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Brazilian continental aquaculture: a model for the development of its regularization

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Abstract:

The Brazilian fish farming in Federal reservoirs is being discouraged by the country's current legal system due to the bureaucracy and the involvement of many agencies. This research provides a survey of the problems related to the current processes of Authorization of Aquaculture in Federal Waterbodies and Environmental Licensing of the activity and develops a model that gathers theories for improving these processes. In order to do this, 68 questionnaires were applied to key-agents of the sector from different regions of the country. Also, a Grounded Theory methodology was used to organize, code, and analyze the data collected and to outline the model of the main emerging theories. The model revealed 21 recommendations to unlock and accelerate the current process of regularization. Putting some of these actions into practice, it's believed that fish farming would be able to attract new and old interested parties, reducing many illegal enterprises.

Keywords: aquaculture authorization, environmental licensing, aquaculture management, grounded theory.

Introduction

Brazilian aquaculture production has been increasing in recent decades (Serviço Brasileiro de Apoio às Micro e Pequenas Empresas [Sebrae], 2015; Brabo, Pereira, Santana, Campelo, & Veras, 2016). In 2018, only continental fish farming produced 772.5 thousand tons, representing a growth of 4.5% in relation to 2017 (PeixeBR, 2019).

Nile tilapia (Oreochromis niloticus) is in all Brazilian States and is the most cultivated species (440 thousand tons) followed by tambaqui (Colossoma macropomum) and their hybrids, with almost 288 thousand tons. Tilapia production is more concentrated in the South, Southeast and Northeast regions of the country, highlighting the state of Paraná (123,000 tons) and São Paulo (69,500 tons) (PeixeBR, 2019), especially in net cages, in Federal waters (Scorvo Filho, Frascá-Scorvo, Alves, & Souza, 2010).

Brazilian aquaculture is considered a very promising agribusiness sector (Confederação da Agricultura e Pecuária do Brasil [CNA], 2011). Prospects are very good, the production is expected to grow 52% above the average level of the last years until 2024 (Organisation for Economic Co-operation and Development-Food and Agriculture Organization [OECD-FAO], 2015). According to Food and Agriculture Organization

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(FAO, 2013), Brazil should produce 20 million tons by 2030, making it one of the world's largest fish producers. Despite the encouraging figures, there are many factors that hinder this expansion, such as difficulty in obtaining licenses, lack of technical assistance, inadequate management, lack of standardization, and of research in the area (Sidônio et al., 2012a).

Another factor is the regularization of aquaculture projects in public waters. It is very time-consuming, costly and composed of a wide range of administrative regulatory acts (decrees, ordinances, resolutions, etc.), often conflicting with each other (Ayroza, Furlaneto, & Ayroza, 2006; 2008). Aquaculture in public reservoirs is also directly affected by laws concerning soil, water, environment, natural resources conservation, hunting and fishing, animal health, public health, sanitary laws, among others (Eler & Millani, 2007). In addition, it involves many Federal and State agencies (Ayroza & Ayroza, 2011). Currently, only in federal waters, there are production requests totalling 3 million tons awaiting the procedural process in the Aquaculture and Fisheries Secretariat (PeixeBR, 2019).

Aquaculture is considered a recent activity and, therefore, requires more information and an adaptation of the current regulations for its sustainable development (Ayroza et al., 2006; Sidônio et al., 2012b; Goulart, Merino, & Merino, 2013). Thus, the objective of this work was to identify the main difficulties related to the current influential regulation on the activities of fish farming practiced in the Brazilian Federal reservoirs. In addition, it was sought to develop a model that compiles the main actions for the better ordering of the current processes of public water use and environmental licensing of this activity.

Material and methods

This article is the result of a qualitative research methodology. This technique is an investigative method used when results cannot be obtained through statistical procedures or other means of quantification because the phenomena are dynamic or complex, and the relevant variables are not easily identified (Creswell, 2013; Saldaña, 2013; Yin, 2015).

