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Productive diagnosis off rog culture in the state of Rio de Janeiro

Diagnóstico produtivo da ranicultura no estado do Rio de Janeiro

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ABSTRACT

Brazilian frog farming has a history of production that began in the state of Rio de Janeiro in 1935. Over the years, this activity has spread throughout Brazil, with technological advances that have improved the productivity and health of enterprises. However, structuring the production chain has presented moments of growth and decline, culminating in low production compared with other aquaculture activities. Despite efforts focused on restructuring the chain, data on enterprises and their actors remain scarce. To obtain information on the current scenario of frog farming in the state of Rio de Janeiro, in this study, an online survey of data on frog producers in Rio de Janeiro was conducted. In general, frog farming in Rio de Janeiro has not shown substantial improvements in terms of structuring. Its dynamics are still linked to low production, family run enterprises, little insertion into the market, and not being formalized, encompassing aspects related to fiscal, environmental, and health issues. Therefore, the restructuring process of the frog chain in the state depends on overcoming the bottlenecks mentioned in this study. These predominantly refer to the availability of information on the relevant aspects of management and regularization of production.
Keywords: productive chain, promotion, aquaculture, bullfrog.

RESUMO

A ranicultura brasileira apresenta um histórico de produção que se iniciou no estado do Rio de Janeiro em 1935. Com o passar dos anos essa atividade se difundiu para todo o Brasil, apresentando avanços tecnológicos que melhoraram o manejo sanitário e a produtividade dos empreendimentos. Contudo, a estruturação da cadeia produtiva

apresentou momentos de crescimento e declínio, culminando com uma baixa produção em comparação com outras atividades aquícolas. Apesar dos esforços focados na reestruturação da cadeia, ainda são escassos dados sobre os empreendimentos e seus atores. Com o objetivo de obter informações acerca do cenário atual da ranicultura no estado do Rio de Janeiro, o presente trabalho executou levantamento de dados referentes aos produtores de rã fluminense por meio de formulário online. De uma maneira geral, a ranicultura no Rio de Janeiro não conseguiu apresentar grandes melhorias em termos de estruturação. Sua dinâmica ainda está atrelada a empreendimentos com baixa produção, familiar, pouca inserção no mercado e não formalizados, englobando aspectos relacionados às questões fiscais, ambientais e sanitárias. Assim, o processo de reestruturação da cadeia ranícola no estado depende da superação dos gargalos apontados neste estudo, principalmente referentes à disponibilização de informação acerca dos aspectos de manejo e regularização da produção.
Palavras-chave: cadeia produtiva, fomento, aquicultura, rã-touro.

INTRODUCTION

Frog farming began in Brazil with the1935implementation of the Aurora frog farm, the largest in South America in Seropédica, Baixada Fluminense. In the 1980s, this creation was established in the city of Rio de Janeiro as a productive activity. In the same decade, the country had approximately 2,000 frog farms. (LIMA AND AGOSTINHO, 1989).

In 1986, the first association of frog farmers was created in Rio de Janeiro, the ARERJ (Association of Frog farmers of the State ofRio de Janeiro), producing five tons (MELLO, 2018) and reaching 91 producers in its membership.

In 1995, the first frog warehouse with SIF was installed in the municipality of Itaboraí in the metropolitan region of Rio de Janeiro. In 1996, it received the "Rio-Quality Seal" offered by Rio de Janeiro State Fisheries Institute Foundation -FIPERJ. Through the technical assistance provided by FIPERJ technicians, production increased substantially, reaching 60 tons/month and 200 frog farms (MELLO, 2018).

In 2002, management problems, divergent opinions among partners, and abandonment of members resulted in the creation of the Regional Cooperative of Frog and Fish Farmers of Vale do Macacu and Adjacencies Ltda COOPERCRÃMMA, 2003). In this decade, frog farming was considered a secondary activity for retirees.

From the 2010s, a new cycle of investment in the area took place with the entry of new producers (RODRIGUES, 2010). This resumption was driven by the R&D of new products (OLIVEIRA, 2015).

In 2010, as an attempt to integrate and promote the activity, in partnership with several institutions, EMBRAPA launched "Frog culture in Network", sharing information with the actors in the frog production chain (AFONSO, 2012).

Currently, it is estimated that there are 151 frog farmers in Brazil, with their distribution concentrated in the southeastern region. The main species cultivated in the country is the bullfrog (*Lithobatescatesbeianus*) totaling an estimated production of 400 ton in 2019 with a turnover of approximately 1.9 million dollars (RIBEIRO E TOLEDO, 2022). According to Pahor-Filho et al. (2019), the main rearing systems used were amphifarm (LIMA E

AGOSTINHO, 1997), flooded (SOUZA et al, 2017), and cages.

Despite the history of support for the development of the sector, data on frog chairs in Brazil, and especially in the state of Rio de Janeiro, are still limited and scattered. The last survey on the current state of frog farming in the state was conducted in 2010 by Carvalho (2011). Given the informality of the sector, the number of active producers is still uncertain, with FIPERJ data indicating a total of 20 producers. Despite this scenario, the state has still added a center for scientific production and aquaculture extension with the aim of developing the sector.

