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ANALYSIS OF FISH FARMING, NUTRIENT INPUT AND PRODUCTION OF THE OCOY RIVER WATERSHED

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ABSTRACT

Geotechnologies have become an essential tool for determining the sustainable development potential of aquaculture. The objective of this work was to map the physical and natural resources of the Ocoy River watershed. The mapping of the excavated ponds was carried out to estimate the discharge of Nitrogen and Phosphorus due to the fish farming activities of the microbasin. The methodology adopted was the qualitative and quantitative exploratory research for fish production and the use of open access geotechnology tools, such as QGIS and google Earth for mapping physical and natural resources. The methodology employed by Coldebella et al (2020) was used to estimate the nutrient input of fish farming in the watershed. characteristics are considered suitable for the development and expansion of fish farming in excavated ponds. The characteristics of the watershed are suitable for the expansion of aquaculture activity in the region, as it has a predominance of relief in hypsometric ranges of 200 to 300 meters, with gently undulating relief; the soil type Red Nitosol and morphometry that indicates that the watershed has a low risk of flooding and an elongated shape. Estimated ratios of Nitrogen and Phosphorus are low.

Keywords: Aquaculture. Total Phosphorus. Geotechnologies. Total Nitrogen. Excavated Nurseries.

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INTRODUCTION

To be successful, aquaculture activities need public policies to promote them, good logistics, appropriate areas and, above all, water quality. These factors combined with the expertise of fish farmers minimize environmental impacts (Feiden et al., 2018). Water quality is critical to any aquaculture activity. The Ocoy River is a tributary of Lake Itaipu, being a class 2 river, according to Conama Resolution 357/2005 and with 11 tributaries in its hydrology (Silva et al., 2010). Its springs are close to the Iguaçu National Park while its mouth flows into the Paraná River, in the reservoir of the Itaipu Hydroelectric Power Plant. This, in turn, belongs to the Paraná Hydrographic Basin 3 (Roderjan et al., 2002). The micro-basin of the Ocoy River covers the municipalities of Medianeira, Matelândia, Missal, São Miguel do Iguaçu, Itaipulândia and Ramilândia (IBGE, 2012).

To analyze watersheds, we currently have numerous georeferencing tools, among them the Geographic Information System (GIS) and Remote Sensing (SR). These tools can assist in the planning and execution of environmental licensing projects and analyze the watershed in various aspects such as land use and hydrology, and thus collaborate in the estimation of costs and investments that will be necessary to implement the activity (Klein et al., 2023, Macedo et al., 2024).

Geotechnologies have become an essential tool to determine the sustainable development potential of regional aquaculture. They make it possible to quantify and map the excavated tanks, optimize logistics, and explore areas with greater aquaculture potential, avoiding unnecessary expenses and minimizing environmental risks (Bernardi, 2014; Feiden et al., 2018). The objective of this work was to map the physical and natural resources of the Ocoy River watershed and evaluate the activity. The mapping of the excavated ponds was carried out to estimate the discharge of Total Nitrogen and Total Phosphorus generated by the fish activity of the watershed.

METHODOLOGY

PLACE OF STUDY

The watershed of the Ocoy River is located in the western region of the state of Paraná, and is bounded to the north by the municipalities of Missal and Ramilândia, to the south by Medianeira and São Miguel do Iguaçu, to the east by Matelândia and to the west by Itaipulândia, as shown in Figure 1. In relation to climate, the region is framed in Cfa (Köppen-Geiger, 1936).

