JNT FACIT BUSINESS AND TECHNOLOGY JOURNAL
ISSN: 2526-4281 - ANO 2026 - MÊS DE MARÇO
Ed. 72. Vol. 2 - Págs. 130-147
DOI: 10.5281/zenodo.19336551

CAPES

CNPq
Conselho Nacional de Desenvolvimento
Científico e Tecnológico

QUALIS
A2

LIMNOLOGICAL PARAMETERS IN FISHING-PAYING NURSERIES IN ARCHI-PELAGO OF MARAJÓ, AMAZON, BRAZIL[1]

PARÂMETROS LIMNOLÓGICOS EM VIVEIROS DE PESQUE E PAGUE NO ARQUIPÉLAGO DE MARAJÓ, AMAZÔNIA, BRASIL

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[1] COMO CITAR: (ABNT): SILVA. F. N. L.; HUNGRIA, A. P.; MACHADO, R. A.; MOREAU, J. R.; OLIVEIRA, L. C.; OLIVEIRA, L. A. A.; LINS, P. M. O.; QUADROS, M. L. A. Limnological Parameters in Fishing-Paying Nurseries in Archi-Pelago of Marajó, Amazon, Brazil. **JNT Facit Business and Technology Journal.** Qualis A2. ISSN: 2526-4281, Mês de Março de 2026 - Ed. 72. VOL. 02. Págs. 130-147. Disponível: http://revistas.faculdadefacit.edu.br. Acesso em: ___/___/___.

ABSTRACT

The aim of this work was to evaluate the water quality in ponds used in the creation of tambaqui (Colossoma macropomum) in fishing activities in the archipelago of Marajó, Pará, Brazil. The analysis of the limnological parameters of the ponds was carried out monthly, close to the entrance and exit of water from the ponds in the morning (8 am) and afternoon (5 pm), between the months of June to September 2018. The results were submitted to analysis of variance (ANOVA) and, in case of significant difference ($p<0.05$), the Tukey test was performed to compare the averages with 5% probability. The electrical conductivity (mS.cm-1), turbidity (mg.L-1), total dissolved solids (mg.L-1), and transparency (cm) var-ia-bles showed significant differences over the months. On the other hand, there was no sig-nificant difference for the variables temperature, dissolved oxygen, hydrogen potential, ammonia, nitrite, nitrate and phosphorus. All variables agreed with the National En-vi-ronment Council (CONAMA nº 357/2005). In conclusion, the limnological parameters showed low alteration in the nurseries and they were able to create tambaqui for the pur-pose of fishing..

Keywords: Aquaculture. fish farming. Colossoma macropomum. water quality.

RESUMO

O objetivo foi avaliar a qualidade da água em viveiros utilizados no cultivo de tambaqui (*Colossoma macropomum*) em atividade de pesque-pague no arquipélago do Marajó, Pará, Brasil. As análises dos parâmetros limnológicos dos viveiros foram realizadas mensalmente, próximo à entrada e saída de água dos viveiros pela manhã (8h) e à tarde (17h), entre os meses de junho a setembro de 2018. Os resultados foram submetidos à análise de variância (ANOVA) e, em caso de diferença significativa ($p<0,05$), foi realizado o teste de Tukey para comparar as médias com 5% de probabilidade. As variáveis condutividade elétrica (mS.cm-1), turbidez (mg.L-1), sólidos totais dissolvidos (mg.L-1) e transparência (cm) apresentaram diferenças significativas ao longo dos meses. Por outro lado, não houve diferença significativa para as variáveis temperatura, oxigênio dissolvido, potencial de hidrogênio, amônia, nitrito, nitrato e fósforo. Todas as variáveis estavam em conformidade com o Conselho Nacional do Meio Ambiente (CONAMA nº 357/2005). Concluímos que os parâmetros limnológicos apresentaram baixa alteração nos viveiros e estes estavam aptos ao cultivo de tambaqui com a finalidade de pesque-pague.

Palavras-chave: Aquicultura. Piscicultura. *Colossoma macropomum*. qualidade da água.

INTRODUCTION

The creation of tambaqui (*Colossoma macropomum*) is relevant both in the social and economic context in Brazil (Valenti et al, 2021; Petillo et al, 2025; Faria-Junior; Santos; Braga, 2025). This is a species originally from South America, from the basins of the Amazon and Ori-noco rivers, and from its main affluents (Hilsdorf et al, 2022).