After 13 years, the present study aims to fill in the gaps in information regarding frog farming activity in the state of Rio de Janeiro, provide subsidies for the elaboration and development of public policies for the sector, and, therefore, assist in the security of the chain of the Fluminense frog farming.

MATERIAL AND METHODS

Data collection was conducted from January 25, 2021, to February 3, 2021, by the primary method, by surveying representative samples using the survey technique (MINEIRO, 2020). This was based on the application of online questionnaires through the Google Forms tool. An Excel spreadsheet was generated from the forms collected for grouping, descriptive analysis, and data processing.

The target audience was a frog farmer in Rio de Janeiro. Awareness of participation in the research was carried out through dissemination in a digital group with a free mobile application that includes frog producers from throughout Brazil, in addition to telephone contact with those registered in the FIPERJ database who still did not use digital tools such as email, social networks, and others.

The questions were arranged according to the main themes that included I) geographic distribution and general data,II) production data, III) data on inputs, labor, and credit, IV) regularization data, V) slaughter and processing data, and VI) technical assistance data.

For comparative purposes, data with monetary values, such as the price of inputs, credit, and labor costs, were converted from reais to dollars using a quotation for the analysis period. The quotation value of the commercial dollar for January 29, 2021, was R$5.48 (BANCO CENTRAL DO BRASIL, 2022). Regarding the analyzes carried out using the minimum wage as a basis for comparison, this value was R$1,100.00 for 2021 (IPEA, 2023).

To group the municipalities that comprise the state of Rio de Janeiro, the political–administrative division of the state was used (CEPERJ, 2019). These regions were defined as (i) Norte Fluminense, (ii) Baixada Litorânea, (iii) Metropolitana, (iv) Centro Sul Fluminense, (v) Médio Paraíba, (vi) Costa Verde, (vii) Noroeste Fluminense, and (viii) Serrana.

RESULTS

Geographic distribution and general data

A total of 11 forms were answered, representing approximately 55% of the total active frog farmers that FIPERJ identified in its own database until 2021 (unpublished data). They were spread across 11 municipalities in virtually all regions of the state, with the exception of Serrana (Table 1). In addition to not having more than one producer per

municipality, there was no significant concentration in any of these regions. Only Metropolitana (Itaguaí, Nova Iguaçu, Cachoeiras de Macacu ,and Magé), and Médio Paraíba (Rio das Flores and Valença) had more than one respondent producer.

Table 1. Distribution of frog farmers by region and municipality, obtained according to the questionnaire used.

Region	Municipalities	Nº of producers
Norte Fluminense	Macaé	1
Baixada Litorânea	Silva Jardim	1
Metropolitana	Itaguaí	1
	Nova Iguaçu	1
	Magé	1
	Cachoeiras de Macacu	1
Centro Sul Fluminense	Vassouras	1
MédioParaíba	Rio das Flores	1
	Valença	1
Costa Verde	Paraty	1
NoroesteFluminense	Cambuci	1

Of the respondents, only 22% reported frog farming as their primary economic activity. For the rest of the producers, the main source of income came from other rural activities (38%) in addition to the relevant participation of retirees (25.0%). Three other less representative categories – services, commerce, and public services – comprised 13% each (Figure 1).

The income from frog farming was relatively low for most producers. Only 9% of the respondents had an income above five minimum wages, 27% had an income between three and five minimum wages, 27% had an income between one and two minimum wages, and 37% had an income below one wage.

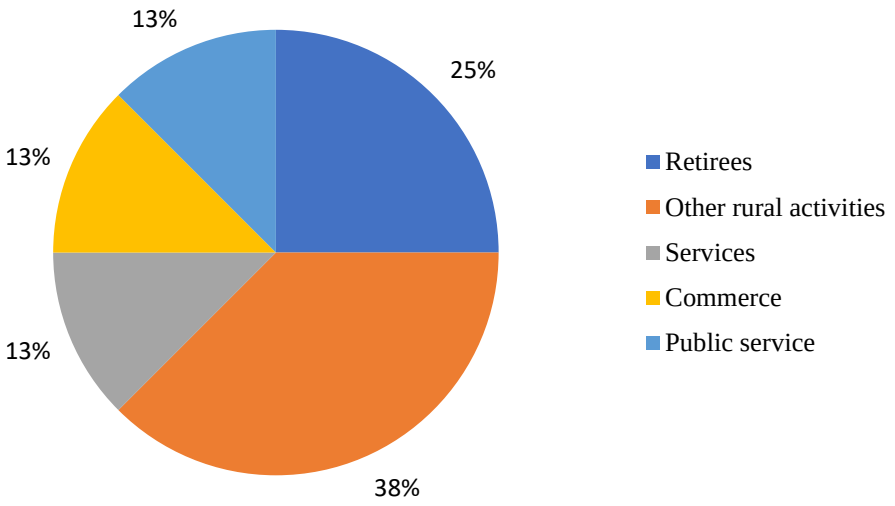

Figure 1. Distribution of the main sources of income for frog farmers. The minimum wage for 2021 corresponded to R$1,100.00.

Production

There was no dominant category regarding the size of the properties (FIGURE 2). Properties smaller than 100 m^2 comprised 28% of the answers, followed by developments of 100–500 m^2 and larger than 1,000 m^2 both with 27%,and properties of 501–1,000 m^2 (18%).

