Challenges in the aquaculture production chain in Curralinho, Marajó archipelago, Pará, Brazil

Desafios na cadeia produtiva da aquicultura em Curralinho, arquipélago do Marajó, Pará, Brasil

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ABSTRACT

The Participatory Rural Diagnosis (PRD) methodologies are efficient instruments of agricultural extension, since they take into account the desires and the reality of rural communities. Thus, the aim of the present study was to present, through PRD, the obstacles of tambaqui (*Colossoma macropomum*) production chain in Curralinho city, Marajó archipelago (state of Pará - Brazil). The data were obtained by the following PRD techniques: semi-structured interviews; problem tree; reality/desire; Strengths, Weaknesses, Opportunities and Threats (FOFA/SWOT); cross walks; description of flow production and marketing tambaqui. These methodologies are part of the actions practiced in the project “Technology transfer through training and technical assistance for tambaqui farmers in the archipelago of Marajó/PA”, from the Federal Institute of Education, Science and Technology of Pará (IFPA) Campus Breves. Data collection was carried out in March 2020. The information was analyzed using a simple description of the local fish production chain. The producers indicate as main difficulties: feed, fry, financing, technical assistance, environmental regularization, technological packages, processing and commercialization. In conclusion, the rural extension tools indicated difficulties in acquiring and using minimal inputs for sustainable aquaculture.

Keyword: Amazon, PRD, Tambaqui, Social, Extension, Rural Education.

RESUMO

As metodologias do Diagnóstico Rural Participativo (DRP) têm se apresentado como instrumentos eficientes na extensão, uma vez que levam em consideração os anseios e a realidade das comunidades rurais. Assim, o objetivo do presente estudo foi mostrar por meio de um DRP os obstáculos da cadeia produtiva do tambaqui (*Colossoma macropomum*) no município de Curralinho, arquipélago do Marajó (estado do Pará - Brasil). Os dados foram obtidos pelas seguintes técnicas de DRP: entrevistas semiestruturadas; árvore de problemas; realidade/desejo; Fortaleza, Oportunidade, Fraqueza e Ameaça (FOFA/SWOT); caminhadas transversais; descrição do fluxo de produção e comercialização de tambaqui. Essas metodologias fazem parte das ações praticadas no projeto “Transferência de tecnologia através da capacitação e assistência técnica para criadores de tambaqui no arquipélago do
Palavras-chave: Amazônia, DRP, Tambaqui, Social, Extensão, Educação do Campo.

1 INTRODUCTION

The supply of fish in the world has been fed an increasing slice by aquaculture (FAO, 2018; RAHMAN et al., 2019; AKTER et al., 2020; OLIVEIRA et al., 2020). One of the advantages is that it generates income for the aquaculture farmer, boosts the regional economy and improves the quality of life of the population (GAMBELLI et al., 2019; ARAVINDAKSHAN et al., 2020).

The Amazon has enormous potential for the development of aquaculture, due to the water course, the favorable climate and the geographical condition, among others (SILVA et al., 2018; MEDEIROS et al., 2017; DANTAS et al., 2019; FERREIRA et al., 2020; TROMBETA et al., 2020). In the state of Pará, fish farming is growing, being an activity developed by small, medium and large aquaculture farmers. An activity also carried out by family farming, extractivists and riverside dwellers (AIZAWA et al., 2014; ZACARDI et al., 2017).

Thus, the application of diagnostic techniques is extremely important to know the local reality and, consequently, to understand the difficulties of the aquaculture value chain (AMACHREE et al., 2019). In the rural extension, the use of the Participative Rural Diagnosis (PRD) allows an integrated and interdisciplinary document on the reality of the rural environment (GOMES et al., 2000; SILVA et al., 2011; MARINHO and FREITAS, 2015).

1 INTRODUCTION

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Under understanding the difficulties in the aquaculture production chain allows an overview of the system, which will help in the development of strategies and promote the integration of the activity (IBEMERE and EZEANO, 2014; POMEROY et al., 2017; SOUSA et al., 2019; SILVA and OLIVEIRA, 2020). Thereby, the objective of this study was to carry out a PRD about the obstacles
in the tambaqui production chain in Curralinho, Marajó (Pará - Brazil). These results promote the visibility of local fish farming, as well as generate information for future research and extension actions to develop the local scenario.

