

## THE SUSTAINABILITY OF CATFISH AQUACULTURE IN COASTAL SUBURB OF PADANG, INDONESIA

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### Abstract

The research objective is aimed at the sustainability analysis of catfish aquaculture business that is run by small fish farmers in coastal suburb of Padang. Value Chain Approach (VCA) and Strength, Weakness, Opportunity, and Threat (SWOT) Analysis are applied and used as the base of descriptive qualitative analysis. It is found that the supply of production input especially fish food plays the most important role on the sustainability of aquaculture development. The intervention of government policy to push the aquaculture development in Padang coastal suburb is also important on one side but it could cause dependency of fish farmer on government support on other side. The contribution of parties in value chain are not yet optimum. Therefore, efforts should be focused on the optimizing the role of actors including institutions on the value chain according to market-based solutions which would sustain catfish aquaculture system in coastal suburban of Padang.

**Keyword:** *Catfish Aquaculture, Value Chain Approach, Sustainability*

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### 1.0 INTRODUCTION

Padang is the capital of West Sumatra Province located precisely facing Indian Ocean. According to BPS Provinsi Sumatera Barat (2014), 92% of total 6,913 fishermen in Padang are categorized as full fishermen; around 42% of them work traditionally. Nazmar (2013) described that off-fishing and non-fishing activities are potential to develop as an alternative income generation in this region. It relates to their actual situation i.e. lack capacity of fishing vessel, high competition on the utilization of fishing ground, and the depletion tendency of fisheries resources in their main fishing ground nearby coastline.

Oluwasola and Ige (2015) described that although the intensity of urban growth can pose a major challenge to the development and growth of large scale farming, fish production is an enterprise that requires small area of land and which can make use of the several stream channels for the sustainability of the urban environment. Fish farming is not just uniquely placed to reverse the decline in supplies

experienced by capture fisheries but also has notable potential for new livelihood opportunities, providing mechanism for lower priced fish, enhanced nutritional security and employment for poor communities (Jagger and Pender, 2001). Catfish cultivation has been significantly developed in Indonesia after 2005. District Boyolali in Central Java is well known as the centre of catfish aquaculture. Village Tegalrejo in this region which is called as Catfish Village produced more than 12 tonnage of catfish per day. In Padang, catfish cultivation developed after 2010. Catfish market has also developed in many regions in West or out of West Sumatra Province. Catfish aquaculture is considered by coastal community as an alternative choice for shifting activities from fishing to fish farming. Its uncomplicated technology, low cost investment for starting up, and government support are important reasons for small fish farmer running catfish farming partially or totally. However, some fish farmers could maintain their business only in several

production cycles. The catfish aquaculture has not significantly developed yet as it is expected. Theoretically, a sustainable farming is the freedom to access and combine on- and off-farm production factors and practices that are compliant to natural laws that lead to increased production of crops and livestock products sufficient for local and export markets (C.O.A., 2011).

## **2.0 OBJECTIVE AND METHODOLOGY**

Catfish aquaculture is expected becoming an alternative income generation of coastal suburban community in Padang especially for fishermen households. For a sustainable practice of this fish cultivation needs analyses on constraint probability faced by fish farmers who are sceptical to carry out the catfish aquaculture. This raised several questions regarding whole activities and interrelation patterns amongst actors along the value chain of catfish aquaculture practices in Padang coastal suburb. What are strength, weakness, opportunity, and threat of catfish aquaculture development? What strategy to recommend? The study objectives are analyzing the sustainability and finding relevant policy intervention and upgrading strategy of small catfish aquaculture in rural coastal of Padang.

