International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-9, Issue-7; July, 2022
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.97.11

Animal protein production in aquaculture in the semi-arid northeast - challenges and perspectives for small businesses

Msc. Dajana Gabriella Nóbrega Santos da Silva[1], Dr. Jairton Fraga Araújo[2], Dr. Luciano Sergio Ventim Bomfim[3], Dra. Anna Cristina Freire Barbosa[4], Dra. Eliane Maria de Souza Nogueira[5]

[1]Doutoranda no Programa de Pós-Graduação em Agroecologia e Desenvolvimento Territorial PPGADT- *Universidade Federal do Vale do São Francisco- UNIVASF/Universidade do Estado da Bahia – UNEB, Campus – III, Juazeiro – BA, e-mail*: engenheiradajana@hotmail.com
[2]Docente no Programa Pós-Graduação em Agroecologia e Desenvolvimento Territorial PPGADT - *Universidade Federal do Vale do São Francisco- UNIVASF/Universidade do Estado da Bahia – UNEB, Campus – III, Juazeiro – BA*, e-mail:jafararaujo@uneb.br
[3]Docente no Programa Pós-Graduação em Agroecologia e Desenvolvimento Territorial PPGADT - *Universidade Federal do Vale do São Francisco- UNIVASF/Universidade do Estado da Bahia – UNEB, Campus – III, Juazeiro – BA*, e-mail:lbomfim@uneb.br
[4]Docente no Programa Pós-Graduação em Agroecologia e Desenvolvimento Territorial PPGADT - *Universidade Federal do Vale do São Francisco- UNIVASF/Universidade do Estado da Bahia – UNEB, Campus – III, Juazeiro – BA*, e-mail:acbarbosa@uneb.br
[5]Docente no Programa Pós-Graduação em Agroecologia e Desenvolvimento Territorial PPGADT - *Universidade Federal do Vale do São Francisco- UNIVASF/Universidade do Estado da Bahia – UNEB, Campus – III, Juazeiro – BA*, e-mail:emsnogueira@gmail.com

Received: 08 Jun 2022,
Received in revised form: 05 Jul 2022,
Accepted: 10 July 2022,
Available online: 15 July 2022

Keywords*— *Economy, Development, Aquaculture, Possibilities.

***Abstract*—** *In this article, we sought to analyze aquaculture in the northeastern semi-arid region, with an emphasis on the animal production of Nile tilapia (Oreochromis niloticus), dialoguing with its challenges and perspectives for small business and potential impacts on its performance. The region presents as a prominent factor the climate, which is responsible for the variation of the other elements that make up the landscapes. The activity uses natural, human and manufactured resources. In order to achieve the proposed objectives and obtain data on the state-of-the-art on the subject, we sought to carry out a literature review of articles published in national and international journals, published in the Scielo, Google academic and Science direct databases, and classic authors.*

I. INTRODUCTION

The Brazilian semiarid region is composed of 1,262 municipalities, belonging to the states of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia and Minas Gerais. The criteria for delimiting the semiarid region were: average annual rainfall equal to or less than 800 mm; the Thornthwaite Aridity Index equal to or less than 0.50 and; the daily percentage of water deficit equal to or greater than 60%, considering every day of the year (IBGE, 2018).

The purpose of this article focuses on the analysis of aquaculture activity in this region, with a view to the challenges and perspectives for small business and projection with other territories. Given this scenario, we will analyze the aquaculture of Nile tilapia.

For Duarte, the growth potential of global aquaculture is significant because it can operate in the ocean, which despite covering 70% of the Earth's surface, represents only 2% of human food production (DUARTE et al., 2009).

In this scenario, aquaculture represents 41.2% of the total volume of fish produced in the world and contributes to the growth of international trade with species of high value, such as salmon, sea bass, sea bream, shrimp and molluscs, but also species of lower value. such as tilapia, catfish, panga and carp, traded both nationally and in major producing regions, as well as internationally (FAO, 2014).

According to Embrapa (2017), the most common species produced in the country, by region, are: i) tambaqui, pirarucu and pirapitinga in the North region; ii) tilapia and marine shrimp in the Northeast; iii) tambaqui, pacu and painted in the Midwest; iv) tilapia, pacu and painted in the Southeast; and v) carp, tilapia, silver catfish, oysters and mussels in the southern region.