2 MATERIAL AND METHODS

2.1 STUDY AREA

The research was conducted in the municipality of Curralinho, in the Marajó archipelago, state of Pará, Brazil (Figure 1). Marajó is located on the Amazon coast, comprising 16 municipalities, which comprise the micro-regions of Arari (Cachoeira do Arari, Chaves, Muaná, Ponta de Pedras, Salvaterra, Santa Cruz do Arari and Soure), Furos de Breves (Afuá, Anajás, Breves, Curralinho and São Sebastião da Boa Vista) and Portel (Bagre, Gurupá, Melgaço and Portel) (AMARAL et al., 2012). The hydrography of Marajó consists of drainage networks of recent channels, such as: streams, basins, channels, meanders, lakes and streams, among which the Amazon, Pará, Anapu, Jacundá and Anajás rivers stand out, with their numerous tributaries. Curralinho has a territorial extension of 3,620,279 km² and its population was estimated at 33,893 people for 2018 (IBGE, 2010). The majority of this population is settled in rural communities along the “holes”, small rivers that surround the city and nearby islands, with an emphasis on fishermen, extractivists, aquaculture and family farmers.
2.2 THE EXTENSION PROJECT

The project “Transfer of technology through training and technical assistance for creators of tambaqui, *Colossoma macropomum* in the archipelago of Marajó/PA” was funded by the Dean of Extension and External Relations (PROEX) of the Federal Institute of Education, Science and Technology of the Pará (IFPA), under notice number 03/2019. The project called “Piscicultura Marajoara” was conducted by teachers and students at IFPA Campus Breves. Data collection took place in March 2020.

2.3 PARTICIPATIVE RURAL DIAGNOSIS

The participatory rural diagnosis (PRD) methodological tools were used to collect data. According to Gomes *et al.* (2000), PRD is based on three fundamental pillars: participation, behavior and field techniques. Based on this, the PRD techniques used were:

- **Semi-structured interview**: Interviews play a very important role in DRP. It is an interview that is guided by key questions previously determined (PEREIRA *et al.*, 2009). This tool facilitates the creation of an open dialogue environment and allows the interviewee to express themselves freely, without the limitations created by a questionnaire (SOUSA *et al.*, 2019). The semi-structured interview can be conducted with key people or with groups (VERDEJO, 2006).

- **Problem Tree**: This is a methodology used to deepen the understanding of a specific problem identified during discussions and diagnostic activities carried out previously with a certain group (SILVA *et al.*, 2013). Thus, a particular problem identified as a key is chosen and the causes and effects arising from that problem are discussed. The awareness of cause and effect relationships allows for a more adequate planning to solve the problems of the group involved in the intervention (KUMMER, 2007).

- **Reality/Desire**: It is a methodology used to guide the planning process in order to deepen the aspects that interfere in the lives of the people in the group involved in the intervention, whether positive or negative (SILVA *et al.*, 2013). Based on the characterization of reality, the group's desire is discussed, that is, where it is intended to reach, with respect to a certain aspect of the life/dynamics of this group. Thus, it starts with the details of the process, that is, actions, assignments of responsibilities, deadlines and resources necessary for the group's desire to materialize (MARINHO and FREITAS, 2015).
• **FOFA / SWOT**: Diagnostic methodology and assessment of socio-environmental and productive processes related to a specific social group, organization and institution. From this methodology it is possible to identify the Strengths, Weaknesses, Opportunities and Threats (SWOT) that interfere in the dynamics of the group involved in the diagnosis / intervention process. From the debates, it is possible to evaluate and plan strategies that enhance the actions and objectives and goals determined by that group, the focus of the intervention (MARINHO and FREITAS, 2015).

• **Production and commercialization flow**: Diagrams make it possible to analyze in an accessible way all complex and interrelated aspect. Cause-effect relationships can be visualized, as well as the intensity and importance of institutional, commercial or production relationships (trade and production flowcharts) (VERDEJO, 2006; SILVA et al., 2011).