Coastal rural area of Pasié Nan Tigo in Sub district Koto Tengah of Padang Suburb is chosen as research location purposively. Because, the catfish aquaculture system was firstly introduced to fishermen in this area. Besides, the practice of catfish aquaculture of coastal community is concentrated also in this region. The chairman of fish farmers in the research area was chosen as main informant. Element of catfish farming stakeholder namely catfish fish farmer, fish food supplier, fish product processor and trader, government fishery officer, and other relevant parties of private and public sector were interviewed based on information from informants. The criteria of fish farmers which are selected as respondent is the continuity of production at least three years. Meanwhile, the criteria of other respondents out of fish farmers is their participation on catfish aquaculture in accordance with their own role. The respondents

are chosen by applying snowball approach. Value chain mapping was conducted based on the data and information from respondent. Value chain and SWOT analysis in the frame of qualitative approach were applied.

## **3.0 LITERATURE REVIEW**

It is predicted that by 2025 the Indonesian total population will be around 273 million people. Food and income security will be a raising issue for this largest archipelagic state in the world with around 17,500 islands and 95,181 km coastline. Bahri and Tiesnamurti (2012) mentioned that the government should prepare a strategy of medium and long-term livestock development in sustainable manner by leveraging the availability of local resources.

Promoting aquaculture is considered as a suitable strategy for poverty alleviation in rural coastal area. Because, fishery development program by stressing on the industrialization of capture fisheries in fact, does not always contribute positive impact on household economy of small fishermen (Nazmar, 2013). In line with this matter, Oladimeji *et al.* (2014) described that fishermen need education to understand work diversification, adopt technology which is able to improve the life quality of rural household, maintain fisheries resources, and avoid environment pollution.

According to Manikmas (2012), farmers are rational in decision making process with respect to any introduced agriculture technology. They may consider the economic sacrifices in term of additional cost and potential benefit or additional income before they accept and adopt the introduced technology. Munzir (2001), Munzir and Heidhues (2002), and Munzir (2009) described that rural aquaculture plays significant role for food and income security in rural social economic development. Oluwasola and Ige (2015) mentioned that the development of fish farming in Nigeria was driven by socio-economic objectives including nutrition improvement of rural community, generation of additional family income, creation of employment, and diversification of income activities.

VCA and SWOT are analytical instruments for analyzing interrelation various activities and institutions concerning of production system, sector, business, and their development strategy which is important for the aspect of sustainability. VCA is applied by the World Bank (2011) in agribusiness and agriculture in Sub-Saharan Africa, in the context of quality management (Popescu and Dascalu, 2011), and in seaweed farming in India (Krishnana and Narayanakumarb, 2010). German International Cooperation (GIZ) has applied VCA and SWOT as analytical instruments for Regional Economic Development Program in various home industries, tourism, agribusiness, and other commodity development in Indonesia including the value chain study of white pepper in West Kalimantan (GIZ, 2012).

#### 4.0 RESULTS AND DISCUSSIONS

Introduction of catfish aquaculture to Padang Suburb Pasie Nan Tigo was conducted in mid 1990s. Coastal rural household in this area run this catfish farming as side activity for additional nutrition source. Later, more households tried to gain income from catfish aquaculture. In January 2008, the catfish farmers established a group which is conditional for having access to government's program support such as training and micro credit facilitation.

##### 4.1 Profile of Catfish Production

All fish farmers in Pasie Nan Tigo were accounted 63. However, some of them consider aquaculture is just as a side business and do not conduct fish culture activity regularly. For them, aquaculture is a side business only. This does not fit the criteria of research respondent of 50 fish farmers, that is then determined as population. Ninety percent of them produce catfish for consumption purpose, 10% produce catfish seed. One of fish farmer's household also worked on fish processing to produce smoked fish. Production and its value of catfish farmer activity including fish processing in research area are presented in Table 1.