The *Colossoma macropomum* belongs to the class Actinopterygii, family Characidae and subfamily Serrasalminae, being the largest characiform in the Amazon. It reaches sexual maturity between the third and fourth year of life, presents total spawning, high fecundity and semi-pelagic eggs (Araújo-Lima; Goulding, 1998).

In the state of Pará, in the Eastern Amazon, continental fish farming is developed in several municipalities, with diversified cultivation modalities (Costa et al, 2022; Hungria et al, 2024; Oliveira et al, 2024). It is practiced by subsistence fish farming to large producers, with production focused to the interstate market (Souza et al, 2023).

In the municipality of Breves, Marajó archipelago, most of the fish production is sold on the properties, where it is also common in a “fish-pay” system (Silva et al, 2017).

Fish-pays are ur-ban or rural establishments, intended for the practice of sport fishing (Manrique et al, 2020). In this way, several species of fish are created that are appreciated by amateur fishermen. You can en-joy hours of leisure with the fishing equipment, upon payment, fee and/or re-muneration to the owner, according to the total number of fish caught.

In this system, the availability and quality of water has great relevance, because in inadequate conditions, problems like the death of fish occur (Boyd; Tucker, 2019; Souza; Soares, 2020; Tatagiba et al, 2022; Cavalcanti; Barbosa, 2025). For this reason, planning becomes necessary to maintain water quality control in nurse-ries, where aquatic organisms are being raised (Albuquerque et al, 2022; Jesus et al, 2025).

The most appropriate physico-chemical variables for water qualification in nurseries are: dissolved oxygen, hydrogen potential, free carbon dioxide, total alkalinity, hardness, elec-trical conductivity, temperature, transparency, nutrients and plankton abundance (Boyd; Gross, 2018; Hurtado et al, 2018; Ladislau et al, 2020; Cavalcante et al, 2022; Khanjani et al, 2024).

The creation of fish for leisure purposes must fit the principles of sustainable aq-ua-culture, since it aims to reduce the environmental impact of the activity, improving feed-ing efficiency, water quality and increasing the income of fish (Correa et al, 2020; Valenti et al, 2021). The Knowledge of water quality is of fundamental importance for aquaculture, being es-sential in fish breeding work (Ribeiro et al, 2023).

In the Marajó region, there is no information regarding the quality of water in exca-vated ponds, in a fish-pay system. Thus, there is a need for limnological studies that con-tribute to the better characterization of water in this aquaculture activity. Therefore, it serves to assess some problems and possible management actions that can generate a more sustainable environment.

Before the exposed, the study aimed to assess the physical-chemical quality of the water in ponds for the creation of tambaqui (*Colossoma macropomum*) in the Marajó archi-pelago, Brazil.