• **Cross walks**: Walking technique that aims to explore the spatial characteristics of the study area (SILVA et al., 2017). Systematic walks were taken with fish farmers, observing and asking about different areas, local technologies, introduced technologies, history and tradition of the activity. The meanings given to places considered important by them were also raised. It is a record of people's perception of the place (SILVA et al., 2013; SANTOS et al., 2014).

2.4 ETHICAL CONSIDERATIONS

This work is qualitative and was approved by the Research Ethics Committee of the Institute of Health Sciences (CEP) of the Federal University of Pará (UFPA), registration number 2.576.907. The participants' identities were kept confidential, guaranteeing their anonymity and confidentiality of the information.

2.5 DATA ANALYSIS

From the techniques used in the PRD it was possible to collect information and trace the obstacles faced and solutions found. The collected data were analyzed using descriptive statistics (OLADEJO, 2010).

3 RESULTADOS E DISCUSSÃO

The DRP was conducted with a group of 13 fish farmers, from the communities of Boa Esperança (8%), Cafezal (8%), Ilha das Araras (23%), Perpétuo Socorro (8%), Piriá Miri (8%), Rio Açú (15%), Santa Izabel (15%) and groups of people from the city of Curralinho (15%).

Through semi-structured interviews, restrictions were detected in the production chain (Figure 2).
The lack of technical assistance, food for fish, training of producers and financing in fish farming were the most common problems reported by aquaculture farmers (100%). They report that local fish farming still presents significant obstacles in some of its links. These difficulties have different effects depending on the size of the fish farmer, with family farmers being more affected. This result is similar to that reported by Fazzi-Gomes et al. (2016) and Brito et al. (2018), who report several difficulties in the fish farming value chain. Fish farming is an important activity in the Amazon region, for subsistence in addition to generating income for local families, so it is important to understand aspects of the value chain (AIZAWA et al., 2014; ZACARDI et al., 2017; SOUSA et al., 2019; TROMBETA et al., 2020).

The problem tree showed that the chain does not yet have a sector of inputs and rural extension services for local fish farming (Figure 3).
The producers reported that they never received training courses in the area of aquaculture. The transfer of knowledge through training aims at the growth of the activity, in order to generate income and make the properties viable (KATO et al., 2017). For these fish farmers studied, almost all the feed used comes from other municipalities in Pará (Marituba, Santa Izabel do Pará and Castanhal), in view of the lack of commercial factories in the region. This factor ends up raising production costs, since the feed item represents about 70% of the total costs involved in the cultivation of tambaqui (SILVA, 2019). Large producers have minimized these effects by purchasing feed directly from factories located in neighboring states. Another way to reduce producer expenses with food would be the use of alternative foods, complementary to feed (BICUDO et al., 2018; MMANDA et al., 2020), which has already been occurring.

With regard to young forms, the chain does not yet have a fish breeding farm. Through the production flow, the producers also purchase from other municipalities in Pará, such as Castanhal, Igarapé-Açu and Peixe-Boi (Figure 4).
Figure 4: Production flow in Curralinho, Marajó archipelago, Pará, Brazil.

The amount purchased by the producer ranged from 1 to 3 thousand, purchased from one to three times a year. Regarding the price, it varied according to the size (cm) of the animal, ranging from R$ 70.00 to R$ 300.00 per thousand. The supply of fingerlings from regions close to the cultivation projects can decrease the costs of acquiring them and reduce losses due to mortality. The ease in acquiring fingerlings can contribute to the advancement of production and new producers in Pará (BRITO et al., 2017).

The reality and desire technique highlighted that the credit and technical assistance sectors also have important bottlenecks in Curralinho (Table 1).