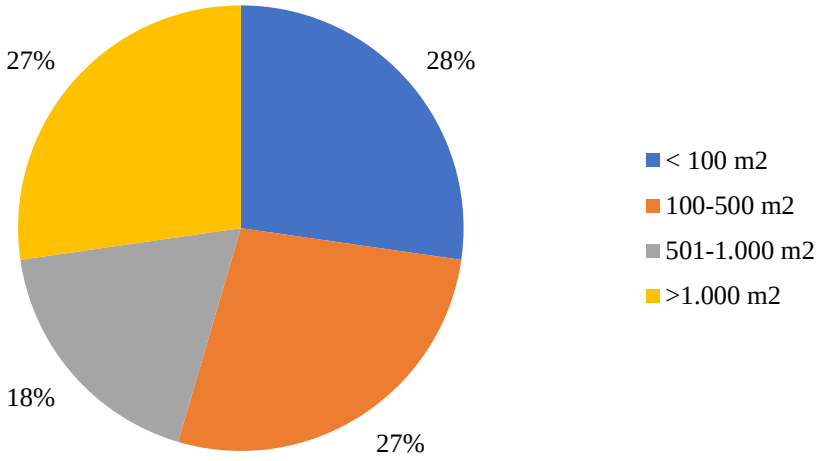

Figure 2. Distribution of size ranges owned by frog farms in Rio de Janeiro.

Regarding production systems, the semi-flooded system was the most commonly reported by four producers, followed by the flooded system with its use by three producers, the combination flooded/semi-flooded with two and, finally, the amphifarm system and the semi-flooded/amphifarm combination represented by only one producer each (Table 2).

Table 2. Frequency of use of different systems and their compositions in frog farming in Rio de Janeiro

System	Nº of producers
Semi-flooded	4
Flooded	3
Amphifarm	1
Flooded, semi-flooded	2
Semi-flooded, Amphifarm	1

The number of producers (82%) that still operated at all stages of production was relatively high. Only 18% cultivated in two phases, that is, tadpole and growth (9%), and growth and fattening (9%) (FIGURE 3). No producer specialized in only one stage of production.

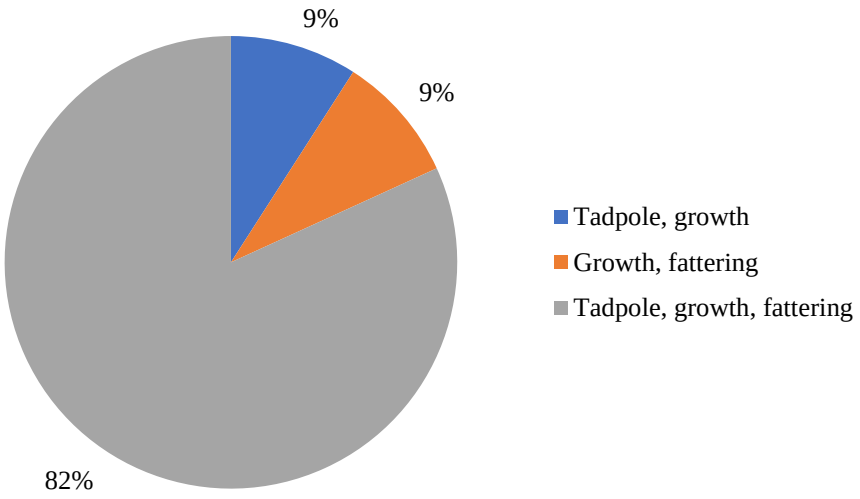

Figure 3. Composition in specialization of production phases in frog farming in the state of Rio de Janeiro.

The annual production of tadpoles was 40% of the respondents with cultivation above 50 thousand (Figure 4a). However, a relevant number of producers (30%) have small productions of tadpoles between 1–10 thousand, 20% between 11–50 thousand and only 10% with less than one thousand.

In the case of froglets(newly metamorphosed frogs), this annual production decreased, with most respondents reporting that they cultivated less than one thousand (30%) and between 11–50 thousand (30%) (Figure 4b). Even so, productions between 1–10 thousand and above 50 thousand were representative, with 20% each.

Regarding the annual production of frogs for slaughter, 45% of the frog farmers produced a volume of 1,001 to 10,000 kg/year, 33% answered that the production was from 100 to 1,000 kg/year, and 25% of the frog farmers produced less than 100 kg/year. In approximately 18% of cases, producers carried out winter reproduction, which maintained sales throughout the entire period (Figure 4c).

