data. In this analytic technique, the data were matched with the concepts of system boundaries and metropolitan agriculture. The procedure of this analysis followed the next steps.

- Organizing and preparing the data: Transcribing the results of the interviews and document study.
- Reading all data: Obtaining the overall meaning of the data gathered from the interviews and documents.
- Coding the data: Labeling and matching the data with the indicators of the analytical framework.
- Interpretation: Identifying the meaning of the collected data in perspective of the concepts of system boundaries and metropolitan agriculture.

## 4. Results and Discussion

### 4.1. Condition of natural resources

The condition of natural resources in this study is related to land, water and nutrient availability. Both the individual farmers and the farmer associations revealed that the availability of land is the most important condition for fish cultivation in Bogor Regency. Besides using their own land to cultivate fish, farmers also use vacant land and/or lease parcels of land. Farmers can use vacant land without permission from the government. However, according to the local government officers, the expansion of settlements due to urban growth of Jakarta threatens the available land for fish farming in Bogor Regency. In line with this, regional government officers described the competition for land use between agricultural and residential as well as industrial sector at regional scale. Especially, many paddy fields are being converted into residential and industrial areas.

*“Bogor Regency is located in the vicinity of the capital of Jakarta and the population in the capital city is increasing rapidly. As a consequence, there is a competition for land in Bogor Regency between agriculture and new settlements. Many housing developers try to convert agricultural land into settlement area”*  
(Interviewee 8).

All farmers and local government officers perceived the amount of water in Bogor Regency is sufficient for the demand of fish farms. Farmers obtain water from irrigation systems, seepage water or spring water for free. However, when a dry season over seven months occurs, farmers who usually take water from irrigation systems will suffer from water scarcity. In this case, farmers address the obstacle by altering the water sources, so their inland aquaculture business can still operate. Furthermore, all farmers and local government officers declared the quality of water is sufficient to support the practices of inland aquaculture. Farmers do not need to treat the water before using it in the fish farms. Moreover, local government officers claimed that there is no competition for the use of water. However, the farmers revealed that wastewater produced in inland aquaculture activities is disposed directly to surface water without being treated properly.

*“In the rain season, the quantity of water is sufficient. Also, if a dry season less than seven months takes place, it is still normal. However, if a dry season more than seven months occurs, water capacity will diminish”*  
(Interviewee 2).

In the interviews, nutrients were defined as the fish feed needed for inland aquaculture. All farmers stated that they rely entirely on pellet fish feed produced by private factories. They employ commercial fish feed because pellet fish feed is more effective to produce fish products and it is always available in the market. However, according to the farmers, the price of commercial fish feed is too high because the raw materials of the fish feed are being imported. The local government officers confirmed that commercial fish feed is relatively expensive for the majority of farmers in Bogor Regency. It is rooted in the fact that Indonesia is not able to produce the raw material of pellet fish feed itself. In response, many farmers who practice fish farming in the fattening phase use rotten eggs and chicken carcasses as an alternative fish feed in order to minimize the production costs. Local government officers confirmed that farmers in Bogor Regency utilize rotten eggs and carcasses of chicken in their fish production.

*“Rotten eggs and carcasses of chicken are boiled first, before being given to fish in the ponds”*  
(Interviewee 2).

To conclude, the results revealed that the natural resources support aquaculture in Bogor Regency because of the availability of land as well as the sufficient amount and quality of water and nutrients. Furthermore, other studies confirm that the government in JMA offers flexibility in the use of vacant land for agricultural practice by allowing farmers to grow food on unused land without getting permission from the government in advance [20]. This practice is different from what mostly happens in developed countries where landowners often do not lend their unused land for agricultural activities due to a lack of sufficient policy for regulating a lending arrangement [8]. Also, the results showed that the price of fish feed is relatively high for the majority of farmers. Farmers deal with this challenge by using rotten eggs and chicken carcasses as an alternative fish feed. While this would not be possible in many other countries, it is not prohibited by the Indonesian government, nor does it result in refusal of consumers to buy the fish or protest from society. It confirms that standards by the government and consumer and societal demands concerning agricultural production differ between countries [5].