The research project was submitted to the analysis of the ethics committee (protocol's number: 85826217.0.0000.5257). It was carried out between December 2016 and August 2017. At the first moment, a pilot questionnaire composed of ten open questions to allow greater qualitative data collection (Creswell, 2013; Saldaña, 2013; Yin, 2015) was applied with sixteen people, with at least three agents from each research group (producer, consultant, researcher, and institutional agent), from different cities of the country, which served for the validation of definitive questionnaire. Five of the questions in the pilot questionnaire were directed to the focal point of the survey. Therefore, only these were validated for the definitive questionnaire.

The validated questions used in the final questionnaire were: 'Regarding the current regulation of aquaculture developed in Brazilian federal waters, answer: a) How do you consider the development of the fish farming activity practiced in the federal reservoirs in recent years? Why? b) How do you evaluate the licensing and authorization process for the use of federal waters for aquaculture purposes? Why? c) List the main obstacles of these processes. d) What could be modified (technically, legally, etc.) to improve these processes? e) How could these changes be made?'.

Then, the definitive questionnaire was applied with fifty-two other participants. In overall, there were sixty-eight interviews, seventeen were conducted with fish producers from ten Brazilian states; seventeen with technical consultants, mostly fishing engineers with an average of more than fifteen years of experience in project design and implementation of aquaculture enterprises; seventeen with institutional agents of public agencies linked to the development of national fisheries and aquaculture; and another seventeen with renowned Brazilian academic researchers in the field of national aquaculture.

They were selected by non-probabilistic sampling (Creswell, 2013). The selection was based on bibliographic research on their knowledge, perceptions, and experiences, or by a referral from other

participants. It is also important to mention that they were all senior employees and they came from different Brazilian states, so, one can ensure an expansive view of the theme (Boone, Skipper, & Hazen, 2017).

The responses were organized and coded according to the techniques of content analysis (Bardin, 1977) and the 'Grounded Theory' (Corbin & Strauss, 2014), which performs the systematic analysis of qualitative data collected from observations, questionnaires, interviews, and case studies, and the theory emerges from data (Chamaz, 2006; Creswell, 2013; Corbin & Strauss, 2014). This part of the process was performed with the help of NVivoTM 10 software (SQR International Pty Ltd.) (Johnston, 2006) to group data by similarity, to define categories and relate them, forming the basis for the creation of the theory (Chamaz, 2006; Creswell, 2013; Corbin & Strauss, 2014).

The size sample (n) was defined based on the theoretical saturation, i.e., at the moment where new data collections do not bring any new or relevant information, it just repeats what has already been said, it is no longer necessary to conduct new interviews (Corbin & Strauss, 2014). The theoretical saturation point was reached around sixty-five interviews.

To complement and validate the primary data, it was used secondary data obtained from articles and books (Saldaña, 2013; Yin, 2015) and we carried out the constant comparative analysis of the data, a fundamental action of the Grounded Theory, allowing the emergence of theories (Chamaz, 2006; Corbin & Strauss, 2014).

From the emerging theories, the structure of the conceptual model was created. Afterward, a quarter of the participants were interviewed again to validate the proposed model (Chamaz, 2006; Corbin & Strauss, 2014).

The validation questions were: 'On Figure 1 (Representation of the critical points of the current process of aquaculture regularization most cited by the interviewees), do you agree with the schematic presented? Or is there any 'critical point' that you think is missing or should not be in it? b) On Figure 2 (Model with the actions to be implemented or repaired in the current process of regularization of aquaculture activities practiced in Federal Brazilian reservoirs), do you agree with the model presented? Or is there any 'action' that you think is missing or should not be in it? c) On Figure 2, which of the 'actions' presented do you consider most important/ relevant to the success of regularization of aquaculture activities in Union reservoirs in Brazil? d) On Figure 2, is there anything else you would like to comment/criticize/suggest?'.

Results

The first question of the questionnaire was 'How do you consider the development of the fish farming activity practiced in the federal reservoirs in recent years?'. According to the interviewees' opinion, the development of this sector has grown in recent years. However, this growth has been slow, below the real national potential and still with many producers without being regularized by the competent agencies.