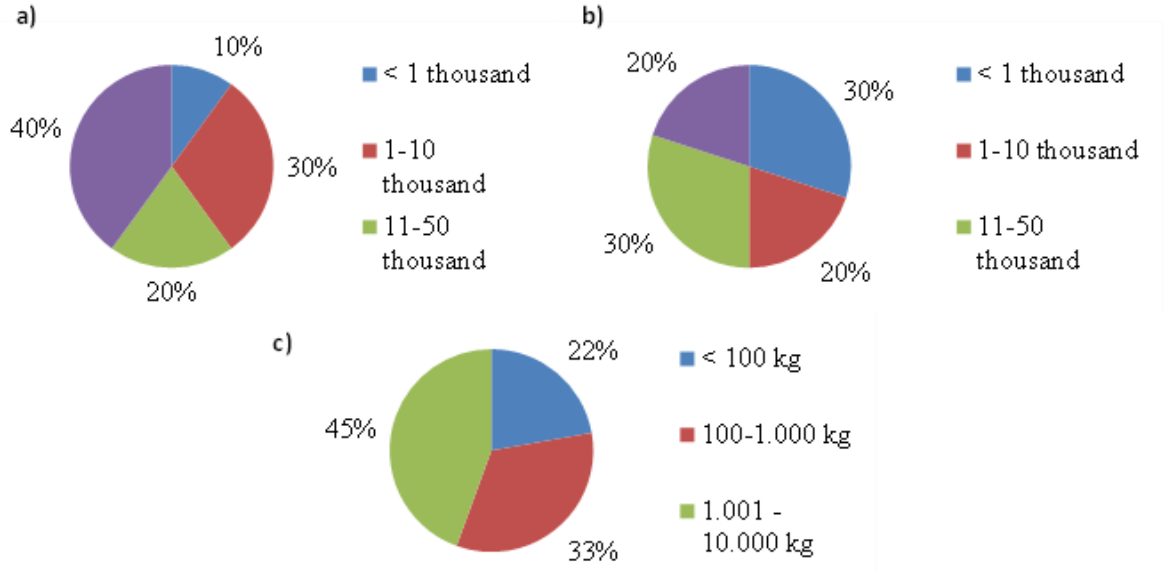

Figure 4. Distribution of production ranges within each cultivation phase: a) tadpole; b) growth, and c) fattening

Approximately 55% of the frog farmers participating reported idleness in productive capacity. Such idleness was between 20–50% for 50% of producers, less than 20% for 33% of producers, and above 80% for 17% of respondents.

Supplies, Labor, and Credit

Supplies

For most respondents (81%), there was some difficulty in acquiring adequate feed for the development of the activity, while 18% registered no obstacle to purchasing this input. In general, it could be observed that the difficulties in acquiring feed were concentrated in four main factors, that is, theprice practiced by the market (n=6), distance from the place of sale (n=6), quality of feed (n= 5) and constancy of supply (n=5). Only one respondent attributed this to the lack of government support for feed acquisition.

The average price per kilogram of feed purchased by producers for the tadpole, growth and fattening phases were, respectively, US$0.87 (±0.44); US$0.99 (±0.45) and US$1.01 (±0.56) (Table 3). The percentage of crude protein in the ratio (CP) varied significantly among producers. This variable range of 24–55%, 24–45%, and 28–42% for tadpole, growth, and fattening, respectively. Despite this high level of amplitude in all phases, there was a greater homogeneity in the percentage of protein for the rations used in the fattening (± 4.40), growth (± 8.06), and tadpole (± 9.20) phases.

Table 3. Variation in the price and percentage of protein in the feed purchased by frog farmers.

Parameters	Phases					
	Tadpoles		Growth		Fattening	
	Valueof kg(US$)	% of CP	Value of kg(US$)	% CP	Value of kg(US$)	% ofCP
Maximum	1.95	55.0	1.95	45.0	2.32	42.0
Minimum	0.47	24.0	0.47	24.0	0.47	28.0
Average	0.84	33.9	0.98	37.9	1.00	38.8
Standard Deviation	0.44	9.2	0.44	8.1	0.57	4.4

CP=Crude protein

Regarding one of the most expensive inputs for cultivation, electricity, most frog farmers (55%) did not know how to inform tariff discounts practiced by concessionaires in their locality. In addition, 27% said they knew about the discount, and 18% reported that there was no tariff discount in their region. All those who reported knowing about the rebate used this subsidy. None of the interviewees used collective purchasing strategies to acquire inputs.

Labor

The workforce reported for the activity was mostly family labor (61% of respondents), the range of remuneration of the workforce employed in the activity was 50%, with remuneration below the minimum wage and 50% earning between one and two salaries. Eighteen employees were informed of the universe of responding producers, with an average of 1.6 ± 0.8 employees per producer.

Credit

Borrowing by frog farmers was low, with 27.3% of the respondents claiming to have accessed some type of credit. From this universe, costing, investment, and costing/investment items were accessed in equal proportions by producers. The amounts financed for 66.7% of the respondents were in the range US$1,825.01 to US$9,124.00. The remainder (33.3%) accessed loans with amounts between US$182.00 and US$1825.00.

Regularization

None of the producers was fully compliant in terms of tax, environmental, and administrative documentation. Most producers had the Rural Environmental Registry (n=7), followed by the National Registry of Users of Water Resources and invoice (n=3), Federal Technical Registry, and General Fisheries Registry (n=2), and only one had an environmental license and one had a water grant (Figure 9).
As a strict sensu business activity, none of the respondents had a National Register of Legal Entities (CNPJ).

Slaughter and Processing

Slaughter was carried out in 83% of the cases (n=5) on the property itself in an artisanal way. None of these has any type of inspection seal (municipal, state, or federal). Only one respondent claimed to perform this procedure in a fish warehouse with an SIE, in the municipality of Silva Jardim-RJ.

