



Overview on the fish farming in the Porto Grande municipality (Amapá, Brazil)

Panorama da piscicultura no município de Porto Grande (Amapá, Brasil)

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Abstract This current study performed a prognosis on the overview of fish farming in the Porto Grande municipality (Amapá, Brazil), where there were analyzed the socio-economic aspects of the fish farms in the region. The sampling data occurred in the period from December 2015 to December 2016, with the use of semi-structured questionnaires joint to the owners of fish farming properties. The results show that the basis of the workforce on fish farming is mostly performed by men, by the use of family labor, and the pisciculture activities has existed for less than a half decade in the region. The fish farming is in small scale, and it is performed in semi-intensive and extensive production systems, with the predominance of excavated earthen ponds which are primarily used for fattening tambaqui (monoculture) for subsistence and commercialization ends. The fish produced (≈ 200 kg of fish per year, by fish farmer) is totally consumed in the municipality, but part of it is taken (stored in ice or *in natura*) to urban centers where it is commercialized. The main obstacles found by the sector was the lack of training, technical service and high prices for fish feed acquisition. The fish farming profile in this study area is classified as small-scale and it resembles the ones found in other regions in Brazil, which shows that fish farming is still a little explored activity in the country.

Keywords: aquaculture, farming, production chain, fish.

Resumo O presente estudo realizou um prognóstico sobre o panorama da atividade piscícola no município de Porto Grande (Amapá, Brasil), onde foram analisados os aspectos socioeconômicos das pisciculturas da região. As amostragens de dados ocorreram no período de dezembro de 2015 a dezembro de 2016, com a aplicação de questionários semiestruturados juntos aos proprietários dos empreendimentos aquícolas. Os resultados indicam que a base do trabalho na produção de peixes é majoritariamente realizada por homens, mediante o uso da mão-de-obra familiar, e existe a menos de meia década na região. A piscicultura é de pequeno porte, operando nos sistemas semi-intensivo e extensivo de produção, com predomínio dos tanques de terras escavados utilizados prioritariamente para a engorda de tambaqui (monocultivo) para fins de subsistência e comercialização. O pescado produzido (≈ 200 kg de peixes por ano, por piscicultor) é consumido em sua totalidade no município, mas parte é escoada (conservada em gelo ou *in natura*) para os centros urbanos onde é comercializado. Os principais entraves encontrados para o setor foram à falta de treinamento, assistência técnica e os altos custos com a aquisição de ração. O Perfil das pisciculturas na área do estudo é de pequena escala e se assemelha aos encontrados em outras regiões do Brasil, indicando que a criação de peixes ainda é uma atividade pouco explorada no país.

Palavras-chave: aquícultura, criação de peixes, cadeia produtiva, pescado.

Introduction

In Brazil, fish farming activity started in the 18th century by the Dutch people, especially with the extensive production system, by using pens to store water where fish was held captive until they reached the ideal size for consumption (Boeger & Borghetti, 2007). However, it was not until 1927 that more thorough studies on fish farming and induced fish reproduction (by using pituitary gland extraction from fish) were started by German researcher Rudolf Von Ihering, in Pirassununga's region (São Paulo state), where they installed the first Fish Farm Site in the country, in 1939 (Sousa & Teixeira Filho, 2007; Araújo, 2015). Thus, fish farming has spread through all Brazilian states and it currently shows an exponential annual growth between 10% and 30% (Souza-Filho, Schappo & Tamassia, 2003; Souza, Pádua, Oliveira & Maia, 2014) with a growth perspective of 104% until the year of 2025 (FAO, 2017).

Among the Brazilian states, Amapá has been winning market in fish production, especially because the region has many rivers and native fish species with capacity for farming (Gama, 2008). The culture basis of fish farming is made up of local resident farmers in small communities in the region. In these places, they buy fingerlings (fish-seeds) in order to meet the market demands (Tavares-Dias, 2011). The main fish species farmed in the state are tambaqui *Colossoma macropomum* (Cuvier, 1816) and its hybrids tambatinga and tambacu (*C. macropomum* x *Piaractus brachypomus*, Cuvier, 1818) and pirarucu, *Arapaima gigas* (Schinz, 1822) according to the data from Research and Development Bulletin (Tavares-Dias, 2011).