Currently, aquaculture can be carried out through four basic production systems, namely: (i) ponds; (ii) net tanks; (iii) raceways (tanks that simulate the conditions of a rapid for fish); and (iv) recirculation systems, such as aquariums and ponds. Fish production, for example, can be carried out in any of these systems, according to the best suitability of the chosen species (CALDER, 2005).

Among the species, tilapia has already established itself as the main fishery/aquaculture product in Brazil, being often cultivated in net-tanks and excavated ponds (MATOS; MATOS, 2018). It was primarily responsible for the high growth rates of the white fish sector, with production expanding to more than 80 countries and volumes growing at an average rate of 11% per year over the past decade. Currently, tilapia is the second most cultivated fish in the world, after carp (HEINHUIS; NIKOLIK, 2015).

Aquaculture has thus become a source of employment and income for families in the semi-arid region since the 19th century, because in the face of the scarcity scenario caused by recurrent droughts, alternatives and answers have been sought to cope with its effects, so that the activity is seen as a food strategy.

For the year 2050 it is estimated that the world population will be 9 billion people and, to feed this growing number of individuals, the annual production of meat will have to increase by more than 200 million tons. Population growth, food security and environmental sustainability are among the main challenges to be faced by the fish farming production chain for the coming decades. However, the average annual rate of production has been decreasing, which can be explained by factors such as water limitations, the limited availability of ideal locations for production and the rising costs of fishmeal, fish oil and other foods (FAO, 2012). .

According to data from the Food and Agriculture Organization of the United Nations (FAO, 2016), world fish production in 2015 – aquaculture and capture – reached 199.7 million tons, of which 106 million came from aquaculture and 93.7 million tons. million, from capture.

The present research is the result of discussions originated in the Doctorate in Agroecology and Territorial Development, by the Federal University of Vale do São Francisco - UNIVASF and the State University of Bahia-UNEB, in particular the concerns proposed by the professors of the discipline Agroecology, Territory and Development, regarding the challenges and prospects of aquaculture, specifically tilapia, for small businesses. Therefore, it was necessary to analyze and reflect on the challenges and economic research of the activity, as well as the environmental issues experienced.

II. DEVELOPMENT

In Ávila's (1983) perspective, we define "scientific research as a “stimulating and solitary activity that develops between the limits of logical certainty and science fiction” (ÁVILA-PIRES ,1983, p.17).

Quali-quantitative research structured in three sequential phases, being first carried out a bibliographic review of the literature in order to present a theoretical basis on the object of study, with the definitions corresponding to the research object being exposed.

In the second moment, to survey the articles, in the month of April and 2022, a systematic literature search was carried out, using as descriptors: Embrapa (2016). FAO (2016). The keywords were related, since the purpose of the investigation was to identify the scientific studies that correlated the research study objects

At this point, the study was carried out through bibliographic research, with data analysis and condition that makes it possible to identify the state-of-the-art on the topic addressed and to collect better subsidies for the basis of the topic in question, as well as the expansion of the discussion of the its generalities. Thus, the analysis and reflection on the subject are based on material available in the written press and publications (books, internet portals, monographs and theoretical articles), worth mentioning: Arana (1999), Casaca; Tomazelli Junior, (2001), Embrapa (2016). FAO(2016). Heinhuis; Nikolik, (2015). IBGE(2008-2009) Lima; You are; Souza(2013), OECD(2017). FISH (2020). Rana(1997). Rocha,(2008) Silva(2007). Valenti,(2008).Vieira Filho; Gasques, (2017) Ximenes (2021), among others.

In the third moment, the inclusion and exclusion criteria were established. As inclusion criteria, it was required: to be a scientific article and concluding in writing.

The delimitation of the study included the Brazilian semiarid from a holistic view, since the look turns to aquaculture activity as a whole.