The following two questions asked the interviewee to evaluate the processes of assignment of use of the public water for aquaculture and environmental licensing purposes and to identify the main impediments to them. Among the reasons stated are: the great slowness of the process, the complex bureaucracy in the legislation that deals with the assignment and licensing processes, the low number of studies on the environmental impacts generated by aquaculture, the fact that the current normative instruments are still obsolete and can cause juridical insecurity to the processes, the lack of preparation of the teams responsible for issuing licenses and authorizations and more. The whole set of reasons is illustrated in Figure 1.

According to the data collected, the current procedures adopted in Brazil are inefficient and composed of many rules, stages, and requirements. Some examples are: the obligation to fill out questionnaires requesting unnecessary information, the repetition of documents presented in the various phases, the requirement of maps with plants scales incompatible with current printers, calculation model of the number of necessary cages outdated, the signaling and coordination schemes required in the project by the Navy are incompatible

with modern standard, the payment of fees and taxes, insufficient environmental studies, the necessary consent of various administrative and supervisory agencies for a series of legal regulations, among others that generate such negative characteristics to the process.

In addition, it was emphasized that the constant changes in the political structure of the sector – the extinction of the Ministério da Pesca e Aquicultura (MPA) in October 2015, linking the Secretariat of Aquaculture and Fisheries to the Ministério da Agricultura, Pecuária e Abastecimento (Mapa), its relocation to the Ministério da Indústria, Comércio Exterior e Serviços (Mdic) in March 2017 and its return to the Presidency of the Republic in January 2018, with the status of Secretaria Especial de Aquicultura e Pesca (Seap) – have delayed the appreciation of the processes of assignment of the use of public water and generated instability and insecurity.

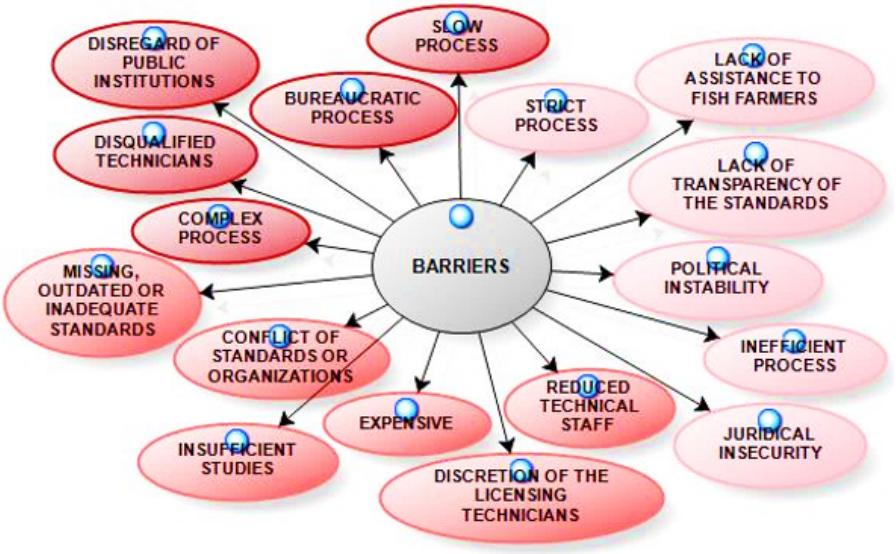

FIGURE 1.
Representation of the critical points of the current process of aquaculture regularization most cited by the interviewees, anti-clockwise starting at 'slow process'. Source: Authors.

