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Good management practices course and social technologies for aquaculture farmers in Marajó, Pará, Brazil

The objective of this study was capacitate aquaculture farmers and develop social technologies for the culture of tambaqui (Colossoma macropomum) in the archipelago of Marajó (Pará - Brazil). The study was carried out in the municipality of Curralinho by the Federal Institute of Education, Science and Technology of Pará (IFPA) Campus Breves, in March 2020. Two structured questionnaires were applied to 13 course participants who participated in the training. The first was before the course, about fish farming and the adoption of Good Management Practices (BPM) adopted by aquaculture farmers in the Marajó region. The second, composed of closed questions to evaluate the training course, whose themes were: 1) water quality, 2) indicated species, 3) fish transport management, 4) fish quarantine and stock, 5) fish biometrics, 6) liming and fertilizing ponds, 7) management of fish nutrition and health, and 8) fish harvesting and slaughter, were approached in the course. At the end of the lectures/training, a workshop for the production of social technologies was conducted, among students, teachers and aquaculture farmers. Previous knowledge about fish farming and the adoption of BPM were essential for the effectuation of the course. Issues about water quality, biometrics and fish nutrition and health were the ones that called the most attention from aquaculture farmers. Secchi's disk, ichthyometer, hand net and net-tank were the social technologies built. Post-course evaluation was essential to understand the impact of the socialization of knowledge provided to the community. In conclusion, the project reinforced teaching, research and extension actions, involving the community in favor of strengthening aquaculture in the Marajó island, Pará, Brazil.

Keywords: Amazon Paraense; Extension; Tambaqui; Strengthening.

Curso de boas práticas de gestão e tecnologias sociais para aquicultores de Marajó, Pará, Brasil

O objetivo deste estudo foi capacitar aquicultores e desenvolver tecnologias sociais para a cultura do tambaqui (Colossoma macropomum) no arquipélago do Marajó (Pará – Brasil). O estudo foi realizado no município de Curralinho pelo Instituto Federal de Educação, Ciência e Tecnologia do Pará (IFPA) Campus Breves, em março de 2020. Foram aplicados dois questionários estruturados para 13 cursistas que participaram da capacitação. O primeiro, foi antes do curso, sobre a piscicultura e adoção de Boas Práticas de Manejo (BPM) adotados pelos aquicultores na região do Marajó. O segundo, composto por perguntas fechadas para avaliar o curso de capacitação, cujo os temas foram: 1) qualidade da água, 2) espécies indicadas, 3) manejo de transporte de peixes, 4) quarentena e povoamento dos peixes, 5) manejo de biometria de peixe, 6) calagem e adubação de viveiros, 7) manejo de nutrição, alimentação e sanidade de peixes, e 8) despesca e abate de peixe, foram abordados no curso. Ao final das palestras/ou capacitação, foi conduzida uma oficina para produção de tecnologias sociais, entre estudantes, professores e aquicultores. O projeto capacitou homens e mulheres de diversas comunidades rurais e da cidade de Curralinho. O conhecimento prévio sobre a piscicultura e adoção de BPM, foram essenciais para a efetivação do curso. Assuntos sobre a qualidade da água, a biometria e a nutrição e sanidade de peixes, foram os que chamaram mais atenção dos aquicultores. O disco de Secchi, ictiômetro, puçá e tanque-rede, foram as tecnologias sociais construídas. A avaliação pós curso foi essencial para entender o impacto da socialização do conhecimento prestado à comunidade. Em conclusão, o projeto reforçou as ações de ensino, pesquisa e extensão, envolvendo a comunidade em prol do fortalecimento da aquicultura no Marajó, Pará, Brasil.

Palavras-chave: Tambaqui; Fortalecimento; Extensão; Amazônia paraense.

Topic: **Extensão e Desenvolvimento Rural**

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INTRODUCTION

The Brazil has enormous potential for the development of aquaculture (SILVA et al., 2018; MEDEIROS et al., 2017). The water resources of the Amazon, the favorable climate and the geographical condition, are essential factors for its growth (DANTAS et al., 2019; FERREIRA et al., 2020). Fish farming in the State of Pará is growing and is an activity developed by small, medium and large aquaculture farmers. An activity also performed by family farming, extractivists and riverside dwellers (AIZAWA et al., 2014; ZACARDI et al., 2017).