III. DELIMITATION OF THE RESEARCH FIELD

For the elaboration of this article, the territory of the Brazilian semi-arid or landlocked in the Brazilian Northeast was used as a geographical cut. Given the boundaries (figure 01) of the states Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia and Minas Gerais. (IBGE, 2018)

Fig.1: Delimitation of the Brazilian semi-arid regionSource: National Water Agency-ANA/Ministry of Integration-MI

To better elucidate the theme, it is necessary to define the semiarid terminology, especially in the reality observed in Brazil and, in this way, we can say that:

> The technical concept of semi-arid is derived from a rule of the Brazilian Constitution of 1988, more precisely from its Article 159, which establishes the Constitutional Fund for Financing of the Northeast (FNE). The constitutional norm requires that 50% of the resources allocated to the Fund be invested in the semi-arid region. Law 7,827, of September 27, 1989, regulating the Federal Constitution, defines as semi-arid the region within the Sudene area of operation, with average annual rainfall equal to or less than 800 mm. According to the last delimitation made by the Ministry of National Integration, according to Ministerial Ordinance n. 89, of March 2005, the Semi-arid region covers 1,133 municipalities in an area of 969,589.4 km2, corresponding to almost 90% of the total area of the Northeast plus the northern region of Minas Gerais. With a population of around 21 million people (11% of the Brazilian population), it is an increasingly urban space (SILVA, 2007, p.468-469).

A major highlight when dealing with the semi-arid region lies in the understanding that it constitutes the most comprehensive biome in the sub-area of the Brazilian northeast, today widely known as semi-arid. Thus, we can say that the caatinga is "the only uniquely Brazilian biome" (CONTI; SCHROEDE, 2013, p.10).

It is also worth considering that:

> One of the outstanding factors of the landscape is the caatinga vegetation. It is a biome with high biodiversity, where the xerophilous plant formation stands out with small leaves that reduce transpiration, succulent stems to store water and roots spread out to capture as much water as possible. In addition to cactus, tree, herb and shrub species stand out (SILVA, 2007, p.469).

The semi-arid regions are generally characterized by arid climate, water deficit with unpredictability of rainfall and the presence of soils poor in organic matter. The prolonged annual dry period raises the local temperature, characterizing seasonal aridity (SILVA, 2007, p.468). This demonstrates the importance of the debate about alternatives to guarantee the population's food sustainability.

IV. AQUACULTURE AS ALTERNATIVE

In the 1990s, there was a leap in growth in fish farming, when studies and research in management began to emerge and expand, as well as specialized publications that greatly contributed to the dissemination of technology and knowledge. Feed began to be manufactured specifically for the most cultivated fish species, as factories and animal nutrition researchers focused on the quality and effectiveness of the product in terms of weight conversion. The processing structures contributed to the increased consumption of farmed fish in the market. The Public Authorities recognized the potential and importance of this activity, in the economic context, and subsequent years (SEBRAE/BA, 2005).

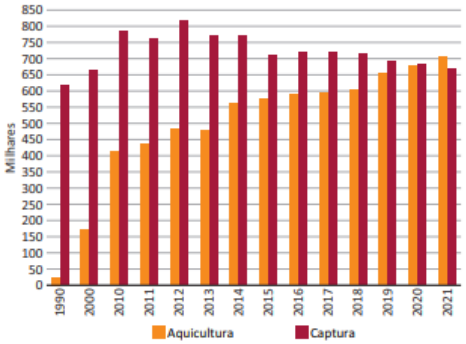
The potential that aquaculture has to meet the challenges of food security and job creation is more than evident when looking at the rapid expansion of the sector, which has experienced an annual growth rate of more than

8% since 1981, unlike of what has happened with the livestock and fishing sectors, whose growth rates are 3 and 1.6% per year, respectively (RANA, 1997).

Thus, in the planning of fish farming, the economic aspects of the activity are highly relevant. Investments carried out without proper economic analysis may constitute a loss (CASACA and TOMAZELI JÚNIOR, 2001).

In Brazil, the behavior of fish production was similar to that observed worldwide, with the stagnation of the volume of capture and the vertiginous growth of aquaculture from the 2000s onwards. Considering only the most recent data from FAO (2020), which correspond to the period from 2010 to 2018, aquaculture grew by 4.94% p.a., while fisheries retracted by -1.18% p.a. As shown in the chart below of Brazil's fisheries production by capture and aquaculture (in thousand tons), prepared by the authors of FAO Fisheries & Aquacultures (FAO, 2020).

Graph 1 – Fisheries production in Brazil by capture and aquaculture (in thousand tons)



Source: Prepared by the authors of FAO Fisheries & Aquacultures (FAO, 2020).