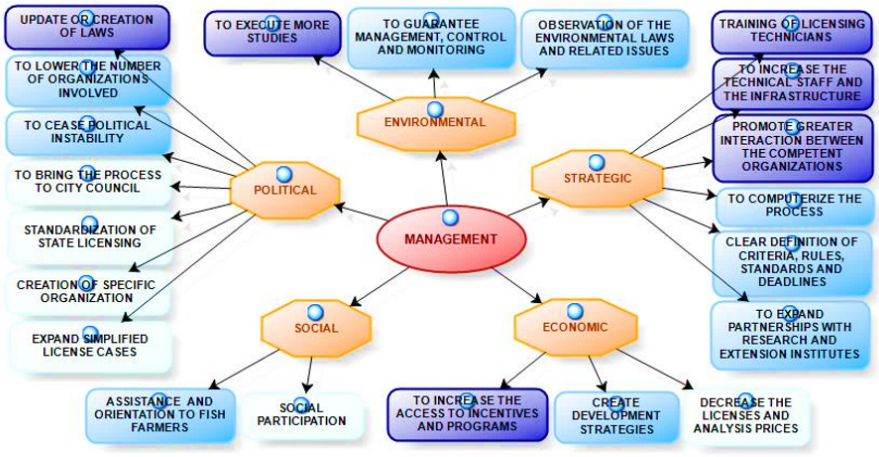

FIGURE 2.
Model with the actions to be implemented or repaired in the current process of regularization of aquaculture activities practiced in Federal Brazilian reservoirs. Caption: The more intense the color blue of the rectangular boxes, the greater the relevance of the attribute. Source: Authors.

Another point was the delay in the process of transferring the aquaculture areas within the organizations. Some interviewees said that the analysis of a process can exceed 8 years, and many are not approved or, even if they do, only a small area is authorized to be used, which makes production impracticable. The main arguments described to explain this slowness are not only the need for consent by many different public agencies, often conflicting with each other, but also because of the process being totally physical, without the use of digital resources, and because of the lack of preparation of the technicians in charge of the environmental licensing.

Many technicians feel insecure when analyzing the license applications and, based on the precautionary principle, often require unnecessary documents or reject the project. So, the interviewees have also pointed out the unpreparedness and insecurity of the technicians due to the lack of theoretical and practical knowledge of aquaculture and its real impacts. This generates a sense of disregard of the licensing agencies with aquaculture and attributes the characteristic of questionable discernment to the process, leaving it at the mercy of the subjective and ideological convictions of these technicians.

The last two questions asked what could be modified to improve such processes and how such modifications could be made. The most prominent suggestions presented by the respondents can be observed in Table 1.

These suggestions are directed to the agencies responsible for planning, managing and controlling the fish farming activity practiced in reservoirs of the Brazilian Union and considered by the interviewees of great importance and necessity in the resolution of the difficulties related to the current processes of public water use and environmental licensing of this activity.

Summing the most representative and relevant considerations given by the research participants to the considerations made by them during the validation stage and the corroboration phase by bibliographical research, according to the recommendations of Corbin and Strauss (2014), it was possible to construct the model (Figure 2) with twenty-one suggestions necessary to improve the regularization process of aquaculture ventures located in Federal Brazilian reservoirs.

Discussion

The Grounded Theory is a unique methodology due to the holistic and interactive nature of its principles (constant comparison, coding, sampling, and theoretical saturation), which allows the researcher to develop the theory (O'Reilly, Paper, & Marx, 2012). In this case, its use allowed a deep understanding of the phenomena investigated here and facilitated the categorization of the data so that the associations and interpretations were clearer and more comprehensible (Corbin & Strauss, 2014), enabling the construction of the model.

TABLE 1.
Main suggestions presented in the questionnaires to improve the processes of Environmental Licensing and Assignment of Use of Federal Waters for Aquaculture Purposes in Brazil.