MATERIAL AND METHODS

Study Area Description

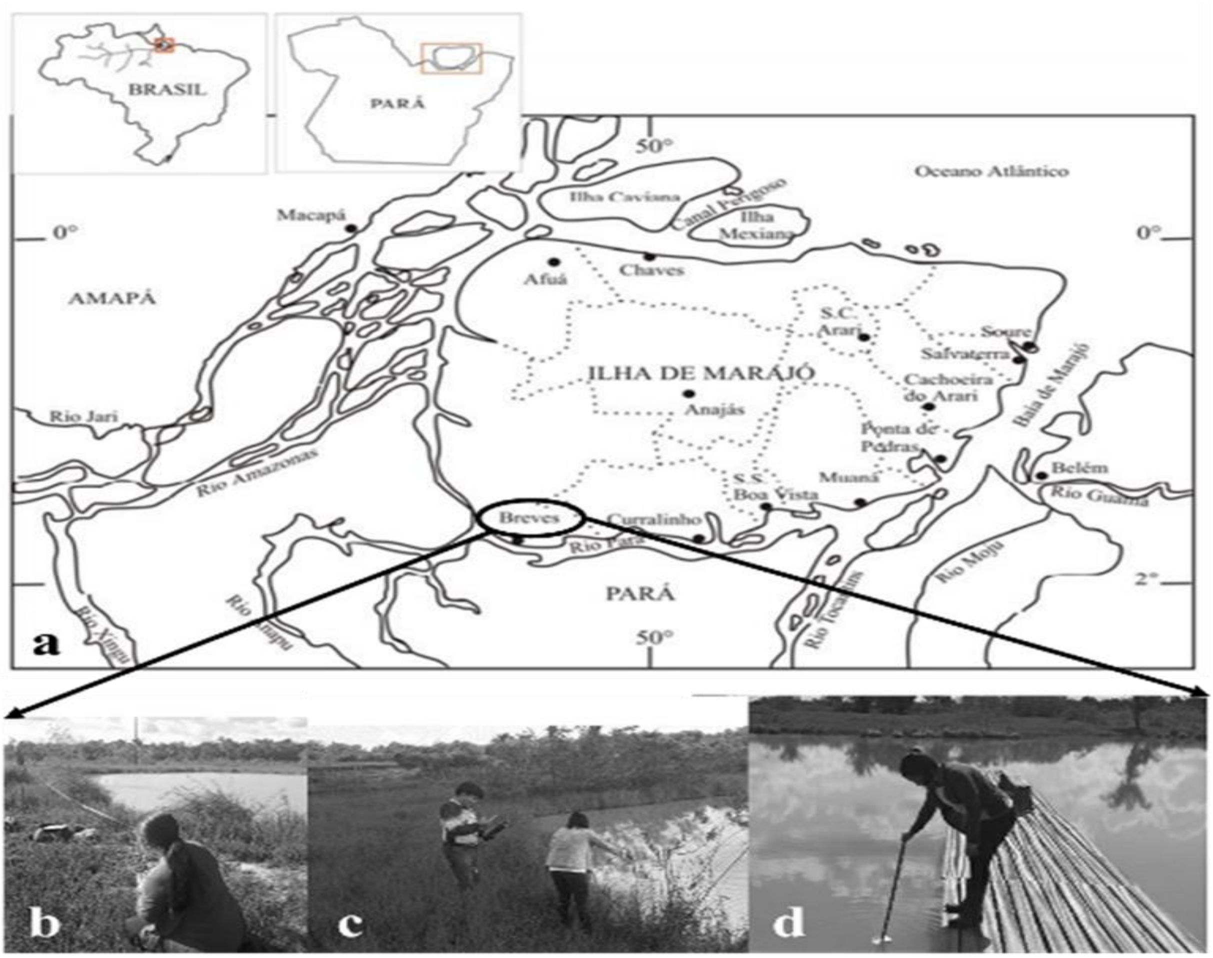
The study was developed in a fish-pay located in the rural area of the municipality of Breves, archipelago of Marajó, Pará, Brazil (Figure 1). The fish-pay has geographical coor-dinates -1.536111 (latitude) and -50.380553 (lon-gitude), and is approximately 22 km away from the city center, on the road (PA-159) that connects Breves to Anajás.

The enterprise has 28 excavated ponds, with irregular and deep sizes, of which only eight were functioning for the practice of sport fishing for tambaqui.

The Marajó has a humid tropical climate with an average temperature of 27°C. The rainiest season is from January to June, dominating the Af climate in the Köppen classi-fi-cation. The variety of soil and vegetation on the island reflects its two ecosystems: natural fields in the eastern portion covering 1/3 of the area, and in the western portion the forest ecosystem, distributed in 2/3 of the island.

The vegetation in turn will also reflect the characteristics of the topography where the vegetation cover presents species of the firm ground and the floodplain (Furtado et al., 2007).

Figure 1: (a) Map of the municipality of Breves, archipelago of Marajó, Pará, Brazil and (b, c and d) Loca-tion of fish ponds with the creation of tambaqui.



Source: Adapted from Furtado, França, Pimentel (2007).