The documentary requirements regarding the environmental licensing of fish farms have been the main obstacle. Several specific lines of credit for aquaculture have been launched by the federal government, but these barriers have prevented the release of funds by banks. Only for family aquaculture, seven credit lines were created within the portfolio of the National Program for Strengthening Family Agriculture (PRONAF). The lack of technical assistance by public agencies of rural extension has also been a significant bottleneck. This obstacle hinders not only technical assistance itself, but also the performance of other institutions linked to sectors such as research, environmental management and credit, since generally the rural extension service has an intermediation function in aquaculture. The result is analogous to that described by De-Carvalho et al. (2013), Brito et al. (2018) and Sousa et al. (2019), making it difficult to use the minimum inputs necessary for sustainable activity.
Table 1: Reality and desire realized in Curralinho, Marajó archipelago, Pará, Brazil.

| Desires                                      | Realities                                           |
|----------------------------------------------|-----------------------------------------------------|
| River transport to transport production;     | Aquaculture farmers do not have a vessel to transport production; |
| Rural extension, information and training courses; | Rural extension is not carried out in all communities. scarce information. They legitimate, however, they do not guide; |
| Better remuneration and reduction of operating costs; | High input costs (fry, feed, etc.). Low price; |
| Garbage collection in rural areas;           | Inadequate disposal;                                |
| Credit and valorization of work in the field; | Lack of financial support and public institutions;   |

The environmental licensing process is also an important bottleneck observed in this scenario. It was reported as bureaucratic and with high overhead involved. Thus, the lack of environmental regularization makes access to credit impossible, hinders commercialization and access to public policies. In addition, few technological packages are aimed at native species under local conditions, which results in lower zootechnical performance of crops and little diversification in relation to the cultivation of new species. The absence of public fish warehouses in operation makes it difficult for small aquaculture farmers to comply with the sanitary legislation for the slaughter of fish and, thus, hinders the valorization of fish through processing.

Through the FOFA / SWOT matrix, we perceive the lack of social organizations in aquaculture (associations, cooperatives, among others), which consolidate the volumes of the producers and carry out their commercialization (Table 2). In the present study, through the marketing flow technique, the tambaqui trade occurs throughout the entire year on the properties for the final consumer or for middlemen (Figure 5). In Curralinho, there is a greater difficulty for small producers in accessing the sales channels of local supermarkets and neighboring municipalities. There are producers who end up selling their fish exclusively during Holy Week, as they find it more profitable. However, it is undeniable the increase in the frequency of tambaqui from fish farming at fairs and markets in the city.
Table 2: Strengths, Opportunity, Weakness and Threat (FOFA / SWOT) held in Curralinho, Marajó archipelago, Pará, Brazil.

| Indoor environment | Outdoor environment       |
|------------------|----------------------------|
| Strengths        | Opportunities              |
| Family participation | Partnerships (producers and institutions) |
| Union and Self-Esteem | Training of aquaculture farmers |
| Farmers' Association and Cooperatives | Public policies for activity |
| Electricity      | Marketing of fish          |

| Weaknesses                  | Threats                        |
|----------------------------|--------------------------------|
| Transportation (boat)       | Investment in fish farming     |
| Fish diseases               | Political dispute              |
| Poor education of producers | Input availability             |

Therefore, social organization in aquaculture can be a viable alternative for purchasing inputs at more accessible prices to producers (CARDOSO et al., 2012; VARGAS-HERNÁNDEZ et al., 2020). Through these organizations, production expenses are reduced and there is a better financial return on the activity. In this study, producers reported having great difficulties in acquiring new investments for the production of tambaqui. Through the transversal walk, Figure 6 shows some fish farms in the municipality of Curralinho, Pará, Brazil.
Figure 6: Cross walks carried out at fish farms (A, B, C, D, E, F, G and H) in Curralinho, Marajó archipelago, Pará, Brazil.
4 CONCLUSION

The creation of tambaqui in Curralinho is an important activity for local families. However, the activity is in decline due to several problems that lead producers to abandon the activity, such as the lack of technical assistance, obtaining fry and access to finance. This makes it difficult to use the minimum inputs needed for sustainable aquaculture. Thus, to leverage this activity, effective public policies are needed, which solve the problems raised in this work, in addition to devising strategies that allow access to credit for producers. Fish farming is a viable alternative to strengthen the economy in Marajó, generate and distribute income, as long as the bottlenecks in professionalizing the activity are resolved.

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CONFLICT OF INTEREST

The authors have no conflict of interest.
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