Table 1: The value of production of catfish farmer in Pasie Nan Tigo Padang Suburb in November 2015

Activity	Product/ Size (cm)	Unit	Quantity	Price/ Unit, Rp*	Value Rp**
Producing juvenile	2-3	Ind.	220	50	11
	3-4	Ind.	250	100	25
	4-5	Ind.	420	150	63
	5-7	Ind.	350	200	70
Producing consumption size	Fresh fish	Kg	34	11,000	374
Fish processing	Smoked fish	Kg	1.6	70,000	112
Total					655

Note:

1. Ind. = individual.
2. \* = Figure x 1,000.-
3. \*\* = Figure x 1,000,000.-

From the value of production (in Rp) in Table 1, it is calculated that 57% of the production value came from catfish production for consumption purpose. Most of catfish farmers prefer to produce fish production for this consumption purpose than fish seed. According to farmers, producing fish seed is riskier than producing catfish in bigger size because of higher mortality potential of juvenile. Although it is considered risky, few farmers gained good profit from seed production which contributes 26% of total production value beside other contribution i.e. 17% from smoked fish. So far, demand of the production is not good. Potential buyers cover restaurants and household consumers in Padang, Pariaman, and Bukittinggi. These cities are known as tourism destinations in West Sumatra.

##### 4.2 Pond Ownership and Farm Income

Most of farmers found that having and operating more units of pond enable them to manage productivity, reduce mortality risk, and gain better farm income. But, they could not yet determine the relation between number of pond unit and amount of farm income or fix optimal ownership of pond unit for the best farm income. This would be influenced by pond size, stocking density, feeding intensity, water quality management, etc. Distribution of pond unit

ownership amongst catfish farmers varies significantly (Table 2).

Table 2: Distribution of Pond Unit Ownership and Monthly Farm Income

No.	Pond Unit	Amount of Farmer		Monthly Farm Income (Rp) *
		∑	%	
1	1 - 5	36	72	1.0 - 2.5
2	6 - 10	12	24	2.5 - 4.5
3	11-15	01	2	4.5 - 6.0
4	16-20	0	0	1.0
5	> 20	01	2	8.0 - 10.0

Note:

1. Source: Office of Lead Farmer in Pasie Nan Tigo in 2015
2. \* Figure x 1,000,000.-

Seventy-two percent of catfish farmers have 1-5 units of catfish pond, 24% of them have 6-10 units, one household (2%) has 15 units, and one other household (2%) has 47 units of pond. Average size of a catfish pond is between 2.0-2.5 m x 3.5-4.0 m. Managing 2 units of catfish pond in a productive manner enables fish farmer household in Pasie Nan Tigo earn money in average of Rp. 1,800,000 monthly. According to most of fish farmers, catfish aquaculture in Padang Suburb is a promising activity to improve their household income.

### 4.3 Value Chain of Catfish Aquaculture

Value chain mapping on a certain business system is commonly carried out by field observation, interview, and Focus Group Discussion. The value chain map of same business could be different from time to time or different area due to the difference of business actors, stakeholder element, and access to the business system.

For simplification purpose, two value chain models of catfish aquaculture in Padang Coastal Suburb are depicted i.e.: Partial Model (Figure 1) and Integrated Model (Figure 2). Partial Model depicted interrelation of actors in the technical activities of catfish aquaculture. Results of field observation indicated that famers do not have difficulty on providing land and cultivation media. Small fish farmers could start running up a catfish aquaculture from a

small fish pond built around their house. Beside conventional fish pond, some farmers manage cement pond and special ponds made of thick plastic material so called “kolam terpal”. Technically, managing catfish aquaculture is relative easy to learn and practice. Especially for farmers who specialize their fish culture to produce fish for consumption size, not for seed production purpose.