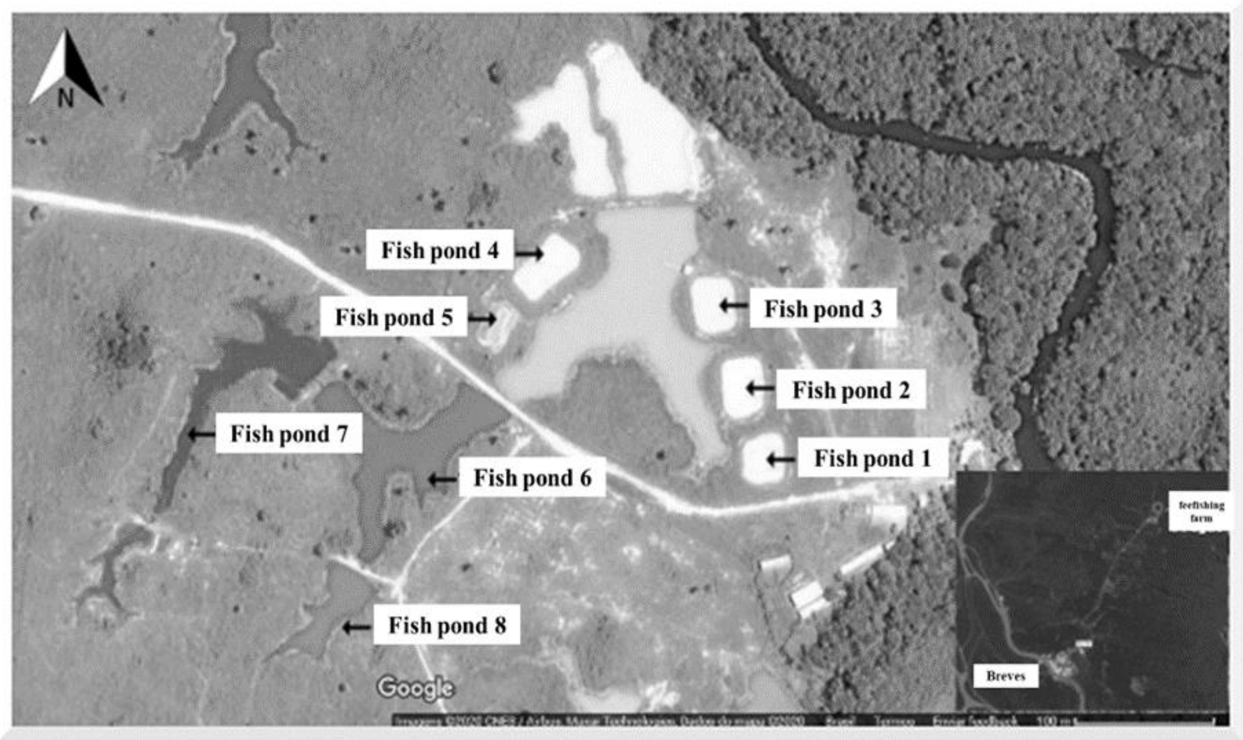
Data Collection

The work was carried out between June and September 2018. The water quality was determined, monthly, in eight excavated nurseries, populated with tambaqui (Figure 2), presenting different areas from 770.56 to 1153.04 m2 (Table 1).

Water collections were carried out at two different points, close to the water source that supplies the nursery (a) and close to the water outlet (b). The analyzes were carried out in the morning (8 am) and afternoon (5 pm).

For each nursery, the following parameters were evaluated: a) temperature (ºC), b) hydrogenionic potential (pH), c) transparency (cm), d) electrical conductivity (mS.cm-1), e) turbidity (NTU), f) dissolved oxygen (mg.L-1), g) total dissolved solids (mg.L-1), h) am-mo-nia (mg.L-1), i) nitrite (mg.L-1), j) nitrate (mg.L-1) and k) phosphorus (mg.L-1).

Figure 2: Sampling sites for fish-pay ponds with the creation of tambaqui in the Marajó archipelago, Pará, Brazil.



Source: Adapted from Google Earth (accessed on: 17/12/2025).

Table 1: Dimensions of the ponds studied in fish-pay with the creation of tambaqui in archipel-ago of Marajó, Pará, Brazil.

Fish ponds	01	02	03	04	05	06	07	08
Length (m)	31,00	40,60	37,40	44,80	34,40	*	*	*
Width (m)	28,80	28,40	27,00	30,00	22,40	*	*	*
Area (m^2)	892,8	1153,04	1009,8	1344	770,56	*	*	*

* Nurseries that have an irregular size, making it impossible to dimension them.
Source: Authors (2025).

Analysis of Limnological Parameters

The water variables verified in situ were: temperature, hydrogen potential, electrical conductivity, turbidity, dissolved oxygen and total dissolved solids, determined with the aid of a digital multi-parameter probe (Horiba U-50), according to Lachi and Sipaúba-Tavares (2008). Water transparen-cy was assessed using Secchi's disk, according Mallasen et al. (2012). The water samples were collected with the aid of a collection bottle of Van Dorn (labeled with date, time and place of the sampling), and kept cooled during the transport, carried out on the same day, to the Natural Resources Laboratory of the Federal Institute of Education, Science and Technology of Pará (IFPA), Campus Breves. The analyzes of total ammonia, nitrite, nitrate and phos-phorus were carried out in a photocolorimeter using technical laboratory kits (AlfaKit, Florianópolis, SC, Brazil).

Statistical Analysis

The results were evaluated for normality and homoscedasticity of variances, using Levene and Cochran tests, respectively. Subsequently, they were subjected to analysis of variance (Anova) and in case of significant difference ($p < 0.05$) the Tukey test was per-formed to compare the means at 5% probability, using the software Statistica Kernel Re-lease 7.1 (StatSoft Inc 2006, Tulsa, USA). In addition, the water quality variables were compared with the standards of the Resolution of the National Environment Council- Conama No. 357/05 (BRASIL, 2005) as well as with the scientific literature.