Given this perspective, the Federal Institute of Education, Science and Technology of Pará (IFPA) *Campus* Breves has been contributing to the strengthening of the aquaculture sector, generating qualified labor for the Marajó archipelago, Pará, Brazil. In 2019, the institution inserted the first class of the Technical course in Aquaculture, with a hub in the municipality of Curralinho in partnership with the City Hall and the Z-37 fishing colony. These enable students to work in the Marajó region, in which aquaculture is economically important.

Aquaculturists in Curralinho, for example, cultivate tambaqui (*Colossoma macropomum* Cuvier, 1818), for subsistence and the surplus is commercialized. However, the culture of the species is practiced in small structures, with low technological development and uses empirical knowledge. Local fish farming contributes to rural development, enables economic returns to producers, contributes to job creation and optimizes the natural resources on the properties. On the contrary, many producers have been presenting problems when developing the activity, due to the lack of Good Management Practices (BPM) in fish farming. A compatible and realistic alternative consists of providing training courses and developing social technologies that are adaptable to the problems experienced by the producer (FAO, 2006; KLEIN et al., 2009; SANTOS FILHO et al., 2016; AKTER et al., 2019; SAMAH, 2020).

Thus, the transfer of knowledge through training, aims at the growth of aquaculture, in order to generate income (KATO et al., 2017; FEITOSA et al., 2019; OLIVEIRA et al., 2020). Thus, it is important to develop training courses that are capable of socializing the correct conditions for handling fish breeded in the Amazon. Given the above, the objective was to train aquaculture farmers in BPM and develop social technologies for aquaculture of tambaqui in Marajó, Pará, Brazil.

MATERIALS AND METHODS

Study area

The study was carried out in the municipality of Curralinho, archipelago of Marajó, Pará, Brazil (Figure 1). Marajó is located on the Amazon coast (AMARAL et al., 2012). Region that comprises 16 municipalities, which compose the Arari microregions (Cachoeira do Arari, Chaves, Muaná, Ponta de Pedras, Salvaterra, Santa Cruz do Arari and Soure), Furos de Breves (Afuá, Anajás, Breves, Curralinho and São Sebastião da Boa Vista) and Portel (Bagre, Gurupá, Melgaço and Portel). Curralinho has a territorial extension of 3,620,279 km2, its population is estimated at 33,893 people in 2018 (IBGE, 2010). The majority of this population is riverside, due to the city being surrounded by rivers and islands, They are aquaculture farmers, fishermen,

extractivists and family farmers.

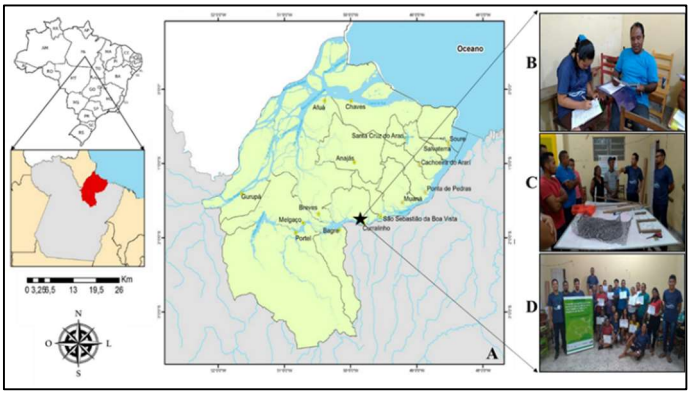

Figure 1: Location of the study area, indicating: a) municipality of Curralinho, Marajó, Pará, Brazil; b), c) and d) students in extension activities. Prepared by Christian Nunes.

The extension Project

The project 'Transfer of technology through training and technical assistance for tambaqui breeders, *Colossoma macropomum* in the archipelago of Marajó/PA'. It was funded by the Dean of Extension and External Relations (PROEX) of the Federal Institute of Education, Science and Technology of Pará (IFPA), under call number 03/2019. It was conducted by students regularly enrolled on the Undergraduate Course in Rural Education and the Technical Course in Aquaculture at IFPA *Campus* Breves. The students received financial support for the acquisition of materials necessary for their execution and scholarships for extension. They participated in all stages of the project, such as: conducting structured interviews and training aquaculture farmers (course participants) in Good Management Practices (BPM) in aquaculture, acting as researchers and instructors, respectively.