Researches on fish production statistics or on the characterization of fish farms in Amapá are rare or they don't exist. They only show the records of quantitative estimates on the current fish farming entrepreneurships and classification of farming modality (Tavares-Dias, 2011). However, there is still a great information gap about the current fish farms in this region, which makes it indispensable to perform an in-depth study on this topic. Therefore, the current study proposes performing a prognosis (pilot Project) on an overview about fish farming in the Porto Grande municipality (Amapá, Brazil), taking into consideration the socio-economic aspects which are inherent to the sector.

Materials and Methods

STUDY AREA

The study field was made up of 12 sites where the aquaculture farms are established for fish farming, which are Cupixi, Nova Canaã, Perimetral Norte, Nova Colina, Munguba, Colônia Agrícola do Matapi, Estrada de Ferro, urban area of Porto Grande, and fish farms located at kilometers 126, 134, 135 and 142 on BR-210 highway in Porto Grande's municipality, situated in the central axis of Amapá state with approximately 4.401.774 km² (IBGE, 2010) Figure 1.

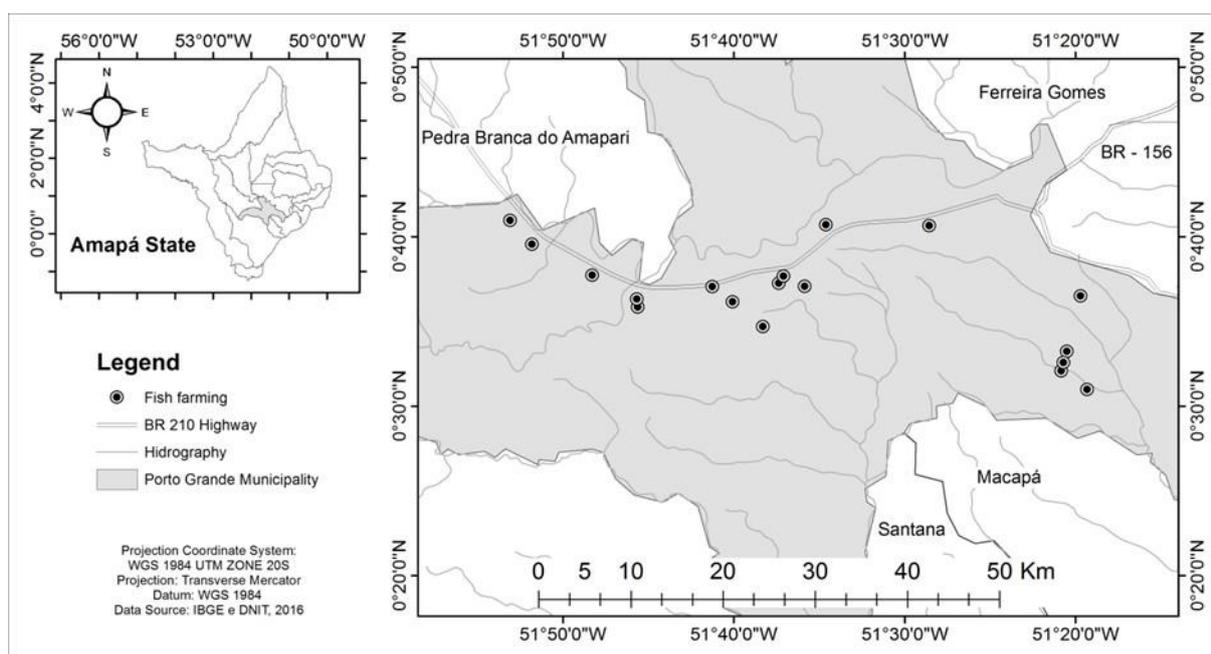


Figure 1. Geographic location of the study area, in Porto Grande's municipality, estado do Amapá (Brazil).

COLLECTION AND DATA ANALYSIS

The data collections were carried out from December 2015 to December 2016. These occurred by using semi-structured questionnaires to the fish farmers in Porto Grande's municipality, which involved topics related to different types of ponds used for fish farming, the type of fish food used, the origin of the fingerlings, the fish production system, the fish production purpose and problems inherent to fish farming. The information collected was tabulated and submitted to descriptive statistics (average, standard deviation, absolute and relative frequency), seeking to check whether the data would show a specific pattern for this production segment. Also, in order to confirm this inference, the data was grouped to be accessible in the form of tables and charts for a better view, understanding and classification of the current panorama on fish farming in Porto Grande municipality. Moreover, a Pearson test was done to verify the linear relation between the fish farming production and fish ponds area.