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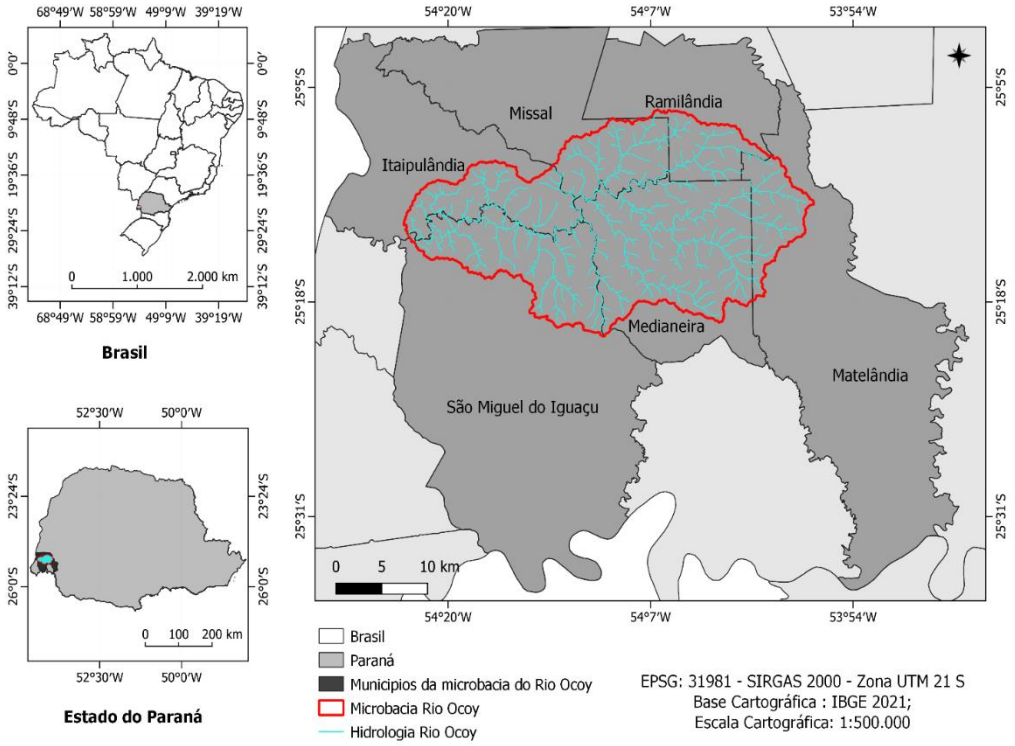
Figure 1: Ocoy River watershed, Paraná River watershed 3, western region of the state of Paraná, Brazil.



Source: prepared by the authors, 2024.

DELIMITATION OF THE WATERSHED

The watershed of the Ocoy River was delimited using a Digital Elevation Model (DEM), acquired from the USGS - Earth Explorer website, with a spatial resolution of 30 meters. The MDE was processed with QGIS® software, version 3.22.14 Biatowieza (QGIS Development Team, 2021). This process was carried out by applying advanced methods of hydrological analysis using native QGIS algorithms, such as: depression correction (r.fill.dir); calculation of the direction of flow (r.watershed); identification of catchment areas and drainage channels (r.water.outlet); vector conversion (r.to.vect).

The use of these tools allowed the precise delineation of the watershed, an essential factor for studies of water resources and environmental management. All data were then reprojected to the SIRGAS 2000 UTM 21S systemic reference.

MAPPING OF THE PHYSICAL AND NATURAL RESOURCES OF THE OCOY RIVER WATERSHED

The maps of physical and natural resources were prepared from the satellite image of the USGS EarthExplorer website, to represent the surface. This image is known as the Digital Elevation Model – MDE. The vectors of the road networks were obtained from the

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website of the Brazilian Institute of Geography and Statistics (IBGE, 2023). The MDE and the vector were redesigned for DATUM, SIRGAS 2000, UTM zone 22 S. The processing was carried out in the free software QGIS version 3.36.3. Data on land use and occupation were obtained in matrix format in collection 7, of the MapBiomas Project, at a scale of 1:500,000 and an average spatial resolution of 30 meters (Mapbiomas, 2022). The following representations on maps of the Ocoy River watershed were elaborated: slope; hypsometry; types of soil and land use and occupation. The methodology, with the steps for the elaboration of these maps, was similar to the works of Werneck et al. (2023a), Morsoleto et al. (2024).

MORPHOMETRIC ANALYSIS OF THE OCOY RIVER WATERSHED

The indices of form factor, circularity, sinuosity, elongation, relative relief, compactness coefficient, drainage density, concentration time were calculated. These calculations were performed using the attribute table of the QGIS software, version 3.22.14 Biatowieza.

CLASSIFICATION AND DELIMITATION OF EXCAVATED PONDS FOR FISH FARMS

The delimitation of the excavated nurseries of the Ocoy River watershed was carried out using google Earth superimposing the QGIS. In this stage, polygons with specific characteristics of fish farms, such as fishing area, existence of equipment aimed at aquaculture, nearby sheds, in addition to other characteristics of the activity's infrastructure, were considered excavated ponds. The nurseries were classified into classes: class I with an area of 300m² to 3000m², class II with an area of 3001m² to 6000m² and finally, class III with an area greater than 6001m². Areas smaller than 300m² were disqualified as they were not considered commercial productive areas (Morsoleto et al., 2022).

