

# ANALYZING THE SUPPLY CHAIN FOR FISH IN SOBRADINHO LAKE, BAHIA, BRAZIL

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Fishing in the São Francisco River has been taking place for a long time due to the size and diversity of fish fauna found in this river basin. Tilapia farming in Sobradinho Lake (Fig. 1) began in 2003, encouraged by government programs to develop this activity with fishermen and others farmers. The activity has grown in an unplanned manner and is dependent on government support for its growth. Private enterprises have also emerged and grown independently. The high productive capacity of Sobradinho Reservoir and the great market demand for fish contribute to the sustainability of production.

However, the percentage of profit generated is small because of disorganization in the local supply chain. The social impact of the activity in the region is positive, despite the lack of organization by stakeholders. This reality was also observed with tilapia production in Bangladesh (Ahmed *et al.* 2012). In the Solomon Islands, a study evaluated the supply chain of fish and identified obstacles that constrained production (Cleasby *et al.* 2014). These studies are examples that prove the need to evaluate disrupted supply chains, especially in regions with a low level of social and economic development to promote its organization and improve productivity and profit for producers.

Brazil is 12<sup>th</sup> in the ranking of countries producing fish (FAO 2014). In the last five years production has been steadily increasing, from 155,500 t in 2010 to more than 207,400 t by mid-2015 (Nunes and Rocha 2015). According to the Brazilian Association of Fish Farmers in 2015, the Brazilian Northeast is responsible for 18 percent of aquaculture production in the country. This finding reinforces the importance and need for studies on regional supply chains as a means of providing structured information to

institutions that support projects for small and medium producers, enabling increased income generation and employment, and hence improved socioeconomic status of these producers.

Currently, fishing native species and tilapia production surrounding the Sobradinho Lake is fragile. Evaluation of the supply chain structure can support and strengthen planned growth of the sector. The aim of this study was to analyze the supply chain and propose options for intervention to support development,

and to serve as a study model for other fish supply chains. It also seeks to complement the activity of identifying baseline problems and technical barriers, analyzing the socio-economic context, and identifying the main limiting factors, critical points and positive aspects of the supply chain.

## CONCEPTUALIZING THE SUPPLY CHAIN

Two workshops were held to evaluate the fish supply chains in the towns that surround Sobradinho Reservoir (Sento Sé, Remanso, Pilão Arcado, Casa Nova and Sobradinho). Workshops were held to address three aspects: 1) to understand the farmed fish supply chain in the region, highlighting its details, the role of its actors and the relationship among the links; 2) to identify strategic issues of the supply chain, with implementation of a SWOT analysis and clarification of objectives to be pursued by actors in the chain; and 3) to structure and validate tools for the survey.

Topics covered in the first workshop were:

- Quality identification and competitiveness of products,
- Identification of strategies used for product appreciation,

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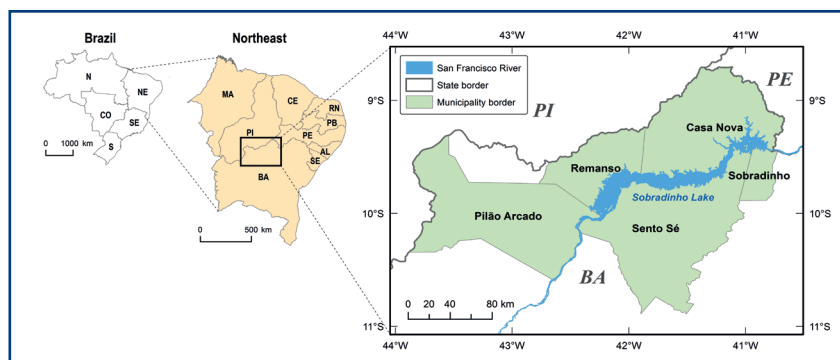


FIGURE 1. Sobradinho Lake map, Bahia, Brazil.

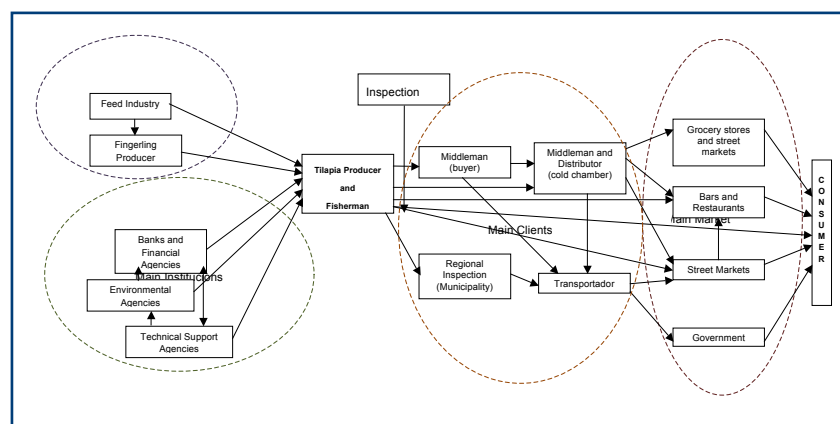


FIGURE 2. Basic structure of the fish supply chain with the main actors and links.