Technical Assistance and Rural Extension - ATER

Most of the producers interviewed (54.5%) did not receive technical assistance. Of the 45.5% received, 80% were assisted by the FIPERJ, while the remaining 20% (n=1) received technical assistance from Forg farm Mandala.

The demands for technical assistance that were most frequently answered were production management (45.5%), environmental regularization (36.4%), and marketing (36.4%) (Figure 5).

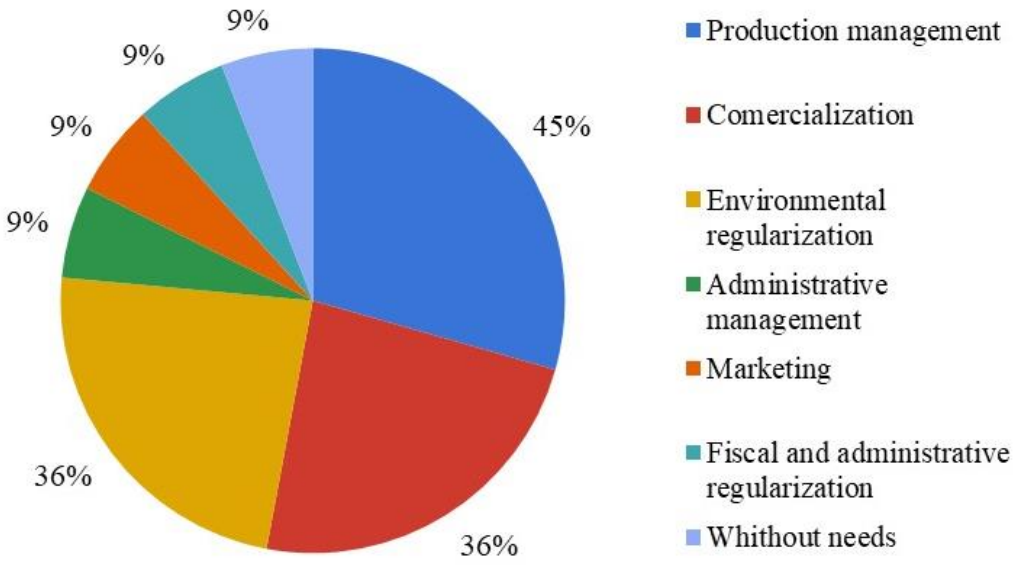

Figure 5. Distribution of frog farmers' main needs in terms of technical assistance.

DISCUSSION

In general, frog farming in Rio de Janeiro has not been able to show substantial improvements in terms of structure since the last survey conducted by Carvalho (2011). Its dynamics are still linked to family enterprises, with low production, little insertion into the market, and production still not being formalized, from aspects related to fiscal, environmental, and health issues.

The scenario of the dispersion of producers throughout the territory has changed slightly since 2011, when the diagnosis carried out by Carvalho (2011) found a smaller scope in distribution, with a marked concentration of producers in the municipalities of Cachoeiras de Macacu (n=13), Seropédica (4), and Nova Iguaçu (n=3). This new configuration may be linked to the institution of new offices of the FIPERJ, a body that provides technical assistance to producers, starting in 2012, mainly in the Centro Sul and Médio Paraíba regions.

According to the FIPERJ database (2018–2020), in this three-year period, there was an increase in the number of visits to frog farmers in the Centro Sulby292% and in the Médio Paraíba by 25% (unpublished data). In addition to providing technical support, the governmental body produces and distributes young forms. The decrease in the number of producers in certain municipalities, mainly Cachoeiras de Macacu, may be a consequence of the closure of the frog slaughter warehouses

in the state located in Cachoeiras de Macacu, Silva Jardim, and Magé.

Frog farming as a secondary economic activity has also been reported in other studies (AFONSO, 2003; CARVALHO, 2011). However, in the present work, in contrast to what was observed in these studies, pensions, although representative, were not the main source of income for producers but worked with other agricultural activities. This replacement may be related to the incentives provided by the sale of young forms and technical assistance in regions further from urban centers, which are characterized as agricultural areas.

Despite the high values found in the sale of frogs, they do not translate into an increase in income for most producers, because of the small supply of products. Compared with the survey conducted by Carvalho (2011) in the state of Rio de Janeiro, there has been an increase in income earned by a small portion of frog farmers, the upper stratum, which in that study only reached 4.6 minimum wages. Given the lack of structure in the chain, this increase in income may be related to a decrease in competition between producers caused by the closure of frog farms over time and the absorption of demand by the remnants. Consequently, there is the formation and strengthening of this vicious cycle, as highlighted by Lima (2003), where the high price generates a low supply of frogs. This has been verified through the large idle capacity of the enterprises, which feeds back the system by imposing higher prices. To maintain producers' profit margins.