RESULTS AND DISCUSSION

The results of limnological parameters in excaveted ponds are described in Table 2. In the present study, electrical conductivity, turbidity, total dissolved solids and transparency showed a difference ($p<0.05$). On the other hand, there was no significant difference for the variables temperature, dissolved oxygen, hydrogen potential, ammonia, nitrite, nitrate and phosphorus.

Table 2: Limnological parameters in excaveted ponds with the creation of tambaqui in the Marajó archipelago, Pará, Brazil.

Parameter	Month	Excaveted ponds*	
		Input	Output
Temperature (ºC)	JUN	28,74 ±0,57	28,26 ±0,56
	JUL	28,52 ±0,77	28,56 ±0,59
	AUG	28,58 ±0,86	28,80 ±0,51
	SEPT	28,62 ±0,41	28,78 ±0,56
Dissolved oxygen (mg.L^{-1})	JUN	6,32 ±0,35	5,88 ±0,38
	JUL	5,98 ±0,55	5,88 ±0,46
	AUG	6,12 ±0,37	5,72 ±0,42
	SEPT	6,13 ±0,46	5,95 ±0,21
Hydrogen potential (pH)	JUN	6,63 ±0,61	6,76 ±0,51
	JUL	7,28 ±0,33	6,98 ±0,43
	AUG	6,73 ±0,35	6,74 ±0,35
	SEPT	6,72 ±0,40	6,43 ±0,37
Electric conductivity (µS.cm^{-1})	JUN	81,32 ±1,13^{d}	80,91 ±0,51^{d}
	JUL	88,26 ±0,85^{b}	87,89 ±0,71^{b}
	AUG	93,48 ±1,82^{a}	93,03 ±2,01^{a}
	SEPT	85,04 ±1,35^{c}	85,38 ±1,03^{c}
Turbidity (mg.L^{-1})	JUN	56,62 ±2,33^{d}	56,94 ±2,13^{d}
	JUL	85,68 ±0,61^{b}	85,86 ±0,67^{b}
	AUG	65,62 ±2,31^{c}	65,77 ±1,77^{c}
	SEPT	93,52 ±1,47^{a}	93,65 ±0,99^{a}
Total Dissolved Solids (mg.L^{-1})	JUN	23,34 ±0,47^{a}	23,64 ±0,53^{a}

	JUL	21,61	±0,68^{b}	21,69	±0,57^{b}
	AUG	20,37	±0,32^{c}	20,60	±0,39^{c}
	SEPT	23,96	±0,58^{a}	23,68	±0,65^{a}
Ammonia (mg.L^{-1})	JUN	0,20	±0,19	0,19	±0,12
	JUL	0,18	±0,07	0,19	±0,06
	AUG	0,28	±0,21	0,33	±0,18
	SEPT	0,13	±0,07	0,14	±0,07
Nitrite (mg.L^{-1})	JUN	0,06	±0,02	0,13	±0,23
	JUL	0,06	±0,03	0,05	±0,03
	AUG	0,06	±0,03	0,05	±0,02
	SEPT	0,06	±0,02	0,05	±0,02
Nitrate (mg.L^{-1})	JUN	1,00	±0,00	1,00	±0,00
	JUL	1,00	±0,00	1,00	±0,00
	AUG	1,00	±0,00	1,00	±0,00
	SEPT	1,00	±0,00	1,00	±0,00
Phosphorus (mg.L^{-1})	JUN	0,03	±0,02	0,03	±0,01
	JUL	0,04	±0,02	0,02	±0,01
	AUG	0,03	±0,02	0,04	±0,02
	SEPT	0,03	±0,01	0,03	±0,01
Transparency (cm)	JUN	40,06	±0,73^{a}	39,74	±0,73^{a}
	JUL	40,09	±0,62^{a}	40,59	±0,64^{a}
	AUG	34,94	±0,82^{b}	35,34	±0,37^{b}
	SEPT	40,19	±1,03^{a}	40,34	±0,84^{a}

* Different letters, when present in the same column, present a significant difference ($p < 0.05$) in each parameter.
Source: Authors (2025).

In the present study, the water temperature was 27.28 to 29.78oC. The values obtained in this work remained within the established by Conama Resolution n° 357/05 (<40ºC) (Brasil, 2005). These values demonstrate the thermal stability of the study region, with no sudden variations. Temperature is an important factor in fish farming and can directly influence food intake. Consumption is reduced or even stopped when the water temperature varies beyond its ideal range (Boyd et al, 2020).