*View of tilapia production in cages at Sobradinho Lake. Photo: Fernanda Muniz Bez Birolo.*



*Producers working at tilapia cages in Sobradinho Lake, Bahia, Brazil. Photo: Fernanda Muniz Bez Birolo.*

- Identification of the main limiting factors, critical points and positive aspects,
- Identification of the family farming role in the supply chain,
- Identification of priority needs of the productive sector to support the sustainability of agribusiness,
- Preparation of a fish supply chain design in the study area,
- Identification each stakeholder and the links among them,
- Determination of information needs for each link to allow achievement of project objectives, and
- Development of questionnaires for each stakeholder/ link studied through the instrument.

In the second workshop, the topics covered were:

- Presentation of the results obtained in the first workshop,
- Survey and refinement of the strengths and weaknesses, risks and opportunities in the chain by SWOT analysis,
- Realization of strategic planning in the chain,
- Realization of presentation, discussion and adjustments of responses obtained in questionnaires formulated in the first workshop,
- Survey activities planning of data from the fishing communities and aquaculture. After the survey application, data were analyzed statistically and qualitatively (Moraes 1999).

## SUPPLY CHAIN ANALYSIS

Information obtained during workshops complemented that obtained in regional work reports to identify key limiting factors, critical points and positive aspects of the chain. Consequently, the process generated opportunities for scenario development and priority mapping of trends and actions for the region, aiming to promote and structure fish farming. The outcome of this process is summarized in the six topics discussed below:

### *Supply Chain Structure, Organization and Actors*

To understand the complexity of the supply chain, a representative design (Fig. 2) was prepared during the workshop and showed to the participants present at the meeting. The stakeholders highlighted in the conceptual model are feed manufacturers, fingerling producers, technical assistance providers, banks and financial institutions, environmental agencies, fish

producers and fishermen, environmental monitoring agencies, middlemen and fish distributors, transporters, supermarkets, street markets and restaurants, processing facilities and final consumers.

The structure of the fish supply chain is regionalized and varies according to the municipality. For instance, there are fishermen who sell fish to street market vendors and others who directly sell on the street. There is consensus that the main power in the supply chain is with wholesalers, who exert very strong pressure on fisherman. However, there is also recognition that wholesalers will always exist in the current structure of the fish value chain and will always be necessary to aggregate production, which is rather fragmented in the region, and to provide assistance to regional and interstate markets. Another factor that reinforces this problem is the short-term view of fisherman, who often need to make money quickly. It is difficult to conceive of actions that could minimize this problem, such as work through associations or cooperatives.

The farmed fish supply chain is exclusively for tilapia. The production system used is low-volume cages that vary between 4 and 12 m<sup>3</sup> of useful volume. According to producers, total production costs (variable plus fixed costs) are not always covered by revenue from fish sales. From the producer's point of view, the main obstacles are the availability of fingerlings and feed delivery in the region, related to the great distance from hatcheries and feed mills to production sites. However, producers are satisfied with the quality and performance of acquired fingerlings. Feed price was not an obstacle to production, but delivery time and freight was.

The organization of producers into associations is still incipient. Currently, there are about 12 associations and settlements in the region. Projects that encouraged small farmers and fishermen to become fish farmers in the region – consisting of modules of 12 cages per producer with funds from a federal program – did not achieve expected results. Most producers failed to get the planned performance and eventually defaulted on bank loans.

### *Fish Marketing*

Of the products derived from fishing, 80 percent are



*Tilapia producers at Sobradinho Lake. Photo: Fernanda Muniz Bez Birolo.*

marketed in other states and 20 percent is consumed in the region, marketed directly to consumers from street markets. Fish are eviscerated locally in a processing facility in the municipality of Sobradinho. The commercial value of fish varies according to species and season. In marketing, the wholesaler buys fish from fishermen at a price 20 percent lower than that obtained in the end market. The middleman has contact with the distribution network, selling higher-value fish mainly to supermarkets and less-valuable fish, usually pre-salted, to street markets. Generally, the middleman and distributor have a cold storage facility and buy the catch from 80 percent of the fishermen. Products derived from fisheries were established in three marketing channels: street market, local wholesaler and restaurant. Some fish farmers sell tilapia directly in more distant markets because they have their own transport truck. In the region, there are also direct purchases made by government institutions to acquire food for distribution in schools.