To revise and update current federal and state legislation for the assignment of production area and environmental licensing processes, specially by reformulating the decree nº 4895/2003 (Brasil, 2003);
To issue new Decrees and other specific normative acts aligned with the current reality of the sector, observing the norms and environmental principles;
To cease political instability and link the aquaculture folder definitely.
To simplify the analysis of processes, reducing the administrative procedures and the number of organizations involved in the authorization of permits and licenses;
To create a unique and specific agency to analyze and decide on the regularization processes;
To standardize the procedures at the national level and states' standards and norms for environmental licensing, reducing the heterogeneity between the different states;
To bring the federal process to the state and city level, making city secretariats and states' environmental agencies the actors responsible for managing new requests for regularization and issuance of environmental licenses;
To promote greater interaction and consonance of the public policies of the Union, states, and cities, with the facilitation of communication between the competent agencies;
To computerize the process, by the implantation of an electronic system for the submission of the projects and documents in digital format, with access by all the involved organs, and that allows the monitoring of the progress of the processes by the interested parties;
To stipulate deadlines for the analysis of the processes by the licensing agencies, as well as to comply with them;
To train environmental analysts about the activity and its impacts so that they have greater security during the licensing, inspection and environmental monitoring process;
To increase the technical staff of the licensing and technical assistance agencies;
To expand the number of partnerships between research and extension institutes and environmental agencies, to assist in process evaluation;
To promote the technical assistance to fish farmers on the steps, norms, and criteria, causing their understanding and, thus, reducing the number of processes submitted incomplete or inadequate;
To advise fish farmers on aquaculture activity, their environmental impacts, good management practices, biosafety measures, etc., making them understand the importance of respecting established norms and making them act as 'environmental inspectors', denouncing actions that degrade the reservoirs, thus contributing to environmental monitoring and oversight;
To make management more participatory, including all stakeholders (government, producers, cooperatives, industries, rural extension agents, universities, civil society, etc.) in the construction of public policies and criteria related to the regularization processes of the activity, and in the decision-making, through referendums, plebiscites, consultations and public hearings;
To review the criteria for calculating the fees collected for the environmental licensing and cessation of use processes, reducing some of the amounts collected or even exempting small aquaculture producers, associations, and cooperatives;
To extend the number of cases subject to exemption from bidding and simplified licensing, rather than ordinary licensing, of microenterprises that generate very low environmental impact, in order to reduce costs and allow access for small producers;
To expand the programs of access to credit, promotion and technical assistance to regularized fish farmers, enabling access to technologies and investments;
To carry out financial planning for aquaculture in the short and long-term in order to stimulate the expansion of activity, the generation of employment and income, etc.;
To conduct further research on water quality, reservoir support capacity, environmental impacts, sustainable technologies, natural resource management, the definition of criteria for environmental licensing processes and assignment of use, among others;
To ensure compliance with environmental standards by aquaculture enterprises;
To ensure monitoring and environmental oversight by responsible agencies.

During the process of structuring the model, it was noticed that the keyword of the emerging theory was 'Management'. Thus, this was defined as the central point of the drawing. From this, the activities that need to be repaired or implemented to improve and streamline the environmental licensing processes and assignment of use of the union waters for aquaculture purposes have branched out.

The suggestions were illustrated in the rectangular boxes of the model. The more intense the color, the greater the number of times this proposition was mentioned by different respondents of the questionnaire, and therefore, classified as of greater relevance for the study. And, according to the subject, the proposals were subdivided into five major areas: Political, Social, Economic, Strategic, and Environmental.

These large areas are not independent. On the contrary, they are connected to each other, since, for example, many of the strategic and economic measures are conditional on politics for the release of resources. As well, politics must address environmental issues. Or, social actions are foreseen in economic programs.

The suggestions of this model constitute a set of planning and management actions for better functioning of the activity, based on the balanced, dynamic and sustainable development of the aquaculture activity (Boyd, 1999; Assad & Bursztyn, 2000; Valenti, 2000).

The processes suggested by it allow the reduction of risks and costs and guarantee a production with higher quality and safety to the environment. Thus, the information brought by it is fundamental elements in the decision making of the organizations (Angeloni, 2003).

The immediate implementation of all twenty-one suggestions by the responsible public entities would require much study, time and resources. Thus, it is suggested initially, the adoption of, at least, the most relevant proposals (in dark blue in Figure 2) would show a great step in the reformulation of the current Brazilian aquaculture.