FISH PRODUCTION IN THE MUNICIPALITIES

The analysis of fish production in the municipalities that make up the Ocoy River watershed was carried out through exploratory documentary research with a qualitative and quantitative approach in data from Municipal Livestock Production – PPM (IBGE, 2024), to analyze the evolution of fish production in the municipalities of Missal, Ramilândia, Medianeira, São Miguel do Iguaçu, Matelândia and Itaipulândia.

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NUTRIENT INTAKE: TOTAL NITROGEN (N) AND TOTAL PHOSPHORUS (F)

The estimated calculations of residual nutrient discharge in the Ocoy River watershed, due to fish farming in excavated ponds were determined based on the study by Coldebella et al. (2020). To make this estimate, the cultivation area and the average biomass produced of 5 kg per m² of water surface were considered, for the excavated ponds mapped and classified in this work. The reference values are indicated in Table 1, adapted from Macedo et al. (2024).

Table 1: Reference values for estimates of Total Nitrogen and Total Phosphorus input, according to nursery class, during cultivation (9 months) and harvesting. An average stocking density of 5 kg of fish per m² of water depth of the excavated ponds was considered.

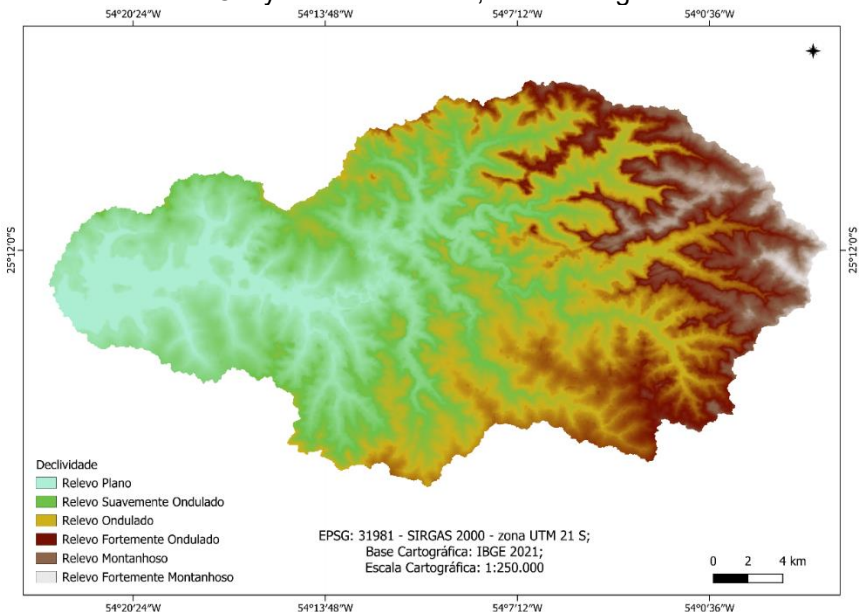
Classes	Size (m²)	Reference values			
		Creation		Fishing	
		Nitrogênio (kg/ha)	Fósphorus (kg/ha)	Nitrogênio (kg/ha)	Fósphorus (kg/ha)
I	300 - 3000	2.047,70	261,91	54,59	16,47
II	3.001 – 6.000	1.951,05	197,30	120,49	26,11
III	> 6,000	2.055,85	260,99	81,56	12,18

Fonte: Adapted from Coldebella et al. (2020).

RESULTS

MAPPING OF THE PHYSICAL AND NATURAL RESOURCES OF THE OCOY RIVER WATERSHED

Figure 2: Relief classes found in the Ocoy River watershed, western region of the state of Paraná, Brazil.



Source: prepared by the authors, 2024.