Application of questionnaires

Two semi-structured questionnaires with open and closed questions were used for aquaculture farmers involved in the project (Table 1). On the first day of the course, before the start of activities, a questionnaire was applied, consisting of open and closed questions for 13 enrolled people (initial questionnaire). At this time, basic information about fish farming and BPM adoption was collected. At the end of the project, on the last day of the course, a questionnaire was applied consisting of closed questions to 13 people about the training course (final questionnaire). The use of this tool is a meeting between people, so that one of them obtains information about a certain subject, through a conversation of professional nature (MARCONI; LAKATOS, 2010).

Table 1: Questionnaires applied to course participants in Curralinho, Marajó archipelago, Brazil.

Before Course	**After Course**
Time working in the activity	Course content and organization
Technical assistance assistance	Applicability of the practical part
Problems faced in the activity	Development of social technologies
Training courses on good practices	Duration of the course
Interest in participating in courses in the area	Instructors
Expectations and benefits in relation to the course	General course evaluation

Training and social Technologies

The BPM (theory and practice) course was taught by students involved in the extension project, adapted from Verdejo (2006). For this, there were guidelines of students with teachers in the area of Fisheries Engineering and Fishery Resources at IFPA *Campus* Breves. Initially, a technical meeting was held with the work team for articulation. At that meeting, the extension project was presented and followed a discussion about the BPM course. After that, the target audience was defined and the technical program was planned focusing on bottlenecks of the tambaqui culture, such as: 1) water quality, 2) indicated species, 3) fish transport management, 4) quarantine and stocking of fish, 5) management of fish biometrics, 6) liming and fertilization of tanks, 7) management of fish nutrition and health, and 8) fishing and slaughtering of fish. The course was held in March 2020, lasting 20 hours. Social technologies for the culture of tambaqui were built. For this, teachers, students and course participants participated in the construction workshop. Simple language was used to build the technology, in order to provide a better understanding by fish farmers. For making, alternative and low-cost materials were used, taking into account the reality of local fish farming.

Ethical considerations

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

Statistical analysis

The collected data were analyzed using descriptive statistics (OLADEJO, 2010).

RESULTS AND DISCUSSION

Profile of participants and interview

In the training course, men and women participate (Table 2). We observed the predominance of males (62%) and the smallest part of females. However, it is in agreement with Amachree et al. (2019), who suggest that women also participate in aquaculture. We emphasize that they are represented in a smaller number, however, the female presence in aquaculture has, over the years, left anonymity and acquired visibility. Since then, the number of studies addressing gender has grown, indicating that gender is fundamental to understanding how men and women participate in the aquaculture production chain (BOSMA et al., 2018; OPARINDE, 2019).

In the present study, 77% of fish farmers work with fish farming for 1 to 10 years (Table 2). They stressed that the BPM course will strengthen the local production chain. We observed several groups of people looking to start or deepen their knowledge in fish farming. We identified fishermen (60%), students (10%), farmers (20%) and domestic workers (10%) in the training course. The project reached an audience of eight locations, highlighting the communities: Boa Esperança (8%), Cafezal (8%), Ilha das Araras (23%),

Perpétuo Socorro (8%), Piriá Miri (8%), Rio Açú (15%), Santa Izabel (15%) and groups of people from the city of Curralinho (15%). A determining factor in the participation of some people in the course, according to the students themselves, was the difficulty of locomotion and availability due to their work. This possibly contributed to a low number of people from other rural communities. Short courses are an excellent strategy for rapid training, they appear as alternatives to long courses (ROCHA-VIDIGAL et al., 2012).

Table 2: Information from the first questionnaire, before the training course in BPM in aquaculture in Curralinho, Marajó archipelago, Brazil.