Results

FARMING SYSTEM, PRODUCTION MODALITY AND FARMED FISH SPECIES

In Porto Grande's municipality (Amapá), 25 fish farms were counted and 18 fish farmers from these 25 farms were interviewed (72% of the total), these interviews reported that the production workforce basis is made by family labor, which is predominated by men (83%), who own the entrepreneurship but do not act as entities (industrial unit). Most of the fish farms (44.4%) do not have an operation license, however, 38.9% of them are licensed and other 16.7% have started the process of legalizing their activity.

These entrepreneurship were established by using resources from the property owners themselves (83.3%) with initial investments which varied from 750.00 BRL to 28,000.00 BRL with an average of 6,370.00 BRL per property. The pisciculture is a recent activity in the region, which the fish farmers have been carrying out for 4.7 years (± 3.7). The main species of farmed fish is *Colossoma macropomum* (tambaqui) with 83.3% of the total analyzed, leading the farming in the monoculture system. However, other species like hybrid tambatinga (artificial crossing between *C. macropomum* and *Piaractus brachipomus*, Cuvier, 1818), pintado (*Pseudoplatystoma tigrinus*, Valenciennes, 1840), the aracu (*Leporinus trifasciatus*, Steindachner, 1876) and curimatã (*Prochilodus nigricans*, Agassiz 1829), are also produced, however, in a polyculture system. In 50% of the fish farms, they detected the presence of exotic species in the farming, so, the following species stand out, apaiari (*Astronotus ocellatus*, Agassiz, 1831), tilápia (*Oreochromis niloticus*, Linnaeus 1758) and tamoatã (*Hoplosternum littorale*, Hancock 1828).

Fish farming was divided into two production modalities, semi-intensive system (50%) and extensive system (50%), which was mostly used for fish farming in excavated earthen ponds (94.4%) followed by pond nets (5.6%) which aimed fish fattening only, usually for subsistence (55.6%), followed by commercialization (44.4%). The fingerlings (100%) for this production originated from Macapá's municipality (Amapá), which were purchased for a price between 170.00 BRL to 500.00 BRL per thousand of young fish (the dollar exchange rate on December 30th, 2016 was 3.26 BRL at the buy rate).

FOOD MANAGEMENT AND PRODUCTIVITY IN FISH FARMING

The farmed fish were fed on commercial extruded food (72%; with sale prices between 2.20 BRL to 2.88 BRL per kg of food), pelleted food (22%; with sale prices between 2.00 BRL and 3.80 BRL per kg of food) and cracked extruded or pelleted food (6%), these were purchased in Porto Grande or Macapá (Amapá) cities.

The fish production varied between 50 to 4,500 kg per farming cycle (in a year), with an average of 695.3 kg.year⁻¹. However, 90% of the fish farms showed a production between 50 and 500 kg fish per year with an average of 185.3 kg.year⁻¹. When compared with the annual fish production (y) together with the fish farm areas (x) through Pearson linear relation, it was observed an increasing relation among the variables with the value of $r = 0.69$. Likewise, r^2 determination coefficient showed that the fish production increases according to the size of the farming ponds area, but it showed a weak relation (48%) among the variables (Figure 2).

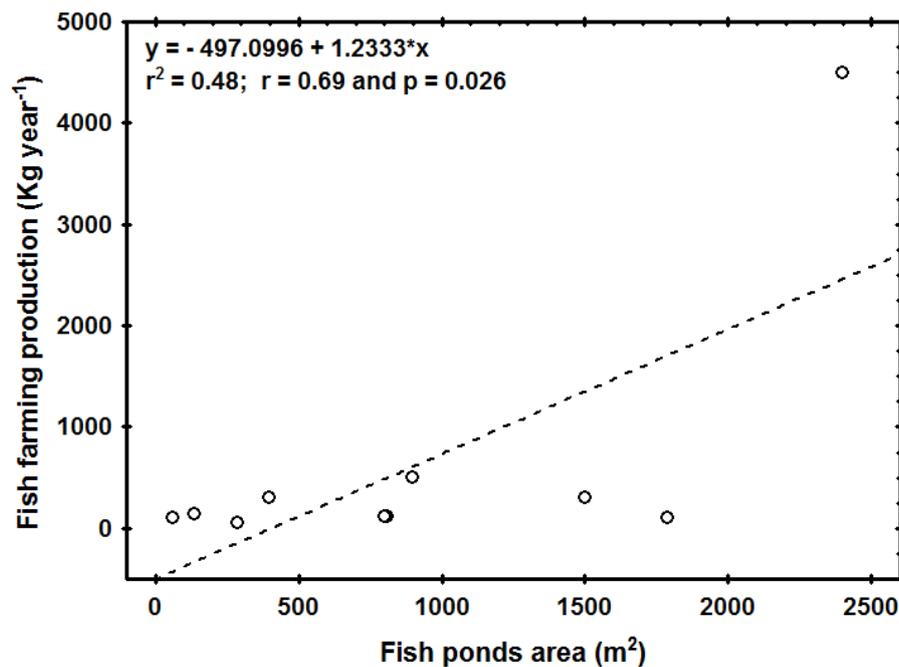


Figure 2. Linear relation among the variables, fish farming production in a cycle per year (kg) and fish pond areas (m²).