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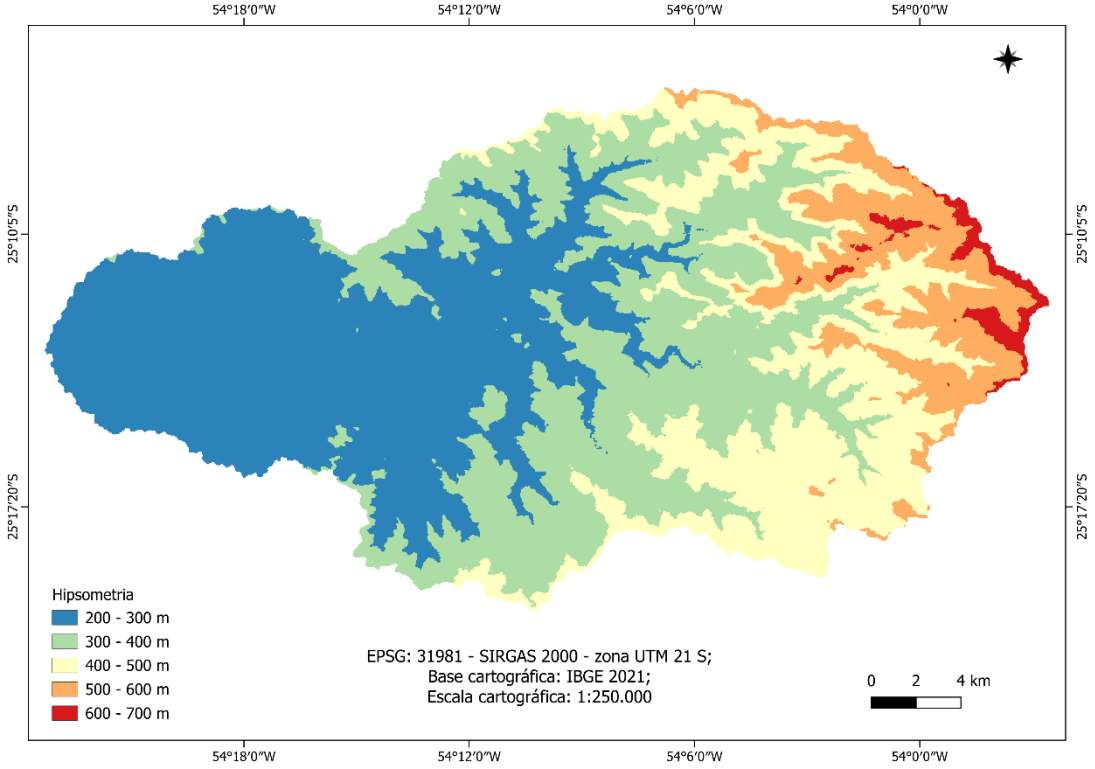
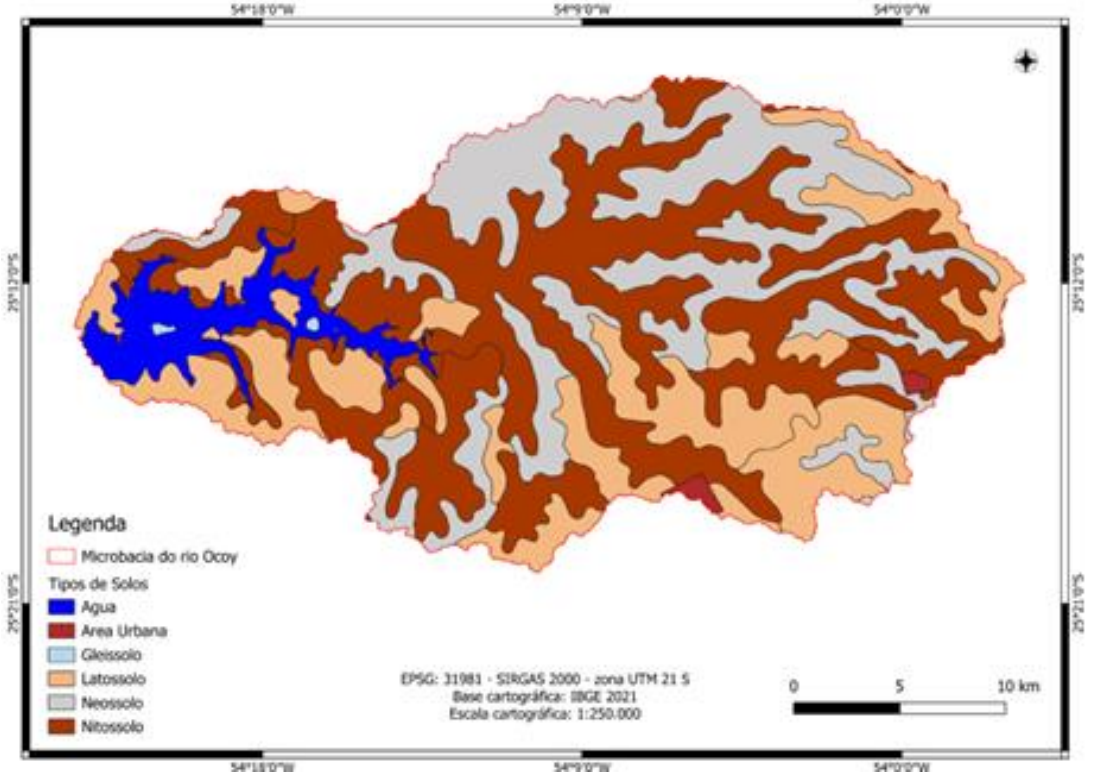
Figure 1: The hypsometric bands in the Ocoy River watershed, western region of the state of Paraná, Brazil.