In fish-pay, this variable remained within the limits suggested by Boyd; Tucker (1992) specific to aquaculture. Results found in the present study were close to those indicated by Lima et al. (2021), who state that fish from tropical waters, generally live well with temperatures between 20-28ºC. Similar conditions were also observed by Craef et al. (1987) and Resende et al. (1985), creating fish in dams in the Amazon region, at temperatures between 27ºC to 31ºC, where they consider them suitable for breeding. It is worth noting that tropical fish grow best when the water temperature remains between 25 and 32ºC (Cyrino; Kubitza, 1995; Faria et al, 2013).

Dissolved oxygen (DO) ranged from 5.00 to 6.77 mg.L-1 in the present study. All DO values recorded were above that established by Conama Resolution No. 357/05 (> 5 mg.L-1) (Brasil, 2005). The concentrations of this gas were ideal for fish development. The DO variations observed in the nurseries during the period from June to September, can be directly related to the collection times and parameter measurements, the different management practices employed and the regional seasonality. Faria et al. (2013) also classify values above 5 mg.L-1 of DO in water as ideal.

In the present study, the use of aerators in nurseries was not necessary, but water renewal practices were adopted by the producer. Probably, the amount of phytoplankton were ideal and may have contributed to this result. During the period of collection, a small amount of suspended material (organic and inorganic debris) can be observed in the growing water, which may have a relationship with the transparency of the water in this period. Another factor that may have contributed is that in the Amazon region it has greater hours of sunshine, which may have favored the production of this gas within the cultivation environment through photosynthesis activity (Ladislau et al, 2020).

It is worth mentioning that many fish can tolerate concentrations around 2 to 3 mg.L-1 for prolonged periods (Kubtiza, 1999). However, fish eat better, have better health and grow faster when these levels are close to saturation. But if the DO is below 3.0 mg.L-1, the fish will stop growing and may die from lack of oxygen. According to Chang and Ouyang (1988), on clear days, the photosynthetic rate increases, increasing oxygen demand and at night it decreases considerably as a result of phytoplankton breathing, causing a deficit of this gas in the morning. The DO concentration is considered optimal when greater than 4 mg.L-1 (Boyd, 1982).

Values for hydrogen potential (pH) between 6.00 to 7.90 were observed in the present study. The values obtained in this work remained within the established by Conama Resolution No. 357/05 (6.0 to 9.0) (BRASIL, 2005). In fish-pay, probably, the primary productivity in the nurseries may have caused the pH values to rise in this growing environment during the periods. The months studied showed similarities in relation to the behavior of pH values, with an increase of this only in the entry of water during the month of July (7.28). The possible causes for not having a significant difference between the months and points of collection studied, may be linked to the rainy season in the region and may also have been influenced by the renewal of the water used in the cultivation.

Research indicates that the pH range close to 7.0 is considered ideal for fish farming (Boyd, 1982; Castagnolli, 1992; Boyd, 2003). pH values below 6.0 and above 9.5 affect the growth of aquatic organisms (Kubitza, 2003). It is worth considering that large concentrations of vegetables, algae and phytoplankton in the water cause acidification of the aquatic environment at night, while high temperatures can accelerate the process of photosynthesis, considerably raising the pH values in the afternoon, which will later become critical during the dawn (Ceccarelli et al, 2000). Resende et al. (1985), obtained good results producing fish with pH ranging from 4.9 to 8.3. The tambaqui's low sensitivity to acidic pH values can be considered as an evolution of the species due to the acidity of the waters in the Amazon region (Aride et al, 2007).

In the present study, the electrical conductivity (EC) of the water varied between 80.13 to 96.78 µS.cm-1, showing a difference between the months of collection. According to Conama Resolution No. 357/05, the EC must not exceed 100 µS.cm-1 (BRASIL, 2005). In the current research, the values were within the established. Hurtado et al. (2018) recorded values higher than that recommended by the current Resolution for EC. During the months of June, July and September, there was a reduction in the EC values between the collection points. Possibly, this behavior was due to the occurrence of rain, in addition to the water exchange carried out, an event that may have influenced the decrease in the concentration of ions dissolved in this cultivation environment.