At the point of sale, tilapia is classified by size because there is a size-based price differential. The Processing Basic Unit (UBP) located in Sobradinho has the potential to form a solid sales channel and is working towards this goal. A women's cooperative provides labor for fish processing at the UBP, which provides proper sanitary conditions for fish processing and increased employment generation and income.

#### *Identification of Tilapia Production Competitiveness*

As an ordinary species, the only way to increase tilapia competitiveness in the semi-arid region of northeast Brazil is to reduce production costs. However, production costs of a suitable model system in the region have not yet been established. Tilapia is increasingly valued in the market, favoring establishment of systems that can adequately compensate all actors in the supply chain. In terms of logistics, the Brazilian semi-arid region is at a disadvantage because it is distant from major consumption centers and from the main input and equipment suppliers, generating greater production costs. In a survey conducted during the workshops, it was estimated that the regional demand for tilapia is 25,000 t/yr. Therefore, at the current production level of 5,000 t/yr, supply is meeting only 20 percent of demand.



*Producers harvesting tilapia at Sobradinho Lake. Photo: Fernanda Muniz Bez Birolo.*

#### *Main Fish Supply Chain Barriers*

Local fisheries production in 1978 was 2,800 t, peaking in 1981 at 30,000 t and the last data recorded in 1997 was 8,000 t (Rocha 2010). Allied with the steep decline in fish stocks, there have been cases of fishing gear theft, compromising the financial situation of fishermen, leaving them increasingly dependent on the owners of cold storage facilities, who serve as financiers for fishermen. Fishermen say that this situation could be different if they had access to bank financing. However, despite the availability of credit to support fishing, fishermen claim that it is difficult to access.

For tilapia producers, there are difficulties obtaining environmental licensing and consequently to obtain bank financing and technical assistance for fish farming. The consensus view among producers is that greater support from public institutions involved in the supply chain could overcome these obstacles. There is knowledge of the existing legal framework for environmental licensing, but it is exactly this legal issue that constrains aquaculture development in the region. There is consensus among the actors about the need for government environmental agencies to render timely decisions on applications for projects already submitted for consideration.

Financing institutions have been called upon to support fish farmers and fishermen, but there are no advisors to monitor projects and assist in the development of activities. Without an environmental permit, obtaining bank financing is difficult. According to tilapia producers, there is an unwillingness of banks to finance capital investments, which prefer to finance variable costs. This lack of investment in capital obstructs growth of the productive base in the region. Technical assistance from public institutions barely supports implementation and monitoring of fish farming enterprises.

#### *Capacity of the Area for Fish Farming*

Positive aspects of the region are linked to the favorable climate and good water quality of Sobradinho Lake, conditions that enable excellent tilapia performance. In addition, the good condition of roads allows logistical support throughout the year. Negative aspects or those that bring uncertainty to fish farming are market problems and relatively low profitability. The discontent and difficulties

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of small-scale producers contrasts sharply with the enthusiasm and reinvestment in fish farming by medium- and large-scale producers. In addition, other problems include 1) a low level of technical knowledge of farming techniques by weak producers, 2) a lack of fish farmer training activities, 3) the lack of associations and cooperatives among small producers, 4) the low management capacity of associations to overcome an irregular supply of fingerlings, and 5) a lack of equipment suppliers for cage culture that can support producers.

Although there are many obstacles, it is possible to organize the sector and engage institutions to support supply chain actors and overcome constraints. Most understand that it is very important to plan and implement actions for fish production to allow production growth and profitability of the activity. To do this, it is very important to assess the capacity of the entrepreneur (farmer) for fish farming. Not all fishermen have the profile and/or knowledge to become fish farmers.

The perception among fishermen is that, for some, aquaculture may be the solution to their income problems, but they have no experience in the activity, which makes this a very fragile and unrealistic perception. Enabling and monitoring these producers and fishermen becomes a prime necessity. Even with proper training and will, fish farmers know that it is necessary to experience the problems and difficulties of fish farming to find appropriate solutions.

#### *Strengths and Weaknesses, Opportunities and Threats (SWOT)*

At the workshops, strengths and weaknesses, risks and opportunities of the activity were raised with the participants. Within each of these, existing themes (present) and those that will inexorably arise (future) in the opinion of participants were established. Subjects were classified according to relevance, urgency and tendency, as can be seen in Table 1, which includes only the five most important issues in each category.