#### *4.2. Governmental policies and regulations*

Governmental policies and regulations refer to regulative, financial and capacity building instruments. At regional level, there are no specific regulative instruments for inland aquaculture. The regional government encourages the development of the agricultural sector broadly by establishing the so-called Agribusiness Distribution Center policy in 2014. The Agribusiness Distribution Center policy aims to meet the food needs of JMA consumers, stabilize the agricultural commodity prices and provide a market for food producers by managing the food logistic system in JMA. However, the center is in the process of development, so the impact of this policy is unknown yet. In 2010, the local government in Bogor Regency established the minapolitan fisheries program in four sub-districts. The program has similarities with the agripolitan concept and aims to create a center of fish production and processing with a high competitiveness, efficiency and quality for public well-being. According to the local government, a significant increase of the number of fish production operations, farmer households and farmer associations occurred after initiation of the minapolitan program (Interviewee 7). In line with this, the farmers perceive several advantages of this program as the prices of fisheries commodities seem to be more transparent and accesses to fish seed and fish products becomes easier. In the process of implementation, the local government tries to engage farmers directly, although two individual farmers argued they were not involved.

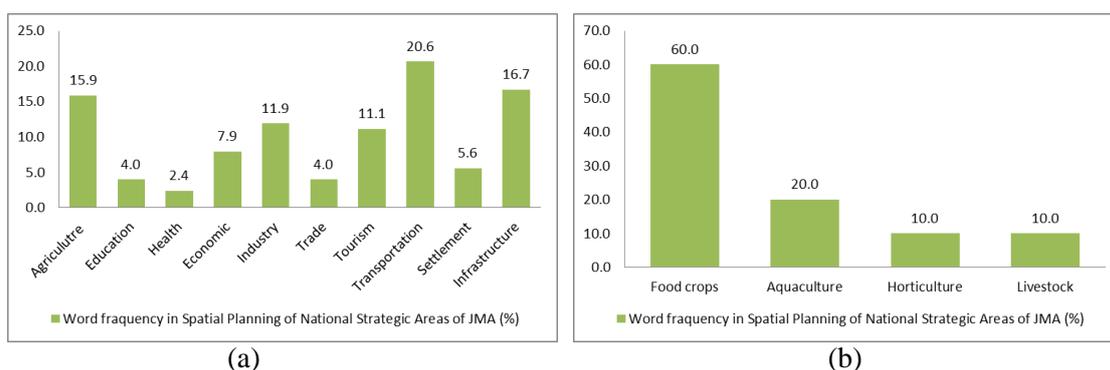
*“When we talk about the impact of minapolitan, its assessment should be measurable. One of the ways to assess this impact is by looking at the progress of the contribution of fisheries sector to Regional Gross Domestic Income. According to this data, we can see that its contribution rose between 2011*

and 2015, so minapolitan has a positive impact on the process of inland aquaculture development in Bogor Regency” (Interviewee 8).

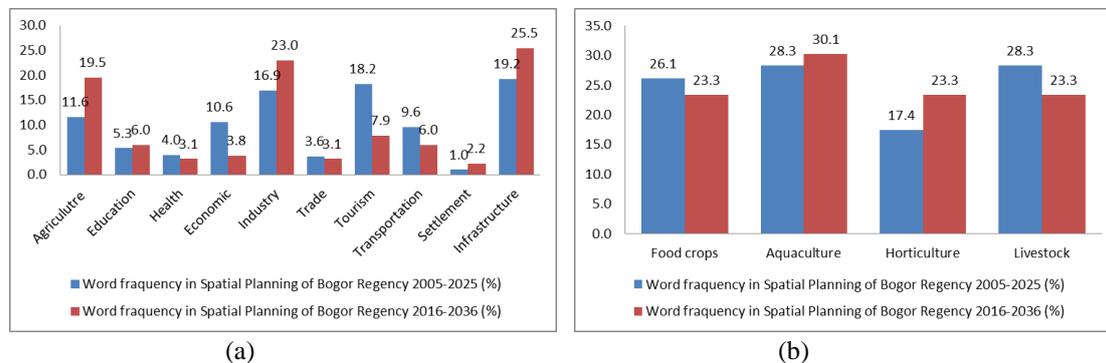
Spatial planning policy at regional level regulates the aquaculture sector in general and supports it by determining zoning regulations for fisheries activities. The word count of the regional spatial plan shows that aquaculture gets the second most attention after food crops (Figure 1). Regional spatial planning policy prohibits the conversion of irrigated agricultural land. However, regional governmental officers argued that, in reality, many productive areas in JMA, especially paddy fields, are being converted into residential and industrial areas. Furthermore, the word count shows that aquaculture gets the most attention in local spatial planning policy in Bogor Regency (Figure 2). Fish farming is a main driver of economic activity of the local community. Local spatial planning policy prohibits the conversion of agricultural land in the minapolitan area to other functions.