For example, related to social and economic management, there is an urgent need to expand programs of training and technical assistance to aquaculture producers as well as to improve the access to credit. Given the many difficulties in Brazilian aquaculture (Ayroza et al., 2006; 2008; Dotti, Valejo, & Russo, 2012; Sidonio et al., 2012a; 2012b), the producers feel discouraged in the activity, since the condition of informality generates fines and embargoes and prevents them from receiving training, credits and public investments (Ayroza et al., 2006; Ostrensky, Borghetti, & Soto, 2008; Dotti et al., 2012; Brabo, Pereira, Santana, Campelo, & Veras, 2017).

In strategic terms, measures related to the training of environmental analysts and managers responsible for issuing environmental licenses are indispensable, in order to limit the responsibilities in the application of environmental licensing, reducing their discretion and juridical insecurity (Ostrensky et al., 2008; Hofmann, 2015; Brabo et al., 2017). As well as the extension of its technical staff, in order to structure and improve the actions of monitoring and control of aquaculture activity (Hofmann, 2015; Brabo et al., 2017).

In relation to the impact of the activity on the environment, it is known that it causes a number of direct and indirect environmental problems, such as the reduction of biodiversity, changes in the hydrological cycle (Tundisi, 2006), changes in water quality (Macedo & Sipaúba-Tavares, 2010), side effects caused by the use of antibiotics (Sebrae, 2015), propagation of invasive species (Vitule, Freire, & Simberloff, 2009; Attayde, Brasil, & Menescal, 2011; Simberloff et al., 2013), alterations on the rating of water availability for public supply, rising costs of water treatment, damage to economic activities and human health, among others (Tundisi, 2008).

Concerning impacts, it is known that many of the producers wanting to formalize their businesses decide to wait for the acceptance of their authorizations producing, with the expectation of being regularized soon. However, their processes drag on for many years (Ayroza et al., 2008; Brabo, Veras, Paiva, & Fujimoto, 2014). This situation, together with the irregular producers who do not seek the legalization of their enterprises and the rapid and disorderly expansion of aquaculture, has caused concern about impacts that this activity can cause to the environment (Carvalho & Ramos, 2010).

Given this fact, of the proposed measures related to environmental management, it is important to point out the indispensability of constant studies in the public reservoirs where there are fish farms. Such as: eutrophication of water bodies (Macedo & Sipaúba-Tavares, 2010), assessment of environmental impacts, research and development (Sidônio et al., 2012b) and, mainly, evaluation of the support capacity of such water bodies (David, Carvalho, Lemos, Silveira, & Dall'aglio-Sobrinho, 2015; Bueno et al., 2017; Canzi et al., 2017) and other measures of control, planning, organization and implementation of aquaculture in reservoirs in a sensitive and sustainable manner (Brabo et al., 2014).

It is worth highlighting that a portion of the interviewees, mainly academic researchers, argued that the fish farming legislation practiced in net cages of public water allows the production of non-native fish. This is a fact. In Brazil, the species of fish that dominates production is exotic, Nile tilapia (Oreochromis niloticus), being responsible for more than 87% of all requests for assignment of water use in Federal Brazilian reservoirs

(Ministério da Pesca e Aquicultura [MPA], 2015) and more than 50% of the production of the last years (PeixeBR, 2018; 2019).

These respondents emphasized the need for incentives to expand the production of native species or even restrict the cultivation of non-native fish to excavated tanks only, to avoid escapes, diseases spreading and other environmental impacts caused by the spread of exotic species (Vitule et al., 2009; Attayde et al., 2011; Simberloff et al., 2013; Lima-Júnior, Lima, Vitule, Orsi, & Santos, 2014 ; Azevedo-Santos et al., 2015; Lima, Oliveira, Giacomini, & Lima-Junior, 2016), in order to ensure sustainable production with greater environmental security.