Notes: Estimated fisheries and aquaculture data (2019, 2020, 2021)

Northeastern production was affected by the effects of the long drought that lasted from 2012 to 2017, and caused the depletion of water resources in the dams and, consequently, the continuity of the rivers. For 2021, under the effects of the La Niña phenomenon, a good rainy season is estimated in the Region, which should replenish the reservoirs (XIMENES, 2021).

Also according to Ximenes, the Northeast, predominantly the semi-arid region, contributed in 2019 with 25% of national aquaculture production, around 151 thousand tons. The main species cultivated in the Region are tilapia (38.61%) and marine shrimp Litopenaeus vannamei (35.83%). Shrimp is predominantly produced in the Northeast (99.6%), although it represents only 9.03% of the volume of aquaculture production in the country, it is the second aquaculture billion (23.0% of the total) showing the high added value of this product, in current values (XIMENES, 2021).

In this context, we seek to bring in the table below IBGE product with the highest production value in Brazil, R$ 1.18 data in the timeline of the years 2013 and 2015 in the Brazilian regions of tilapia production.

Region	2013	2015	%
North	**293.550**	**527.700**	**0,2**
North East	**48.103.265**	**52.964.653**	**24,1**
Midwest	**11.524.425**	**17.785.914**	**8,1**
Southeast	**45.834.891**	**57.083.226**	**26**
South	**63.549.880**	**90.967.713**	**41,5**
Brazil	169.306.011	219.329.206	**100**

Source: IBGE, 2016

Prepared by the author

Analyzing the data, we noticed that the Northeast had a growing production, which may be associated with new technologies and investments in the area.

It is worth noting that for the development of economic activity, it is essential to comply with its environmental legislation before the competent bodies, analyzing average production, polluting potential and production volume, in the search to ensure harmony between the activity and the environment. environment.

V. FINAL CONSIDERATIONS

It was healthy to talk about the activity of aquaculture, in the search for development for the semi-arid region, which experiences long periods of drought; envisioning small businesses.

It is worth mentioning that the design of small businesses in the creation of tilapia is still covered by challenges that need to be overcome with viable strategies. For this, it is necessary to return to the perspective of Sustainable Local Development, making it evident that we need specific public policies for the countryside.

Therefore, it is up to the government and society to plan and execute collective and individual actions that seek solutions to the impacts suffered by the physical, biotic and anthropic environment, and which have significant effects on the socio-environmental good of the activity.

Finally, this study was of substantial relevance, as it allowed for a dialogue with the challenges and perspectives for small businesses, which will certainly be one of the indications for the search for better solutions.

REFERENCES

[1] ARANA, L. V. **Aquicultura e desenvolvimento sustentável**. Florianópolis:, Editora da UFSC, 1999.

[2] CASACA, J. de M; TOMAZELLI JÚNIOR, O. **Planilha para cálculos de custo de produção de peixes.** Florionópolis. Epagri 2001. 38p

[3] EMBRAPA – EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA. **Mercado da Tilápia** – 2o trimestre de 2016. Palmas: Embrapa, 2016. (Informativo Mercado da Tilápia, n. 8). Disponível em: <https://www.embrapa.br/pesca-e-aquicultura/busca-de-publicacoes/-/publicacao/1051014/o-mercado-da-tilapia---2-trimestre-de-2016>.

[4] _____. **Pesca e aquicultura**. Palmas: Embrapa, 2017. Disponível em: <https://www.embrapa.r/tema-pesca-e-aquicultura/>. Acesso em: abr. 2017.

[5] FAO - FOOD AND AGRICULTURE ORGANIZATION**. Of the United Nations. Fishery and aquaculture statistics**. Rome, Italy: Fisheries and Aquaculture Department f FAO, 2010. 72p.

[6] _____ **Global aquaculture production statistics 2009**. Rome: FAO, 2011. 256 p.

[7] _____ **The state of world fisheries and aquaculture**: opportunities and challenges. Rome: FAO, 2016. 243 p.

[8] _____. ***The state of world fisheries and aquaculture***. Roma, 2012. 209p.

[9] _____. **The State of World Fisheries and Aquaculture 2020**. Roma: FAO. Disponível em: . Acesso em 9 dezembro de 2020

[10] HEINHUIS, L.; NIKOLIK, G. The rise of the aquatic chicken. **Rabobank Industry Note**, Netherlands, Vol. 471, 6 p.,2015.