*“It is prohibited to convert technically irrigated agricultural land to other functions”*  
(Spatial Planning of National Strategic Areas of JMA [17] p 43).

According to the interviewees of the local government, the enforcement of local spatial planning policy is much more effective compared to the regional spatial planning policy. This is rooted in the fact that the regional government has no power in controlling the execution of spatial planning policies conducted by local government, because various responsibilities were transferred from the central government to local government, including spatial planning policies, after the fall of the New Order regime in the mid-1990s. In this regard, the regional government cannot take any actions associated with spatial planning violations at the local level. Therefore, the enforcement of spatial planning policies fully relies on the willingness of the local government. The enforcement of local spatial planning policy concerning farmland conversion in Bogor Regency is effective because the local government has a higher interest to protect productive farmland which contributes increasingly to the Gross Regional Domestic Product of the local government. Rukmana [21] and Bunnell and Ann Miller [22] also describe how decentralization created ineffectiveness in the implementation of spatial planning policy in JMA. The decentralization made local governments more powerful, so they are not afraid of the regional government and take control of planning issues. Spatial planning violations in JMA are mostly related to the exploitation of natural resources for generating more local revenues, such as the development of industries or settlements in areas dedicated to agriculture [21]. According to Baker and Hincks [23], the implementation of spatial planning policy is dominated by the process of negotiation and interaction between various actors, each with their own interest and agenda.



**Figure 1.** Word Frequencies of (a) Overall Development Sectors and (b) Agricultural Sector in Spatial Planning of National Strategic Area of JMA



**Figure 2.** Word Frequencies of (a) Overall Development Sectors and (b) Agricultural Sector in Spatial Planning of Bogor Regency

The category of financial policy and regulations includes three types of local financial instruments associated with the practice of inland aquaculture, namely People's Business Credit, subsidies and tax exemption for fisheries businesses. The regional government has no role in these financial instruments. According to the local government officers, the program of People's Business Credit cannot help farmers effectively due to the collateral and bank interest rate. They perceive the subsidies and tax exemption for fisheries businesses as more effective financial instruments to encourage the development of inland aquaculture. Although the individual farmers consider the People's Business Credit a good financial initiative of the government, they are not willing to make use of the program because they require a large amount of supplementary funding. Farmer associations are not willing to access the program because they object to the collateral and bank interest rate. While all farmer associations obtain advantages from the subsidies, the individual farmers cannot apply for these subsidies. However, all fisheries businesses are exempt from tax. One of the individual farmers was critical about the financial aid of the government, claiming that the government aid will only make farmer associations more dependent.

*"How many farmer associations in the minapolitan area do you think can survive without subsidy? If there are a hundred farmer associations, it is likely that only one group can survive without subsidy.*

*Farmers who will survive are the ones who work with their own sweat. Farmers who obtain government aid should be much more successful, because they get a venture capital from the government. In reality, they only seem to be more dependent. They rely on subsidy this year, and next year they will need subsidy again"*

(Interviewee 4).

The Bogor Regency government offers training programs which cover diverse topics to increase knowledge and capacity among fish farmers. Two local government officers said that this action has a positive impact on the development of inland aquaculture, such as a better dissemination of innovative practices in fish farming. In line with this, the farmer associations affirmed that the training provided by the local government enhances their knowledge and capacity, especially concerning business management, fish breeding and vaccines. In contrast to this, the interviewee from the Office of Trade and Industry, Cooperatives Small and Medium Enterprises argued the impact of the training program of Bogor Regency is not optimal yet when it is compared to the increase of farmer income as a result of the training. Also, two individual farmers said that the training program is too generic and is not suited for them.

*"Training should be tailor-made to the knowledge level of a farmer. Farmers who are experts in cultivating fish should be offered training with a higher level than novice farmers. However, the training material designed by the local government is similar each year. So, I think this training is just a formality to spend some government budget. Moreover, it is always conducted from October to December, at the end of the yearly budget period"*

(Interviewee 4).