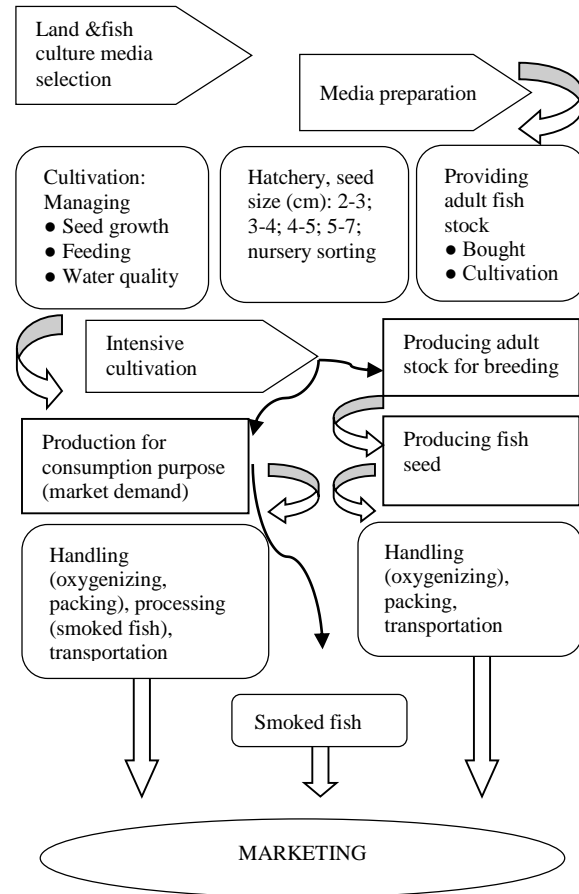


Figure 1: Partial Value Chain Model of Technical Activities of Catfish Aquaculture in Coastal Padang Suburb

As an intensive cultivation, catfish aquaculture needs commercial fish pellet. Some farmers have financial constraint for providing pellet mainly when its price increasing. There is an idea to establish a cooperative to support the small fish farmers in supplying input factors and product marketing. Efforts for this objective were organized by some farmers but it is not yet successfully attained due to the lack of

understanding of the small fish farmers on the important role of self-organized cooperative. An effective extension program is considerably necessary. Indeed, institutionally there is a good opportunity to solve the problem due to the existence of institution dealing with such issues in Padang namely public extension and private extension institution. Initiative to put both in an effective collaboration should be pushed.

Amongst households running fish culture, there is a fish farmer household who is interested in fish processing and produces smoked fish. The smoked fish productions as well as other aquaculture production are mostly absorbed by local markets in Padang and neighbor areas such as Padang Pariaman District and Pariaman City.

For a simplification purpose, an Integrated Model of the catfish aquaculture value chain in Padang Suburb is depicted below.

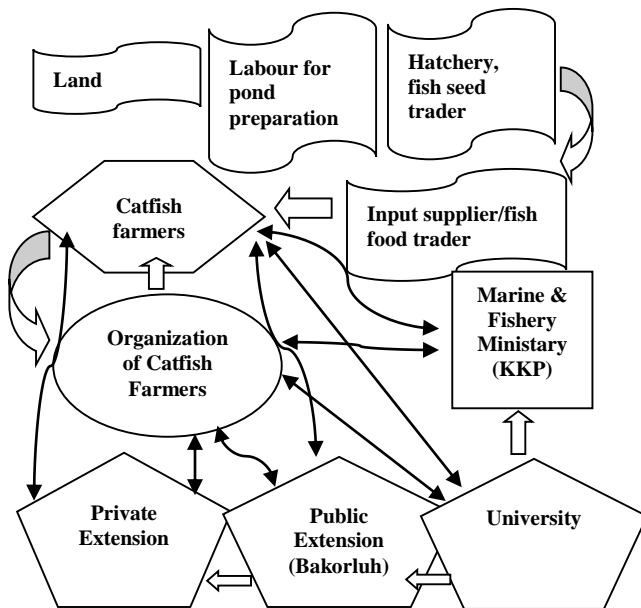


Figure 2: Integrated Value Chain Model of Catfish Aquaculture in Padang Coastal Suburb

Land and labour for pond preparation in Pasie Nan Tigo are available. The catfish farmers' concern is about finding suitable sites having good water quality especially if they start cultivating fish from the smallest size of 2-3 cm that is sensitive to water quality changing. Besides, fish farmers worry about possibility loosing because of flood which could happen if

heavy rain and high tide occur simultaneously. This issue rose after flood disaster occurring in Padang City on March 22<sup>nd</sup>, 2016. So far, there still no site arrangement regarding choosing better location for building pond in Pasie Nan Tigo coastal area. From pond engineering point of view and the sustainability of catfish aquaculture production system, this matter has to be taken in to account mainly by related institution supporting the future sustainable development of catfish aquaculture in Padang coastal suburb. KKP and University could play important role to cope the problem.