The potential for changing this picture is because of an increase in the supply of frog meat at lower prices. However, several factors have prevented this change infrog production chain dynamics. In a general context, the lack of information on the different aspects of cultivation, including management, commercialization, and marketing (CRIBB, 2016), has directly interfered with the success of enterprises. The need for technical assistance in these fields, including environmental regulation, which is perceived in the analysis of assistance to frog farmers registered in the FIPERJ database until 2020 (unpublished data) as the third most discussed subject, ahead of marketing and processing issues, has demonstrated a way to improve production conditions in the state (unpublished data). Reinforcing this statement, Almeida et al. (2017) in their study with family frog farmers in the municipality of Itaguaí-RJ, observed the empirical nature of production, using old methods without a technological basis.

The substantial variation in protein percentage values in the diets also demonstrates a lack of knowledge on the technical criteria in production, which has contributed to productivity losses. This lack of technical knowledge is evident in the choice of some producers for feed for omnivorous organisms, with low protein value, for use in the growth and fattening phases. The impacts related to low production are reflected in the high amount paid and the variation in the price of a kilo of feed, which makes it difficult for producers to acquire this input. This situation has been aggravated by the lack of collective purchase mechanisms not only for feed but also for equipment and young forms, as reported by Almeida et al. (2017) for producers in the municipality of Itaguaí-RJ.

Despite the electric tariff subsidy policies being in operation in the state of Rio de Janeiro, few frog farmers knew aboutor have made use of this

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benefit, given aquaculture in general. However, one factor that shows the effectiveness of this public policy is that all producers who know about this subsidy have managed to use it. This input tends to have a greater weight, as new and more sustainable techniques, such as recirculation systems, are necessary and being demanded by the consumer market.

Although there are financing lines from the National Program for Strengthening Family Agriculture (PRONAF) with more advantageous conditions for family businesses, obtaining credit for frog farmers is still relatively low. Almeida et al. (2017) reported that this difficulty is one of the biggest problems faced by frog farmers. This is a situation that is parallel in all aquacultures in the state because of the informality of production. A factor impeding access is the lack of environmental licensing for most crops in Rio de Janeiro.

The lack of production specialization in only one phase of the frog development cycle, that is, tadpole, growth, and termination, leads to an increase in production complexity. Consequently, small producers incorporate the inefficiencies and waste accumulated throughout production into the final value. Lima (1993) advocated the specialization of producers in the frog production chain, proposing an integration model already used in poultry farming. In the state of Rio de Janeiro there has been the emergence of producers specialized in the cultivation of young forms, who can assume this role within the chain and encourage the formation of enterprises exclusively destined for the production of other phases such as fattening. In the context of expanding activities, there is a need to encourage the implementation of new producers in the initial stages. The structuring of this link in the chain is of paramount importance for the development of the activity and formation of a value chain for frog farming (EMBRAPA, 2020). This perspective parallels what happened during the structuring of the tilapia production chain. The high demand for young forms and the mismatch in supply generated shortages, especially in the coldest months, and distrust regarding the quality and availability of the organisms offered (EMBRAPA, 2015). In this sense, a key factor is the improvement of the production conditions of the producers of young forms that concern the use of technologies and tools that can provide a better quality of organisms (RESENDE, 2009),in terms of productivity and constancy of production, as well as genetic (EMBRAPA, 2015; DIAS E OLIVEIRA, 2021) and health (EMBRAPA, 2015) factors. Technical assistance is highly important for the dissemination of these technologies, as exemplified by the work of the Agricultural Research and Rural Extension Company of Santa Catarina (EPAGRI) with tilapia producers (SCHULTER E VIEIRA FILHO, 2017).

Regarding the low physical structure for maintaining production throughout the year, Fontanello et al. (2018) stated that temperature and photoperiod are the most influential abiotic factors in spawning control. According to Figueiredo et al. (2001), with the control of ambient temperature (between 26 and 29 °C), better gonadal development in female bullfrogs can be attained. Therefore, the development of reproduction in an environment with controlled temperature and photoperiod can result in improvement in the reproduction sector and, consequently,

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regular supply of young forms and frog meat.

Another factor that increases the production complexity is the use of different cultivation system. Each system has its own specificities, and its use without proper understanding can contribute to productivity losses. Contrary to the findings of Pahor-Filho et al. (2019) for the main cultivation systems, the use of the cage system was not identified in the present study. The widespread use of flooded systems may be related to the productive improvement in the fattening phase reported by Reis et al. (2022). This is because of the better distribution and movement of feed in the pens and, consequently, a more homogeneous consumption by the frogs. These authors have attributed a lower energy expenditure of frogs when they are in water, resulting in a more efficient use of nutrients. However, these systems tend to accumulate organic matter in the water and reduce the sanitary quality of the installations, requiring greater care in handling and cleaning the stalls. In this sense, frog farmers have used the semi-flooded system as an alternative, given that producers can opt for treatment in dry areas. However, this strategy is contrary to the previously reported benefits of flooded systems, because it concentrates feeding in a small area of the bay, in addition to the loss of feed movement in water.