The fishing ponds in the month of August presented their highest recorded EC value, which was 93.48 and 93.03 µS.cm-1 for entering and leaving the water, respectively. When the values are high, they indicate a high degree of decomposition and the reverse (low values) presents a marked primary production (algae and aquatic microorganisms), being, therefore, a way to evaluate the availability of nutrients in aquatic ecosystems (Leira et al, 2017). The high EC values can be related to the management dynamics itself, where large amounts of organic matter are constantly added, mainly from food (feeding).

The total dissolved solids (TSD) recorded in the nurseries ranged from 51.85 to 95.21 mg.L-1, showing a difference between the months of collection. In this study, the highest TSD value recorded was in the months of June and September. While the months of July and August, there was a reduction in the TSD values in the fish ponds pay. The increase in TSDs in fish farms has directly contributed to the increase in EC values. Reductions in the values of the TSD parameters are linked in some way to the amount of substances present in the water and the degree of dissolution of these substances can be measured by the electrical conductivity (EC) of the water, thus demonstrating the reduction in the concentration of ions present in these environments in this environment. period. Conama Resolution No. 357/05 establishes the maximum limit of TSD for waters to be 500 mg.L-1 (BRASIL, 2005). We found that in the tambaqui breeding ponds, the TSD values are below the value recommended by the resolution, being suitable for fish farming.

The turbidity recorded in the nurseries ranged from 20.01 to 24.77 mg.L-1, showing a difference between the months of collection. In this study, the highest turbidity value recorded in September was 93.52 and 93.65 NTU, for water entering and leaving, respectively. It is noted that in the months of June, July and August, there was a reduction in the values of turbidity in the fish farms. The reduction in turbidity values in these periods may have been influenced by high rainfall. The observed increase in turbidity, however, may have occurred due to the supply process, which was carried out by means of pumping, carried out a few days before the beginning of the physical-chemical measurements, which may have moved a large amount of particles suspended in the water. cultivation such as: clay, organic and inorganic waste.

Turbidity is the presence of suspended matter in water, such as clay, silt, finely divided organic substances, microscopic organisms and other particles (Leira et al, 2017). According to these authors, the more cloudy the water, the less suitable it will be for fish farming, as it prevents the penetration of sunlight and consequently the development of phytoplankton (microvegetables that live in water and that gives it green color). The turbidity of the water in the fish-pay ponds analyzed, remained within the limits established as satisfactory for the cultivation of fish, according to Conama Resolution No. 357/05 (100 NTU) (Brasil, 2005).

The ammonia in the water varied between 0.00 to 0.50 mg.L-1. The values obtained for ammonia are within the standard required by Conama Resolution No. 357/05, which is 2.18 mg.L-1 (Brasil, 2005). It is worth considering that the water exchange and the food management of the fish occurred regularly in the fish-pay ponds and, therefore, there was no significant difference between the months and points of analysis. Ammonia is the main nitrogenous waste excreted by fish, resulting from protein metabolism, and contributes to the increase in microbial decomposition of organic waste (food scraps, feces and organic fertilizers). In this study, the values remained below those established for waters intended for the production of aquatic organisms, which is 1.0 mg.L-1 (Mardini; Mardini, 2000; Kubitza, 1999). Ammonia comes from the decomposition of organic matter and excretion released by organisms in the water. When the DO content and pH are within the limits considered ideal, the ammonia is converted to nitrite and then to nitrate, not being accumulated in the water (Esteves, 1998). The concentration of the toxic form of ammonia increases with the increase in pH and temperature, so that, above the recommended level, it starts to affect growth and resistance to diseases (Imbiriba et al., 2000). Concentrations of non-ionized ammonia above the recommended level are sufficient to induce chronic toxicity, leading to a decrease in fish growth and disease tolerance (Kubitza, 1999).

The nitrite in the water varied between 0.00 to 0.09 mg.L-1. According to Conama Resolution No. 357/05, nitrite values should not exceed 1 mg.L-1 (Brasil, 2005). Therefore, the values recorded in this study are within the stipulated standards for aquaculture. It is worth considering that the water exchange and the food management of the fish occurred regularly in the fish-pay ponds and, therefore, there was no significant difference between the months and points of analysis. In high concentrations, nitrite is extremely toxic to most aquatic organisms (Esteves, 1998; Kubitza, 2003), causing oxidation of hemoglobin, rendering it unable to transport oxygen, causing methaemoglobinaemia (brown blood disease) (Kubitza, 2003; Arana, 1997). Because it is a very unstable form, nitrite generally occurs in low concentrations in water (Albanez; Matos, 2004). This situation is observed in environments with a high DO content, which contributes to the low concentration of nitrite, while in anaerobic environments the concentration of this nitrogen compound increases. Continuous exposure to sublethal concentrations of nitrite (0.3 to 0.5 mg.L-1) can cause reduction in fish growth and resistance to disease (Leira et al., 2017).