Field observation pointed that some small fish farmers are not able to maintain their fish cultivation sustainably. The constraint is the increasing price of commercial fish food. The profitability of fish farming running by small farmers is sensitive to price increasing of fish food. Sometimes, the price of fish seed is also increasing but, the fish farmers handle matter by reducing density of cultivated fish.

According to commercial fish food trader, the price fluctuation is difficult to avoid. The reasons are relating to the transport cost of fish pellet from Java Island and the shortage of fish food in certain condition. Constraints on the fish food supply as well as its high price in term of low purchasing power of small fish farmer tend to be common problem for sustainable aquaculture development. Oluwasola and Ige (2015) explained that fish feed constituted 79.18% of the total operating cost in catfish production in Oyo State, Nigeria. He concluded that there is the need to access fish farmers to substantially cheaper feed inputs to ensure the use of adequate quantity and quality of feed in catfish production.

Fish food availability in a relative low price is not probably a problem of catfish aquaculture. This could be a common constraint for sustainable development of aquaculture in West Sumatra Province and other region in Sumatra Island as well. It is possible to find an alternative fish food to fulfil local demand. Effort to find solution should be considered by involving both public and private sectors under a win-win solution. Field observation and interview carried out with farmers and policy maker in public sector it is expected that there should be an alternative solution discussed between fish food

supplier and farmers. On the other hand, it is also expected that the farmer organization could also play a role in fish food supply and trading in cooperative institution manner that put the optimum profit of fish farmers as priority.

Several institutions supported the development of catfish aquaculture. Government has conducted regular training and extension programs. It is a kind of regular project implemented annually or periodically. It is not seldom that government also provided seed to deliver to fish farmers under government financial support. This budget was channelled to a selected fish farmers and government hatchery institution. Supporting fish farmers in this way is appreciated as well as expected by fish farmers. However, field observation showed that fish farmers are not so eager to increase profit by increasing productivity or diversify production by producing fish seeds that has good demand in Padang and other neighbour region such as Dharmasraya, Bukit Tinggi and Payakumbuh. In a long term, for sustainable development of catfish aquaculture, the catfish farmers should be more engaged and integrated in market system that would drive their catfish aquaculture development. Lesson learnt from floating net cage aquaculture development at Lake Maninjau at the beginning phase of its technology adoption showed that private sector namely main actors in the value chain played more important and significant role than government extension program. Further, there was no significant role of farmers' formal education level in the production system (Munzir, 2002).

The infrastructure improvement of transportation from West Sumatera to Riau Province has increased market access to this region. Potential tourist destinations between both provinces in which culinary business developed well also prospective demand for catfish production, since the menu of "pecellele" made of catfish is very popular. However, fish farmers have not yet paid attention to take advantage from this opportunity.

Observation on the technical aspect in production system showed that fish farmers have good enough skill in catfish cultivation. Unfortunately, their catfish aquaculture business is not developed as it should be, although they have already practiced catfish farming yearly.

Lack of knowledge in entrepreneurship, household economic management, and farm financial management are considered as constrains for their catfish farming development. So far, the extension program focused more on technical aspect of catfish production system. Efforts through cooperation of actors in value chain should be carried out to enable fish farmers not only diversifying their product orientation but also understanding and managing their household and farm economy properly.

#### 4.4 SWOT Analysis

Analysis of strength, weakness, opportunity, threat, and development strategy based on the combination of each SWOT elements is presented in Table 3.