[11] IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **Pesquisa de Orçamentos Familiares** – 2008-2009. Rio de Janeiro, 2010. Disponível em: <http://biblioteca.ibge.gov.br/visualizacao/livros/liv45419.pdf>. Acesso em: 20 abril 2022.

[12] _____. **Produção Pecuária Municipal**. Rio de Janeiro 2016.

[13] _____. **Semiárido Brasileiro**: IBGE, 2018.

[14] LIMA, C. S.; TUESTA, G. M. R.; SOUZA, C. S. **Redução de proteína bruta em rações para peixes como estratégia para diminuir a excreção nitrogênio**, Viçosa, MG, 2013. In: V SIMPÓSIO BRASILEIRO DE AGROPECUÁRIA SUSTENTÁVEL; II CONGRESSO INTERNACIONAL DE AGROPECUÁRIA SUSTENTÁVEL, 2013, Anais...Viçosa, 2013. p. 139-142.

[15] LUCHESI, J. D.; NEU, D. H.; COSTA, J. M.; FRIES, E. M.; BOSCOLO, W. R.; FEIDEN, **A. Proteína bruta na dieta de alevinos de quinguio (*Carassius auratus*).** Revista Agrarian. Dourados, v.7, n.23, p.101-106, 2014.

[16] MATOS, A. P.; MATOS, A. C. **Tilapicultura em tanques-rede: uma realidade no Oeste Catarinense**. Agropecuária Catarinense, Florianópolis, v.31, n.2, p.33-36, maio/ago. 2018

[17] OCDE – ORGANIZAÇÃO PARA A COOPERAÇÃO E DESENVOLVIMENTO ECONÔMICO. ***The ocean economy*** *in 2030*. Paris, 2016. Disponível em: <https://www.oecd-ilibrary.org/economics/the-ocean-economyin- 2030_9789264251724-en>. Acesso em: 26 out. 2017.

[18] PEIXEBR - ASSOCIAÇÃO BRASILEIRA DA PISCICULTURA. **Anuário Brasileiro da Piscicultura PEIXE BR 2020**. São Paulo: ABP. Disponível em: <https://www.peixebr.com.br/anuario-2020/>. Acesso em 21 de dezembro de 2020. 2020. 136p.

[19] RANA ,K. **Recent Trends in global aquaculture production 1984 -19995**.FAO Aquaculture Newletter, Rome, n. 13, p.14-19, ago 1997.

[20] ROCHA, I.P.**Panorama da Produção Mundial e Brasileira de Pescados, com ênfase para o segmento da Aquicultura**.2008

[21] SILVA, R. M. A. Entre o Combate à Seca e a Convivência com o Semi-Árido: políticas públicas e transição paradigmática. Revista Econômica do Nordeste, Fortaleza, v.38, n.3, p.466-485, 2007.. DA SILVA, R. M. A. Entre o Combate à Seca e a Convivência com o Semi-Árido: políticas públicas e transição paradigmática. Revista Econômica do Nordeste, Fortaleza: V.38, n. 3, p. 466-485, jul.-set. 2007.

[22] VALENTI, W. C. 2008. **A aqüicultura Brasileira é sustentável?** Palestra apresentada durante o IV Seminário Internacional de Aqüicultura, Maricultura e Pesca, Aquafair 2008, Florianópolis, 13-15 de maio de 2008.

[23] VIEIRA FILHO, J. E. R.; GASQUES, J. G. **Agricultura, transformação produtiva e sustentabilidade**. Brasília: Ipea, 2016.

[24] _____. **Agricultura e indústria no Brasil**: inovação e competitividade. Brasília: Ipea, 2017.

[25] XIMENES LUCIANO F. **PRODUÇÃO DE PESCADO NO BRASIL E NO NORDESTE BRASILEIRO.** Caderno Setorial ETENE, Ano 5 | Nº 150 | janeiro | 2021.

[26] ASC – AQUACULTURE STERWARDSHIP COUNCIL. <www.asc-aqua.org.>.

[27] FAO DATABASES. Fisheries and Aquaculture. <www.fao.org.>.

[28] SRAC – SOUTHERN REGIONAL AQUACULTURE CENTER.