The issues raised in the strengths and weaknesses, which are internal to producers, show evidence that their organization into associations is a critical point to allow expression of their potential, but also a weak point that can lead to bad results. The sale organization issue, not through middlemen, can be a lever to achieve their goals. The viability of the activity on a small scale and in relation to training and technical assistance is considered necessary, including assistance in preparation of the application for environmental licensing of projects. Certainly the lake has great potential for fish farming, with favorable climate and water quality. With consistent harvests, favorable sales and higher regional demand for fish, it should be possible to solve supply problems of fingerlings and feed, infrastructure and legalization of associations.

Public institutions involved directly or indirectly in the activity have great importance to achieving fast and efficient development of fish farming in the region. The activity cannot be stimulated until the legal framework and design of the production capacity (both linked to environmental issues) are entirely clear to stakeholders.

Inasmuch as it is common in undeveloped countries, the lack of public power in the organization and management of non-conventional activities, as is still the case with fish farming in Brazil, causes immeasurable losses. For instance, there are limited

opportunities for small farmers and fishermen to increase their income, reinforced by the lack of alternatives in a semi-arid region. In this region, it is water that brings opportunity and wealth.

## CONCLUSIONS

From the producer's point of view, the fish supply chain is problematic with respect to the provision of key inputs. The most common situation is the high degree of dependence of producers on the few companies that provide feed and fingerlings. Because of geographical, hydrological and soil conditions, ponds are not an option for fish production. The structure of fisheries supply chain is regionalized and varies according to municipality. In this context, the presence of the wholesaler is paramount. It is generally understood that the power of the supply chain is with the wholesaler, exerting very strong pressure on fishermen and fish farmers. However, this factor also enables an aggregation value to production to meet regional and interstate markets.

The greater demands of the productive sector structure goes through its internal and external organization and management. Thus, the main needs are training to encourage and strengthen the planning of projects; trained and increased staff engaged in aquaculture, preferably with production practice knowledge; participation and articulation of regional forums dealing with aquaculture, water resources and small rural producers and fishermen; internal organization of producers and, finally, the strengthening of existing producers to continue as pioneers in the activity, encouraging other farmers and fishermen to take up fish farming.

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TABLE I. CLASSIFICATION OF STRENGTHS , WEAKNESSES, OPPORTUNITIES AND THREATS RELATED TO THE FISH SUPPLY IN THE REGION SURROUNDING SOBRADINHO LAKE.

<i>STRONG POINTS</i>		<i>Relevancy</i>	<i>Urgency</i>	<i>Tendency</i>	<i>Total</i>
1	Organization of fishermen and fish farmers into associations and cooperatives	5	5	5	125
2	Water to stimulate activity in Sobradinho (juvenile)	5	3	5	75
3	Lake potential for fish farming	5	3	5	75
4	Trained fish farmers to manage production	3	5	5	75
5	Viability of the perception of small production models for the region	3	5	5	75
<i>WEAK POINTS</i>		<i>Gravity</i>	<i>Urgency</i>	<i>Tendency</i>	<i>Total</i>
1	Reorganization, enhancement and continuous training of associations and cooperatives of fishermen and fish farmers/Discontinuity of training, planning and management of activities and associations and cooperatives.	5	5	5	125
2	Preparation of producers to meet different markets	5	5	5	125
3	Difficulty in environmental licensing (documents /requests, pending and monitoring)	5	5	3	75
4	Physical infrastructure of associations	5	5	3	75
5	Difficulty in acquisition and negotiation to purchase fingerlings, feed, and other inputs	5	5	3	75
<i>OPPORTUNITIES</i>		<i>Relevancy</i>	<i>Urgency</i>	<i>Tendency</i>	<i>Total</i>
1	Strengthening Territorial Management Committee of Fisheries and Aquaculture of the San Francisco Hinterland	5	5	5	125
2	Actions of federal fisheries department /Ability to access the edicts of the federal fisheries department (associations, cooperatives, committee)	5	5	5	125
3	Establishment of aquaculture parks	5	5	5	125
4	Expanding market (consumption) / Appeal to the consumption of fish (expanding)	5	5	5	125
5	Growing importance of native species	5	5	5	125
<i>THREATS</i>		<i>Gravity</i>	<i>Urgency</i>	<i>Tendency</i>	<i>Total</i>
1	Difficulty in environmental licensing	5	5	5	125
2	Unavailability of inputs (fingerlings)	5	5	3	75
3	Lack of technical expertise (quality/quantity)	5	5	3	75
4	Absence of Sobradinho Lake management plan	5	5	3	75
5	Lack of support from municipalities (participation and political support)/ Low quality of roads to lake (increased cost of freight)	5	5	3	75