The analyzed properties were classified as big-sized ones (71.43%) and mid-sized ones (21.43%), according to what is specified by Municipality Law No. 413 of June 26th, 2014, that categorize property areas as: small sized (PP) has up to 5 hectares, mid-sized (MP) from 6 to 50 hectares, and big-sized (GP) has bigger than 51 hectares.

DISTRIBUTION, PRESERVATION AND COMMERCIALIZATION OF FISH

The fish production originated from the fish farms in Porto Grande's municipality is transported on dirt roads, and part of it is stored in ice (83%), *in natura* (11.1%) and salty process (5.6%). The fish is usually commercialized at open air markets (fairs) and supermarkets in urban centers (38.9%), directly to consumers (33.3%) and part of it is locally consumed by the fish farmers (27.8%). The gross monthly income of fish commercialization in the studied region varied from 700.00 BRL to 2,000.00 BRL, with an average of 1,057.10 (± 367.30) per fish farmer/month. Besides, the fish farmers reported that the main obstacles found (one or more barriers mentioned per fish farmer) for fish production are lack of training in the segment (77%), technical service (50%), fish food (50%), fingerling production (44%), commercialization (39%), funding (33%), among others (fish preservation, transportation and lack of cooperatives).

Discussion

Although in Brazil fish farming regulation is required in all of the regions of the country, in Porto Grande's municipality most of the aquaculture entrepreneurship are not yet registered, which might be the consequence of lack of information for the segment or due to the current bureaucracy during the legalization processes of this activity, referring to the Laws which rule the ways for using the earth, water and the natural resources (Tiago, 2003). On the other hand, the shortage of specific instruments which guarantee fish farming as a sustainable development activity is considered complicated within the process of environment licensing in Brazil's regions (Tiago, 2003).

The legalization process where the entrepreneurship are being established occurs gradually, and the delay during the registry process allows for the fish farmers to give up the process, promoting an increase on the fish farms which are operated informally. However, the lack of environmental licensing directly affects the insertion process of fish farmers in credit lines offered by autarchies in the production sector (Emater/Ascar, 2006).

The predominance of excavated earthen ponds in the properties is similar to the ones found in several states of the country, as described by Castellani and Barrella (2005) for Vale do Ribeira's region (SP) where the fish farm facilities are extremely rustic, predominated with conventional ponds used for fish nurseries; by De-Carvalho, Souza and Cintra (2013), by Batista (2013) in rural properties of Dourados-MS, where they describe the nurseries as usually dug-out nurseries, which aims to reuse the inadequate areas for agricultural activities.

Besides, Dutra, Bittencourt and Feiden (2014) identified a total of 201 ponds nurseries in small bordering properties in Southwest of Paraná state. A similar pattern was also found by Nakauth, Nakauth R., and Nóvoa (2015), and by Costa, Rodrigues and Ricci (2015) when analyzing the aquaculture profile in the region of Tabatinga-AM and Ariquemes- RO, respectively.

The organizational profile of the fish farms and the models of fish ponds nurseries presented herein are also similar to the fishing entrepreneurship in other regions of the country, such as the ones shown in researches which were carried out by Silva (2007) for Cuiabá River's basin (Mato Grosso), by Batista (2013) on fish farms in the region of Dourados (MS) and in the municipality of Porto Grande by Nakauth, Nakauth R. and Nóvoa (2015). The fish farmer's preference for a semi-intensive production system, which is shown in this current study, is similar to the system used in the northeast of Pará, as described by Brabo, Pereira, Ferreira, Costa, Campelo and Veras (2016) and by Almeida Junior and Lobão (2016).