Table 3: SWOT Analysis and Upgrading Strategy on Sustainable Catfish Aquaculture Development Pasie Nan Tigo PadangSuburb

<b>Internal Factor</b>	<b>Strength (S)</b> <ul style="list-style-type: none"> <li>● High demand</li> <li>● Simple technology</li> <li>● Land availability</li> <li>● Stakeholder support</li> </ul>	<b>Weakness (W)</b> <ul style="list-style-type: none"> <li>● Fluctuation of production</li> <li>● Entrepreneurship knowledge</li> <li>● Financial management</li> <li>● Pond engineering</li> </ul>
<b>External factor</b>		
<b>Opportunity (O)</b> <ul style="list-style-type: none"> <li>● Potential market of ASEAN Economic Community</li> <li>● Better market access to Riau Province</li> <li>● University's interest in the study on applied technology</li> </ul>	<b>S-O Strategy</b> <ul style="list-style-type: none"> <li>● Market mapping and updating demand data</li> <li>● Building Networking between fish farmers and potential buyer</li> <li>● Increasing communication and network with university</li> </ul>	<b>W-O Strategy</b> <ul style="list-style-type: none"> <li>● Conducting entrepreneurship training, financial, and fish farm management</li> <li>● Improvement on market access of input and output</li> <li>● Integrating network between relevant private and public sector</li> </ul>
<b>Threat (T)</b> <ul style="list-style-type: none"> <li>● Price fluctuation of fish food</li> <li>● Environment degradation</li> <li>● Fish disease</li> </ul>	<b>S-T Strategy</b> <ul style="list-style-type: none"> <li>● Managing fish food stock and supply via system of cooperative</li> <li>● Conducting training on water quality and fish health management</li> </ul>	<b>W-T Strategy</b> <ul style="list-style-type: none"> <li>● Developing alternative fish food</li> <li>● Conducting training and cooperation due to pond engineering with university</li> </ul>

Adopting catfish aquaculture is important for community in Padang coastal rural suburb as alternative and additional income as well besides

fishing. But, maintaining and developing their aquaculture business sustainably are next very important steps in term of food and income security. Conceptually, the paradigm of sustainable development covers ecological, economic, and social aspect. There are several institutions and parties that can cooperate to create and increase added value of activities in the value chain of catfish aquaculture to fulfil the need of its sustainable development.

The sustainable development of catfish aquaculture run by small fish farmer is pragmatically accepted by stakeholder as a practice of livestock production system that can improve household economy of fish farmer, creating social mobility and community empowerment, and maintaining ecosystem integrity as well as the carrying capacity of environment. Optimizing the cooperation of actors and institution in the value chain would enable the catfish aquaculture of small fish farmers developing sustainably. This is strengthened by study carried out by Supriana *et al.* (2014) on the sustainability activities relating to utilization of tuna and tuna like resources in Indonesia. It is stated that tuna and tuna like fisheries depend on value chain system formed by stakeholders ranging from product fishing, processing/diversification, distribution, and marketing. Interaction pattern of fishermen, retailers, collectors, and exporters affected significantly by pricing and the level of role played by stakeholders

## 5.0 CONCLUSION AND RECOMMENDATION

Developing catfish aquaculture is an appropriate solution for income and food security in coastal rural area of Padang Suburb, Indonesia. By generating income from catfish aquaculture, small fishermen could increase their purchasing power to fulfil food security and other household needs. They could also shift their economic activity from fishing as small fishermen to fish farming as small fish farmers.

Result of value chain analysis indicated the need of policy intervention on providing fish pellet, strengthening and empowering fish

farmer's organization and improvement on extension program.

The unavailability of commercial fish food in low price according to purchasing power of small fish farmers, lack of competences in entrepreneurship, household economy, farm and financial management, and pond engineering are considered as bottle neck for sustainable development of catfish aquaculture. These have to be taken into account for the future development of catfish aquaculture in this region.

Optimizing the benefit gained by fish farmers from interrelation and interaction of actors and stakeholder elements in value chain is a substantial strategy to ensure the sustainable development of the catfish aquaculture.

Upgrading strategies could be recommended by developing alternative policies and programs referring to the result of SWOT Analysis. These are formulated in Strength-Opportunity (S-O), Strength-Threat (S-T), Weakness-Opportunity (W-O), and Weakness-Threat (W-T) Strategy. Some policy recommendations that can be concluded from SWOT Analysis are building and developing entrepreneurship attitude and knowledge of fish farmer including financial and fish farm management, improvement on market access of input and output, and cooperative system management.

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