Clandestine slaughter remains the most used in the Fluminense frog production chain, intensified with the closure of the main frog slaughterhouses in the state. During the research period, only the slaughterhouse in the municipality of Silva Jardim remained in operation but with a forecast of the closure of its activities. This informality generates, in addition to the impossibility of accessing formal markets, a risk to food security. Including under controlled conditions in legal slaughter establishments, Alfani (2007) reported the presence of *Salmonella* spp. in samples collected at various points in the slaughter flowchart. Alternatively, frog farmers in allocates a substantial component of their production to the sale of live frogs (ALMEIDA et al, 2017). Ribeiro and Toledo (2022) captured this scenario in their study, with most commercialization in the state being conducted through the sale of live frogs. This strategy, owing to the unavailability of regulated slaughter structures, shifts the problem of clandestine slaughter further along the frog production chain.

With the data presented, the context of informality in Fluminense frog farming is notorious, thus reducing its market competitiveness. Looking at only the environmental dimension, the final consumer increasingly demands the offer of so-called green products, which have a relatively high weight in the purchase direction. This charge is even greater for aquaculture products, where in the population's imagination there is still a link to activities that negatively impact the environment (YOUNG, BRUGGERE and MUIR, 2008). Therefore, the lack of environmental regulations would make it difficult for frog farming products to enter this growing market, not to mention the impossibility of accessing credit.

The process of restructuring the frog chain depends on overcoming the bottlenecks identified in this study, mainly referring to the availability of information on management aspects and production regularization. In this regard, strengthening technical assistance is a condition for the growth of frog farm productivity and, consequently, a decrease in the value of frog meat. The structuring of warehouses for frog

slaughter is vital for the success of this chain, contributing to the supply of products to formal markets with safety and quality.

REFERENCES

AFONSO, A.M. Diagnóstico e caracterização do setor produtivo: Região do estado do Rio de Janeiro. **Boletim Técnico Instituto de Pesca**, São Paulo, n. 34, 61p.nov. 2003.

AFONSO, A.M. Ranicultura se Consolida com Cadeia Produtiva Operando em Rede Interativa. Piracicaba-SP. **RevistaVisãoAgrícola**, n. 11, p. 33-35, 2012.

ALFANI, R. **Ocorrência de *Salmonella* spp. Emcarcaças e vísceras de rãs (*Ranacatesbeiana*-Rã de Touro): Avaliação do processo de abate**. 60f. Dissertação (Mestrado) – Curso de Medicina Veterinária, Universidade de São Paulo, Botucatu, 2007.

ALMEIDA, A.D.P.F.; LOPEZ, F.G.; SEIXAS FILHO, J.T. Diagnóstico do produtor familiar: desenvolvimento local pelo associativismo em ranicultura no município de Itaguaí no estado do Rio de Janeiro. **Revista Semioses**, v. 11, n. 2, p. 17-27, 2017.

BANCO CENTRAL DO BRASIL. Cotações e Boletins. Disponível em:<https://www.bcb.gov.br/estabilidadefinanceira/historicocotacoes>. Acessoem 29 abr. 2022.

BRASIL, A.C.E.E. 1º **Anuário Brasileiro da Pesca e Aquicultura**. Rio de Janeiro, 2014.

CARVALHO, L.T. **Diagnóstico da competitividade na cadeia produtiva de carne de rã-touro no Estado do Rio de Janeiro**. 124f. Tese (Doutorado) – Cursoem Ciências e Tecnologia de Alimentos, Universidade Federal de Viçosa, MG. 2011.

CEPERJ. 2019. Fundação Centro Estadual de Estatísticas, Pesquisas e Formação de Servidores Públicos do Rio de Janeiro**.** Divisão político-administrativa, segundo as Regiões de Governo e municípios Estado do Rio de Janeiro - 2019. Disponível em: <https://www.ceperj.rj.gov.br/wp-content/uploads/2021/08/Divisao-municipal-e-regional-fluminense-2018-

CEPERJ.pdf>. Acessoem 26 abr. 2022.

_____. Fundação Centro Estadualde Estatísticas, Pesquisas e Formação de Servidores Públicos do Rio de Janeiro**.** Mapa das Regiões de Governo e municípios do Estado do Rio de Janeiro. Disponível em: <https://www.ceperj.rj.gov.br/wp-content/uploads/2021/08/Mapa-das-Regioes-de-Governo-e-Municipios-do-Estado-do-Rio-de-Janeiro-2019-CEPERJ.pdf>. Acesso em 26 abr. 2022.

COOPERCRÃMMA, 2003. Cooperativa Regional de Piscicultores e Ranicultores do Vale do Macacu e Adjacências LTDA. **Boletim Instituto de Pesca**. São Paulo, n. 34. p. 83-87.

CRIBB, ANDRÉ YVES. Construção participativa de uma rede socio técnica na cadeia ranícola brasileira: avanços e desafios. *In*: Embrapa Agroindústria de Alimentos-Artigos semanais de congresso (ALICE). *In*: XIX SEMEAD SEMINÁRIOS EM ADMINISTRAÇÃO FEA-USP, 19, 2016, São Paulo. Anais. São Paulo: USP, 2016. p. 1-14.

DIAS, M.E.D.; OLIVEIRA, E.L. A Piscicultura Brasileira pela Ótica do Desenvolvimento da Genética da Tilápia: das horizontalidade do processo de verticalização. III Congresso Brasileiro de Organização do Espaço, v.19, n.1, p.3-15, 2021.