Before course	**Absolute frequency (n)**	**Relative frequency (%)**
Gender		
Male	08	62
Female	05	38
Time working in the activity		
1 to 10 years	10	77
11 to 20 years	02	15
More than 21 years	01	08
Receives technical assistance		
Yes	05	38
No	08	62
Problems faced in the activity		
Professional qualification	06	46
Technical assistance	05	38
Financial resources	01	08
Production outflow	01	08
Has training in aquaculture		
Yes	04	31
No	09	69
Interest in training in good practices		
Yes	13	100
No	00	00

In Curralinho, aquaculture farmers create tambaqui (*Colossoma macropomum*). According to the producers, the species was chosen because it is easy to handle, easy to obtain young forms and is well accepted in the local market. However, a total of 62% of aquaculture farmers claim not to receive technical assistance in aquaculture enterprises, from the competent government agency (Table 2). It is worth considering that the labor used is familiar. Family employment reduces costs during fish production, in addition to contributing to the family's joint work. A total of 46% of aquaculture farmers claim that professional qualification in aquaculture is not practiced in the region, being a major problem for the disappearance of the activity. The majority of course participants had not yet participated in any training course (69%) and those who have already participated represent 31% (Table 2). We observed that all aquaculture farmers showed interest in the BPM course. Training aims to contribute to the development of skills, and it is necessary to seek new learning possibilities to optimize individual results (MAPA, 2015).

Training and social technologies

The water quality, the biometrics, the nutrition and the health of fish, were the subjects that attracted the most attention of the course participants (Figure 2). In the view of producers, the variables of water quality (dissolved oxygen, pH, temperature and transparency) are the most important. There are some

recommendations for dissolved oxygen for tambaqui, on average ≥ 3.0 mg/L^{-1} (SOUZA et al., 1986). The pH range close between 5.0 to 8.0 is considered ideal for tropical fish (BOYD, 1982; KUBITZA, 2003). The temperature in fish farming can directly influence food intake (SCORVO et al., 2001). It is worth mentioning that the consumption is reduced or even stopped with the variation of the water temperature beyond its ideal range (SCHMITTOU, 1993). Transparency is a measure directly related to primary production, the water in a nursery when it is transparent, allows you to see the bottom of it, and is a desert of assimilable organic production; consequently, natural foods for fish development are lacking (LEIRA et al., 2017).

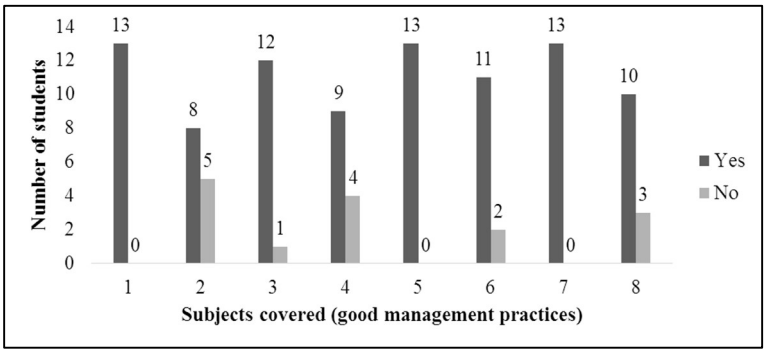

Figure 2: Subjects covered: 1) water quality, 2) indicated species, 3) fish transport, 4) fish quarantine and population, 5) fish biometrics, 6) liming and fertilizing ponds, 7) nutrition and health of fish and 8) fishing and slaughtering of fish, which drew the attention of course participants in Curralinho, Marajó archipelago, Brazil.

With regard to fish biometrics, it is seen that the number of producers that do it is very small, while most do not do it because they don't know what it is about. During biometrics, the entire production process is evaluated in terms of growth and fish health. This management can be adopted, preferably every 15 days or once every 30 days. During this period, the fish will have grown enough to have their food adjusted. Regarding the amount of feed that should be administered to fish, all course participants replied that they do not have a management pattern for the breeding and feeding stages of fish, which puts water quality at risk. It is worth noting that the costs of feeding the fish can correspond to 60 to 80% of the total production costs (PEREIRA FILHO, 1995).