Thus, the fish species which are farmed in Porto Grande's region are mostly of commercial importance, and they are used on fish farms in several regions of the country and they have tambaqui farming as the basis of their productive chain, followed by other species (e.g. pirarucu, tambatinga, pintado, among others) where just the commercial classification order is different, which is related to the quantity produced in each region. This production model was also reported in studies on Guamá's micro-regions, Pará state (Silva, Souza, Melo, Zacardi, Paiva & Nakayama, 2010; Oliveira, Silva, Almeida-Val & Val, 2012; De-Carvalho, Souza & Cintra, 2013; Brabo, Pereira, Ferreira, Costa, Campelo & Veras, 2016; Almeida Junior & Lobão, 2016) where they characterized pisciculture as the productive chain in the northeastern region of the state. Other researchers also detected the same pattern in the preference for the species for Cruzeiro do Sul region, Acre state (Melo, Santos, Souza & Santiago, 2013), Presidente Figueiredo, Amazonas state (Costa, Rodrigues & Ricci, 2015; Barbosa & Lima, 2016) and lower São Francisco river, in Sergipe state (Ribeiro-Neto, Silva, Guimarães & Gomes, 2016).

Fish production on the fish farms under study occurred through the purchase of fingerlings (fish-seeds) in the state (Amapá), supporting the results reported by Rezende, Silva, Mello, Souza, Souza and Kloster (2008) in Acre state, by De-Carvalho, Souza and Cintra (2013), in Guamá-Pará by Almeida Junior and Lobão (2016) where they realized a great part of the fingerlings used on fish farms was also produced in their state of origin.

The great majority of the fish farmers who reported that the commercial fish feed was the most used forage on the fish farms in Porto Grande region may have occurred due to the easy use of the product and its efficacy for the fish development, which are superior to the entrepreneurship which use alternative (artisanal) feeds during the handling of the fish shoal (Silva, Souza, Melo, Zacardi, Paiva & Nakayama, 2010; Melo, Santos, Souza & Santiago, 2013; Barbosa & Lima, 2016). These feeds are usually purchased at marketplaces in the city itself. This pattern in feed acquisition and commercialization was also described in the results from Batista's work (2013) performed in the region of Dourados-MS.

Another important factor observed during the study was that the fish farmers act primarily towards consumption purposes (subsistence), but they commercialize a part of the production, by using this activity, especially family labor. The involvement of family members in fish farming was also reported by studies carried out by Martins, Oliveira, Martins, Hermes, Oliveira, Vaz, Minozzo, Cunha and Zacarkin (2001) in the western region in Paraná state; by França and Pimenta (2012) in Dourados' municipality, Mato Grosso do Sul state, by De-Carvalho, Souza and Cintra (2013) in Guamá-Pará micro-region; by Almeida Junior and Lobão (2013) in the northeast of Pará and by Ribeiro-Neto, Silva, Guimarães and Gomes (2016) in lower São Francisco river region, in Sergipe.

The problems which affect the development of the fish farming in Porto Grande's municipality are also common in other regions of the country, as noted by Martins, Oliveira, Martins, Hermes, Oliveira, Vaz, Minozzo, Cunha and Zacarkin (2001); in Lower Acre by Sá, Balzon, Oliveira, Bayma and Carneiro Junior (2008), in Lower Francisco in Alagoas by Araújo (2015), in Amazonas' Mesoregions by Oliveira, Silva, Almeida-Val and Val (2012), in Porto Velho/RO by Xavier (2013) and in the Southeast of Paraná by Dutra, Bittencourt and Feiden (2014).

In Porto Grande's municipality, the process which involves fish production is initially characterized by the following phases in productive chain, I) acquisition of fingerlings and feed; II) fattening process; III) fish slaughtering process; and IV) distribution of fish production (transportation on highways). However, this structure is still limited and it may be connected to other phases in this productive segment in the region (e.g. use of new technologies, with good handling and management practices), like fish beneficiation and industrialization and large-scale distribution (Borghetti, 1999).

Conclusions

The fish production in Porto Grande region (Amapá-Brazil) is considered a recent activity because it has existed for less than five years in the region and most of the pisciculture facilities are still under legalization process. The fish entrepreneurs were installed in the region on large and mid-size properties, with private resources from the owners. In this segment, most of the people are men, due to family labor. However, they report that the main obstacles for the segment are mainly lack of training, technical service and high costs from fish feed acquisition. Fish farming is considered small-sized, and it acts in semi-intensive and extensive production system, primarily with tambaqui fattening (monoculture) for subsistence and commercialization purposes. The fish produced (≈ 200 kg of fish in just one cycle per year, by fish farmer) is totally consumed in the municipality, in the modality of subsistence, but part of it is distributed (stored in ice or *in natura*) for the urban centers where it is commercialized in open air markets and supermarkets.

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