On the other hand, it was also stated by other groups of interviewees, in particular producers and technical consultants, that fish farming in net cages, responsible for many of the authorization and licensing in Federal waters, is seen as an act of low environmental degradation, since it does not extract water; and its current production, in continental Federal waters, is well below the support capacity estimated by the Agência Nacional de Águas (ANA), being about two million tons/year (MPA, 2015).

The literature also confirms that if this activity is well managed, respecting the support capacities, it can be developed in a sustainable manner (Carvalho & Ramos, 2010; Cyrino, Bicudo, Sado, Borghesi, & Dairiki, 2010; Diemer et al., 2010) and generate positive socioeconomic impacts, such as the financial gain from the sale of fish, and employment and income to the small producers of the region (Henry-Silva & Camargo, 2008).

These opposing ideas emphasize the importance of conducting further studies related to the aquatic environment and aquaculture (Sidônio et al., 2012a) in order to obtain, within a few years, the analysis of the evolution of water quality, the impacts caused by this activity, as well as helping to clearly establish the criteria for evaluating the impacts of aquaculture and to support the environmental management of aquaculture (Eler & Millani, 2007) and the technical and environmental analysts in the processes of environmental licensing and assignment of use.

Finally, in terms of politics, it is necessary to add all the collected information, to change institutional policies and to build a governance that generates positive results in the productive arrangements of organizations and institutions, generating favorable results for the responsible management of natural resources (Tiago & Gianesella, 2003; Tiago & Cipolli, 2010), turning aquaculture a priority instrument in the fight against poverty and promoting food security (Sidônio et al., 2012a).

To do this, the government must adopt policies of incentive and promotion of the activity, implement laws and oversight, support and invest in research and development, adjust the productive infrastructure, seek the development of new technologies, require good production practices and food safety (Sidônio et al., 2012b) and insert environmental legislation that guides the search for sustainable development (Eler & Millani, 2007).

After the establishment of most of these initial measures, the gradual adoption of other suggestions from each major area would consolidate the progress of the modernization of this sector (Sidônio et al., 2012a), bringing greater agility and transparency to the processes, which would possibly attract new and former stakeholders to enter the activity on a regular basis (Cavalli, Domingues, & Hamilton, 2011).

Therefore, the formalization of aquaculture enterprises, a secondary result expected by this work, would provoke a succession of positive events in the sector, both direct and indirect, such as: greater aquaculture awareness, the reduction of the number of illegal enterprises, the facilitation of the access to credit and public investment; the generation of new jobs and an increase in income, the possibility of the country to become self-sufficient in the production of fish and inputs, replacing imports with domestic production, among other events that would contribute to a more dynamic and sustainable development of the national fish production (Boyd, 1999; Assad & Bursztyn, 2000; Valenti, 2000).

Such considerations are not only justified as they demonstrate how indispensable researches like this are. However, the actions proposed by this work are related, largely, to the political-institutional dimension.

Therefore, it is suggested that further studies are carried out on the bottlenecks of aquaculture in the other dimensions (social, economic and ecological) so that the planning and ordering of the entire productive chain are improved.

The next step in this research will be to validate the model in the field in order to confirm the applicability and adequacy of the proposed conceptual model to the reality of the aquaculture sector.

Conclusion

This study reached its objectives by raising seventeen major bottlenecks that help to understand the current problems related to the environmental licensing process and the authorization of the use of Brazilian federal reservoir waters, which, consequently, also limit the expansion of aquaculture in Brazil. To correct such difficulties and to be able to improve these important processes, some cogent and urgent solutions are necessary. Therefore, a model was proposed, with twenty-one suggestions to help unlock current barriers, harmonizing social-economic development with the preservation of the environment, thus promoting the sustainability of the continental aquaculture activity in a more adequate, integrated and dynamic way. The model was accepted by the evaluators and therefore considered valid as to its content, comprehension, originality, and applicability, developed based on the criteria established by the technique of Grounded Theory.

This article can assist in the design of panoramas, in the opinion formation and in the decision-making of public associations that aim to reduce the difficulties hindering the growth of this economic activity of enormous potentiality.

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