In our project, producers report that the lack of knowledge in BPM causes the failure of aquaculture. Many were emphatic in saying that they are unaware of the ideal recommendations for fish farming, and the course clarified the importance of adopting this practice in fish farming. We noticed that the course participants acquired basic notions also in the management for the choice of species; fish transport; quarantine and fish stock; liming and fertilizing nurseries; fishing and slaughtering of fish. Training courses are an excellent tool to minimize barriers in the aquaculture production chain. Once socialized, it improves activity and guarantees qualification for the sector (MPA, 2011). Secchi's disk, ichthyometer, fish-trap and tank-net were the social technologies developed during the BPM course (Figure 3).

Diffusion and transfer are inseparable parts of the same process, which includes the generation of technology (FARIAS et al., 2009). This process aims at the adoption of innovations by aquaculture farmers, aiming at sustainable development. The first technology built was a device called the Secchi disk (Figure 3 B), built with a painted cover (white with alternating black bands), approximately 20 to 30 cm in diameter, with

4 quadrants, two with a white color and two black, suspended by a broom handle and graduated every centimeter (measuring tape, for example) or with a scale (ruler). The ichthyometer was built with wood, approximately 30 cm to 50 cm in length and measuring tape (Figure 3 C). The fish-trap technologies (Figure 3 D) and the net tank (Figure 3 E), were built with 20 mm PVC pipe, in addition to the use of bags and polyethylene mesh. Castellani et al. (2005), highlight that fish farming is based on three pillars: profitable production, preservation of the environment and social development, the three components are essential and inseparable, so that one can have an effective activity.

Figure 3: Social technologies: A) Workshop with course participants, B) Secchi disk, C) ichthyometer, D) fish-trap and E) tank-net, developed during the aquaculture training course in Curralinho, Marajó archipelago, Brazil.

Final course evaluation

With regard to the content covered and the organization of the course, 61% and 54% of the participants rated it as excellent, respectively (Table 3).

Table 3: Information from the second questionnaire, before the training course on BPM in aquaculture in Curralinho, Marajó archipelago, Brazil.

Post course	**Absolute frequency (n)**	**Relative frequency (%)**
Content covered		
Regular	01	08
Good	04	31
Excellent	08	61
Course organization		
Regular	01	08
Good	05	38
Excellent	07	54
Practice part application		
Excellent	13	100
Development of social technologies		
Good	04	31
Excellent	09	69
Duration of the course		

Regular	01	08
Good	07	54
Excellent	05	38
Instructors		
Good	03	23
Excellent	10	77
General evaluation		
Good	02	15
Excellent	11	85

All respondents think that the practical part was important in the BPM course. Regarding the development of social technologies, 69% of the participants rated it excellent. A total of 54% of them pointed out that the duration of the course was good. Regarding the course instructors, 77% rated it as excellent. In general, the results obtained through the general evaluation demonstrated that the course of good management practices in aquaculture presented an 'excellent' concept on the part of the evaluators (85%). When students were asked if they would take another aquaculture training course under the IFPA *Campus* Breves project, 100% said yes. They reported the importance of having more courses focused on aquaponics, alternative fish feed and fish processing, to strengthen the local production chain. It is worth considering that they would recommend this course to other people who raise fish or who intend to join the activity. It is worth mentioning that the Piscicultura Marajoara project kept 100% of the initial public, with a certification at the end of the training. We observed that they were able to solve BPM problems in a tambaqui cultivation system. Thus, training is of fundamental importance for the adoption of technologies that enable the increase of quality fish production and the insertion of producers in the production chain (KATO et al., 2017).

CONCLUSIONS

The profile of the public that sought training in BPM, were men and women from the communities of Boa Esperança, Cafezal, Ilha das Araras, Perpétuo Socorro, Piriá Miri, Rio Açú, Santa Izabel and groups of people from the city of Curralinho. Prior knowledge of the time working in the activity, technical assistance assistance, problem faced in the activity, training courses, interest in participating in courses in the area, expectations and benefits, were essential for the implementation of the BPM course.

Working on water quality, biometrics, fish nutrition and health, were the subjects that attracted the most attention of the course participants, in addition to the construction of the Secchi disk, ichthyometer, fish-trap and net-tank, which were the technologies socialized during the BPM course. Post-course evaluation in the aspects: content and organization; application of the practical part; development of social technologies; duration of the course; instructors and general assessment; were essential to understand the impact of socialization of knowledge provided to the community.