The nitrate in the water did not vary, remaining at 1.0 mg.L-1. Conama Resolution No. 357/05 establishes a maximum limit of nitrate of 10.0 mg/L-1 (Brasil, 2005). For aquaculture, the nitrate tolerance limit is 5.0 mg.L-1 (Leira et al, 2017). It is worth considering that the water exchange and the food management of the fish occurred regularly in the fish-pay ponds and, therefore, there was no significant difference between the months and points of analysis. Nitrate is of great importance in aquatic ecosystems, as it is the main source of nitrogen and is easily assimilated by primary producers (Esteves, 1998; Albanez; Matos, 2007). Nitrate is not toxic to fish, even in high concentrations, so it does not pose any risk to fish farming (Leira et al., 2017).

The phosphorus (P) in the water varied between 0.05 to 0.06 mg.L-1. The values obtained in this work were very close to that established by Conama Resolution No. 357/05, which determines a maximum concentration of 0.1 mg.L-1 (Brasil, 2005). It is worth considering that the water exchange and the food management of the fish occurred regularly in the fish-pay ponds and, therefore, there was no significant difference between the months and points of analysis. P is one of the main nutrients for biological processes; it is one of the so-called macronutrients, because it is also required in large quantities by cells (animals and plants) and because it is a nutrient for biological processes (Hurtado et al, 2018). P is of fundamental importance in energy storage, constituting the molecules of adenosine triphosphate (ATP), in addition to being a constituent of the plasma membrane. It is found in water in the form of phosphate, is essential for the growth of organisms and may be the nutrient that limits the primary productivity of a body of water (Esteves, 1998). The excess of P, on the other hand, leads to processes of eutrophication of the aquatic environment, which results in the disordered growth and bloom of algae (Pereira; Ribeiro Filho, 2004), which was not observed in the present study.

In the present study, the transparency of the water ranged from 34.00 to 42.00 cm, showing a difference between the months of collection. The values obtained in this work remained within the established by Conama Resolution No. 357/05 (25 to 40 cm) (Brasil, 2005). The low values of transparency in the fishing ponds pay during the month of August, is a result of the presence of a greater concentration of material of organic origin in the water of cultivation at this point, such as leaves and branches. Another factor that may have favored the reduction of the transparency of the water between the points (entrance and exit) of water, must be to the increase of the planktonic density and the absence of water exchange, that associated to the reduction of the volume of rains, may have led to a higher concentration of suspended material, thus reducing the penetration of sunlight into the water column. In this study, it is possible to observe an increase in the values of water transparency in fish ponds pay during the months of June, July and September, possibly due to the low concentration of suspended material, which increased the euphotic zone of column d ' water, due to little radiation dispersion.

According to Kubitza (1999), the ideal transparency for the cultivation of aquatic organisms is between 40 and 60 cm. Which indicates the existence of an adequate amount of plankton (slightly greenish water) (Faria et al, 2013). When values of less than 40 cm are observed, greater renewal of the nursery water should be provided for a quick removal of excess algae or suspended material. In the present study, the lowest transparency measures during the months analyzed were probably due to the large amount of inorganic material in suspension. In case of transparency smaller than 40 cm, it is recommended to reduce feeding and fertilization, which are, in turn, in the case of fish-pays, the main enhancers of the intense growth of plankton, mainly phytoplankton, causing low transparency and elevation of parameters abiotics like turbidity and EC and biotics like chlorophyll-a and nutrients (Mercante et al, 2004). Finally, transparency greater than 60 cm indicates a lack of plankton, which can cause a large variation in pH throughout the day. Therefore, it promotes harmful consequences to fish farming, in addition to favoring the appearance of filamentous algae and aquatic plants that hinder management at the time of harvesting (Hurtado et al, 2018).

CONCLUSION

Water quality is essential for tropical fish farming activities. The results obtained in this study allow us to conclude that the physical-chemical parameters of the water showed low alteration in the ponds and that they were able to create tambaqui for the purpose of fishing ponds.

Acknowledgments

The authors would like to thank the Federal Institute of Education, Science, and Technology of Pará (IFPA), as well as the aquaculturists of the municipality of Breves, for their collaboration in the research conducted for this study.

Declaration of Interest

The authors report no conflicts of interest. The authors are solely responsible for the content and writing of the article.

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