Concluding, the results on governmental policy and regulations show that the role of the regional government is not visible because policy related to farming activities in JMA is still in the process of establishment. At the local level, the government encourages the processes of fish farming development by implementing the minapolitan program, subsidies, tax exemption and a training program. According to Brooks [24], subsidies are typically applied by the government in developing countries to address short-term objectives, such as unstable agricultural commodity prices. However, subsidies can make farmer associations more dependent, especially since subsidies in Indonesia are not accompanied by supporting programs to make farmer associations more robust [25]. Tax exemption or tax reduction is effective ways to support the development of agricultural practices, in particular small-scale farms [26]. In addition, capacity building programs can increase the competitiveness of farmers and, in turn, increase the profit of farmers [24]. However, the program of capacity building designed by the local government is not well-organized, indicted by the fact that the training material does not develop over time and is not tuned to the diversity in farmer's knowledge and capacity. According to Anantanyu [27], farmer capacity building programs in Indonesia are often thwarted by conflicts of interest.

Facilitating farmers to gain to access to credit programs is not effective in supporting the development of fish farming because the farmers are reluctant to use this facility due to the collateral and bank interest rate. According to Supriatna [28], farmers in Indonesia are not willing to use credit programs because they object to the requirement of collateral on their house or land. Smit et al. [8] found that agricultural activities situated close to built-up areas are considered a high-risk investment by financial agencies, so the government rarely provides credits without collateral to farmers in these areas.

#### 4.3. Consumer demands

Consumer demands are connected to food price and quality. All interviewees, from consumer organization, farmers to local government officers, claimed Indonesian consumers primarily pay attention to the price of food products because they have low purchasing power. The consumer awareness concerning food quality is still low.

*“Actually, I have a certificate of Good Way to Cultivate Fish, but consumers do not care whether I have it or not”*

(Interviewee 4).

In short, the results showed that consumers in JMA demand food with low price and pay less attention to the food quality. This is in line with Bakrie et al. [29] who also concluded consumers in Indonesia pay much more attention to the price of food than its quality. The main factor influencing Indonesian consumer decisions when buying food products is the family income [30].

#### 4.4. Societal demands

Societal demands are linked to animal welfare and environmental conservation. All interviewees gave unanimous responses that animal welfare and environmental conservation in aquaculture are not issues of concern to consumers in JMA currently. Attention to animal well-being is mainly focused on specific animals, such as orangutan, tuna fish and pets. In addition, the Indonesian society does not perceive agriculture as an activity of environmental concern, but instead as a productive activity practiced by mostly small-scale farmers to improve their economic position.

This confirms findings of other researchers concluding that societal concern for environmental issues and animal welfare in agricultural practices in Indonesia is low [31]. Moreover, Hastreiter [32] concluded there is a general lack of both domestic animal welfare standards and enforceable animal welfare regulations in Indonesia.

#### 4.5. Measures taken by farmers of inland aquaculture

In the process of fish production, the farmers employ a high stocking density to produce as much fish as possible. By applying a high density, they can comply with the demand. The farmers interviewed

further conveyed they do not transport and sell the fish to consumers themselves. Typically, the farmers in Bogor Regency collaborate with wholesalers who collect the fish at the fish farms and sell the fish in the city. In other areas of JMA, farmers transport their agriculture products to the city themselves. This collaboration offers opportunities for farmers to fully focus on optimizing primary production in order to obtain sufficient profit from their agricultural businesses. However, this also comes with a price with regard to animal welfare, as stated by one of the interviewees of the farmers associations.

*“Farmers here cultivate fish by means of high stocking density. Many fish ponds with the area of 100 m<sup>2</sup> are filled with 20 thousand fish. In a normal situation, it should be filled with 7 thousand fish. If ponds of this size are filled with more than 10 thousand fish the ponds are substantially overcrowded (Interviewee 2).*

## 5. Conclusion

The results of this study contribute to an improved understanding on farming strategies taken by fish farmers in JMA. From the research can be concluded that intensification is the dominant farming strategy implemented by farmers of inland aquaculture in JMA. Farmers tend to concentrate on intensive methods of fish production in order to reduce the production costs and subsequently obtain enough revenues from their farming activities. This is further supported by collaboration with wholesalers who take care of transportation and sale. However, it can also be concluded that fish farming in JMA is not sustainable, given the concerns about animal welfare due to high stocking density in the fish ponds as well as the concerns about the financial robustness due to the local subsidy system. Furthermore, the discharge of wastewater from fish ponds to the surface water is a potential issue of environmental concern. The local training programs seem to be too generic in order to be effective to address these issues and making inland aquaculture more sustainable.

Further research is needed to identify potential measures to improve the financial, social and environmental robustness of inland aquaculture in JMA. Such measures should be included in new tailor-made training programs for fish farmers. It is further recommended that other strategies besides intensification will be explored, for example strategies focused on earning additional revenues from fish farming by offering other services to urban dwellers such as educational or leisure activities.

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