Thus, the Piscicultura Marajoara project reinforced the teaching, research and extension actions of the IFPA *Campus* Breves, involving students, teachers and the community in favor of strengthening aquaculture in Marajó, Pará, Brazil.

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REFERENCES

AIZAWA, N.; MASUDA, M.; ITO, L. S.. Current situation of freshwater aquaculture in the lower Amazon River and the potentiality of development. **Tropics**, v.23, n.3, p.127-134, 2014. **DOI:** https://doi.org/10.3759/tropics.23.127

AMARAL, D. D.; MANTELLI, L. R.; ROSSETTI, D. F.. Paleoenvironmental control on modern forest composition of southwestern Marajo Island, Eastern Amazonia. **Water and Environment Journal**, v.26, p.70-84, 2012. **DOI:** https://doi.org/10.1111/j.1747-6593.2011.00265.x

BOSMA, R. H.; NGUYEN, T. D.; CALUMPANG, L. M.; CARANDANG, S. A.. Gender action plans in the aquaculture value chain: what's missing?. **Reviews in Aquaculture**, p.1-11, 2018. **DOI:** https://doi.org/10.1111/raq.12293

BOYD, C. E.. Water quality management for pond fish culture, development in aquaculture and fisheries science. **Elsevier**, New York, v.9, p.730, 1982.

CASTELLANI, D.; BARRELLA, W.. Caracterização da piscicultura na região do Vale do Ribeira/SP. **Revista Ciência Agrotecnologia**, Lavras, v.29, n.1, p.168-176, 2005. **DOI:** https://doi.org/10.1590/S1413-70542005000100021

DANTAS, D. P.; FLICKINGER, D. L.; COSTA, G. A.; BATLOUNI, S. R.; MORAES-VALENTI, P.; VALENTI, W. C.. Technical feasibility of integrating Amazon river prawn culture during the first phase of tambaqui grow-out in stagnant ponds, using nutrient-rich water. **Aquaculture**, n.516, 2019. **DOI:** https://doi.org/10.1016/j.aquaculture.2019.734611

FAO. **El Estado Mundial de la Pesca y la Acuicultura 2006**. Roma: organización de las Naciones Unidas para la Agricultura y la Alimentación, 2007. 2006.

FARIAS, J. L. S.; MENDES, M. E. P.. **Estratégia de transferência de tecnologia como forma de apropriação do conhecimento:** o caso Coomanta Sobral. Embrapa Caprinos e Ovinos, 2009.

FEITOSA, G. P.; SOUSA, K. N. S.. Rede ACQUAPACITA: capacitação universitária para o desenvolvimento do segmento pesqueiro: aquícola de Santarém/PA. **Revista de Extensão da Integração Amazônica**, Santarém, v.1, n.2, 2019.

FERREIRA, G.; MARCOVITCH, J.; VAL, A.. A systematic review of the production chain of the *Arapaima gigas*, the giant fish of the Amazon. **Management of Environmental Quality: An International Journal**, v.31, n.2, 2020. **DOI:** https://doi.org/10.1108 / MEQ-11-2019-0238

IBGE. Instituto Brasileiro de Geografia e Estatística. **Censo demográfico brasileiro 2010**. Resultados gerais da amostra. Rio de Janeiro: IBGE, 2012.

KATO, H. C. A.; EVANGELISTA, D. K. R.; SOUSA, D. N.; MATAVELI, M.. Transferência de tecnologia em piscicultura de água doce: a experiência do projeto 'Peixe Mais' no estado do Tocantins. **Em Extensão**, v.16, n.2, p.129-146, 2017. **DOI:** https://doi.org/10.14393/REE_v16n22017_art06

KLEIN, J. D. L.; COSTA, M.; BUENO, W.; BITTENCOURT, F. R.. Capacitação e Acompanhamento Técnico de Piscicultores Familiares na Região Fronteiriça do Sudoeste do Paraná. **Revista Brasileira de Agroecologia**, v.4, n.2, 2009.

KUBITZA, F.. **Qualidade da água no cultivo de peixes e camarões**. Jundiaí: Kubitza, 2003.