EMBRAPA – EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA. Gerenciamento Genético da Tilápianos Cultivos Comerciais / autores Barroso, R.M. [et al.]. Palmas, TO: Embrapa Pesca e Aquicultura, Documentos, n.23, 2015.
_____. Caracterização da cadeia produtiva da tilapia nos principais polos de produção do Brasil/ autores, Filho, M.X. [et al.]. Palmas, TO: EmbrapaPesca e Aquicultura, 2020.

FIGUEIREDO, M. R. C.; LIMA, S. L.; AGOSTINHO, C.A.; BAÊTA, F. da C.; WEIGERT, S.C. Estufas climatizadas para experimentos ambientais com rãs, em gaiolas. **RevistaBrasileira de Zootecnia**, v.30, n.4, p.1135-1142, 2001.

FONTANELLO, D.; SOARES, H. A.; MANDELLI JR, J.; SANTOS, L.E.; PENTEADO, L. A.; CAMPOS, B. E. S; REIS, J. M.Estação de reprodução da *Ranacatesbeiana* Shaw, 1802, criado em ranário comercial e a influência de fatores climáticos sobre o número de reservas. **Boletim do Instituto de Pesca**, n. 11(único), p. 123-130,2018.

IPEA - INSTITUTO DE PESQUISA ECONÔMICA APLICADA. Evolução da Piscicultura no Brasil: diagnóstico e desenvolvimento da cadeia produtiva da tilápia / autores: Schulter, E.P.; Filho, J.E.R.V. Textos para Discussão, 2328, 35p, 2017.
_____. IPEA data. Salário mínimo vigente. Disponívelemhttp://www.ipeadata.gov.br/exibeserie.aspx?stub=1&serid1739471028=1739471028. Acesso em 27 de janeiro de 2023.

IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. Censo Brasileiro de 2019. Rio de Janeiro: IBGE, 2019.

LIMA, S. L.; AGOSTINHO, C. A. A criação de rãs. São Paulo: Globo, 1989.
LIMA, S.L. 1993.Integração na Ranicultura. **Panorama da Aquicultura**, n 16,1993.
_____. Sistema anfigranja. *In*: Encontro Nacional de Ranicultura. International Meetingon Frog Research and Technology.ABETRA – Academia Brasileira de Estudos Técnicos em Ranicultura/ ABCR – Associação Brasileira de Criadores de Rãs, Santos. Anais. Santos, 1997, p.125-130.

_____. Um OlharSobre a Ranicultura Brasileira. **Panorama da Aquicultura**, n 76, 1-7,2003.

MELLO, S.C.R.P.; SEIXAS FILHO, J.T. Trêsdécadas de pesquisa em ranicultura. *In*: RITTER, P.;

MELLO, S.C.R.P. FIPERJ - 30 anos de atuação na pesca e aquicultura Rio de Janeiro, nov. 2018, p. 175-187.

MINEIRO, M. Pesquisa de Survey e Amostragem: aportes teórico selementares. **Revista de Estudo sem Educação e Diversidade**. v. 1,n. 2, p. 284-306, 2020.

OLIVEIRA, E.G. Ranicultura: Novos desafios e perspectivas do mercado. **Ciência Animal**, v. 25, n. 1, p. 173-186, 2015.

PAHOR-FILHO, E.; MANSANO, C.F.M.; PEREIRA, M.M.; DE STÉFANI, M.V. The most frequently used bullfrog productive system in Brazilian aquaculture: A review. **Aquacultural Engeneering**, 87, p. 1-10, 2019.

RIBEIRO, L.P.; TOLEDO, L.F. Overview of the Brazilian Frog Farming. **Aquaculture**, 548, p. 1-13, 2022.

REIS, G.P.A.; ALVES, A.X.; SANTOS, N.N.; SILVA, J.A.; PAWLOWSKI, V.R.; SANTOS, B.D.; MELO, D.S.; BRAGA, N.G.; BRABO, M.F.; CAMPELO, D.A.V.; VERAS, G.C. **Aquaculture**, 556, p. 1-9. 2022.
REZENDE, E.K. Pesquisa em rede em aquicultura: bases tecnológicas para o desenvolvimento sustentável da aquicultura no Brasil. Aquabrasil. **Revista Brasileira de Zootecnia**, v.38, p. 52-57, 2009.

RODRIGUES, C. A. G.; QUARTAROLI, C. F.; CRIBB, A. Y.; BELUZZO, A. P. Áreas potenciais para a criação de rã-touro gigante *Lithobatescatesbeianus*(Shaw, 1802) naregião Sudeste do Brasil. **Boletim de Pesquisa e Desenvolvimento**. Campinas: Embrapa Monitoramento por Satélite, 38 p.,2010.

SOUZA, A.L.M.; RIBEIRO, C.C.D.U.; FREIRE, L.S. e MELLO, S.C.R.P. Sistemas de Criação. *In*: SEIXAS FILHO, J.T.; PEREIRA, M.M. e MELLO, S.C.R.P. Manual de Ranicultura para o Produtor. Rio de Janeiro, ago. 2017.

YOUNG, J.A.;BRUGERE,C; MUIR,J.F. Green grow the fish-oh environmental attributes in marketing aquaculture products. **Aquaculture Economics & Management**. 3(1):7:17, 2008.