LEIRA, M. H.; CUNHA, L. T.; BRAZ, M. S.; MELO, C. C. V.; BOTELHO, H. A.; REGHIM, L. S.. Qualidade da água e seu uso em pisciculturas. **PUBVET**, v.11, n.1, p.11-17, 2017. **DOI:** https://doi.org/10.22256/PUBVET.V11N1.11-17

MAPA. Ministério da Agricultura, Pecuária e Abastecimento. **Capacitação**. MAPA, 2015.

MARCONI, M. A.; LAKATOS, E. M.. **Técnicas de pesquisas:** Planejamento e execução de pesquisas, amostragens e técnicas de pesquisas, elaboração, análise e interpretação de dados. 3 ed. São Paulo: Atlas, 2010.

MEDEIROS, M.; AUBIN, J.; CAMARGO, A.. Life cycle assessment of fish and prawn production: Comparison of monoculture and polyculture freshwater systems in Brazil. **Journal od of Cleaner Production**, v.156, p.528-537, 2017. **DOI:** https://doi.org/10.1016/j.jclepro.2017.04.059

MPA. Ministério da Pesca e Aquicultura. **Boletim Estatístico da Pesca e Aquicultura, Brasília**. **2011**.

OLADEJO, A. J.. Economic analysis of small-scale catfish farming in Ido Local Government Area of Oyo State, Nigeria. **Agricultural Journal**, v.5, n.6, p.318-321, 2010. **DOI:** https://doi.org/10.3923 / aj.2010.318.321

OPARINDE, L. O.. Fish Output and Food Security under Risk Management Strategies among Women Aquaculture Farmers in Ondo State, Nigeria. **Agris on-line Papers in Economics and Informatics**, v.11, n.1, p.93-105, 2019. **DOI:** https://doi.org/10.22004 / ag.econ.294149

PEREIRA FILHO, M.. Alternativas para a alimentação de peixes em cativeiro. In: VAL, L. A.. **Criando peixes na Amazônia.** Manaus: Instituto Nacional de Pesquisas da Amazônia, 1995. p.75-82.

ROCHA-VIDIGAL, C. B.; VIDIGAL, V. G.. Investimento na qualificação profissional: uma abordagem econômica sobre sua importância. **Acta Scientiarum,** Maringá, v.34, n.1, p.41-48, 2012. **DOI:** https://doi.org/10.4025/actascihumansoc.v34i1.14181

SANTOS FILHO, L. G. A.; AGUIAR, S. V.. A contribuição do projeto Mais Piscicultura para a capacitação de pequenos e futuros piscicultores no norte do Piauí. **Revista Extensão**, v.10, p.123-130, 2016

SCORVO, C. M. F.; CARNEIRO, D. J.; MALHEIROS, E. B.. Efeito do manejo alimentar no desempenho do matrinxã *Brycon amazonicus* em tanques de cultivo. **Acta Amazônica**, v.37, n.4, 2007. **DOI:** https://doi.org/10.1590/S0044-59672007000400018

SCHMITTOU, H.. **High density fish culture in low volume cages.** Singapore: American Soybean Association, 1993.

SILVA, L. J. S.; PINHEIRO, J. O. C.; CRESCÊNCIO, R.; CARNEIRO, E. F.; PEREIRA, B. P.; BRITO, V. F. S.. Tecnologia e desenvolvimento rural: aspectos do cultivo de tambaqui no município de Rio Preto da Eva, AM. **Revista Terceira Margem Amazônia**, v.3, n.10, 2018.

SOUZA, E. C. P. M.; TEIXEIRA FILHO, A. R.. **Piscicultura fundamental.** São Paulo: Nobel, 1986.

VERDEJO, M. E.. **Diagnóstico Rural Participativo: Guia Prático DRP.** Brasília: MDA, 2006.

ZACARDI, D. M.; LIMA, M. A. S.; NASCIMENTO, M. M.; ZANETTI, C. R. M.. Caracterização socioeconômica e produtiva da aquicultura desenvolvida em Santarém, Pará. **Acta of Fisheries and Aquatic Resources**, v.5, n.3, p.102-112, 2017.