Source: prepared by the authors, 2024.

Figure 4: Soil types in the Ocoy River watershed, western region of the state of Paraná, Brazil.



Source: prepared by the authors, 2024.

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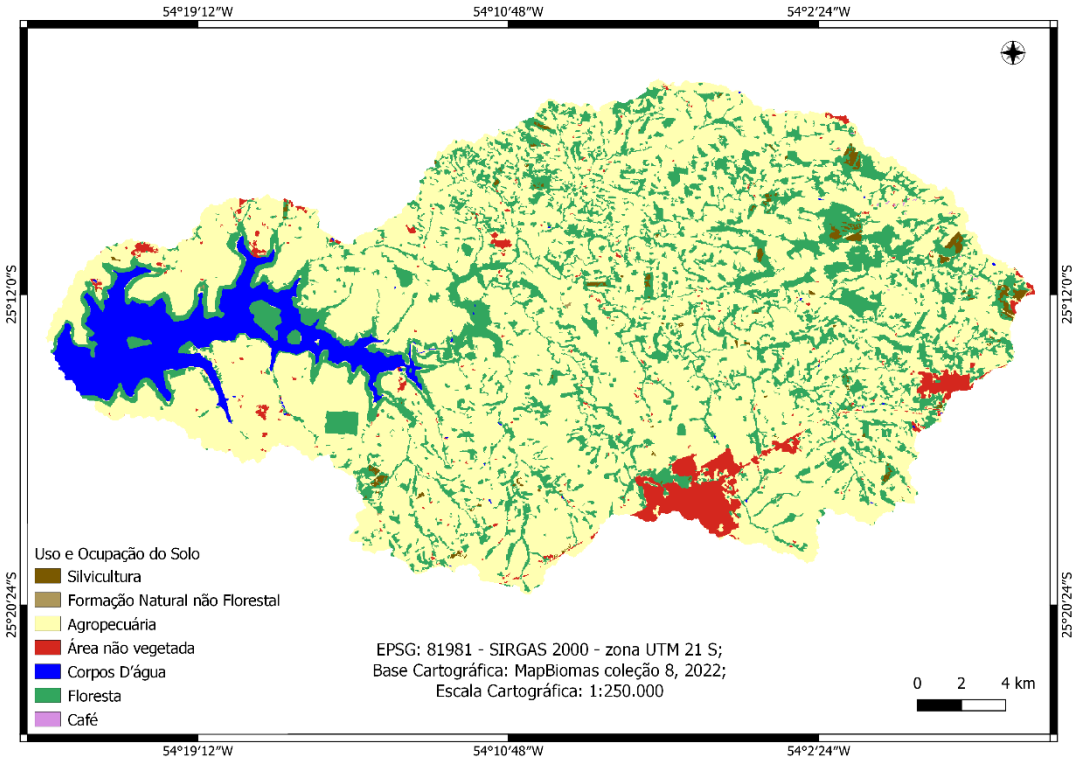
Figure 5: Mosaic of land use and occupation found in the watershed of the Ocoy River, western region of the state of Paraná, Brazil.



Source: prepared by the authors, 2024.

Table 2: Morphometric indices of the Ocoy River watershed, western region of the state of Paraná, Brazil.

Índices morfometricos	Values
Coefficient of compactness (Kc)	1.64
Form coefficient (F)	0.35
Circularity index (Ic)	0.37
Drainage Density (Dd)	0.88
Concentration Time (Tc)	14:07
Sinuosity Index (Is)	45.90
Elongation Ratio (Er)	0.67
Relative relief ratio (Rr)	0.0029

Source: prepared by the authors, 2024.

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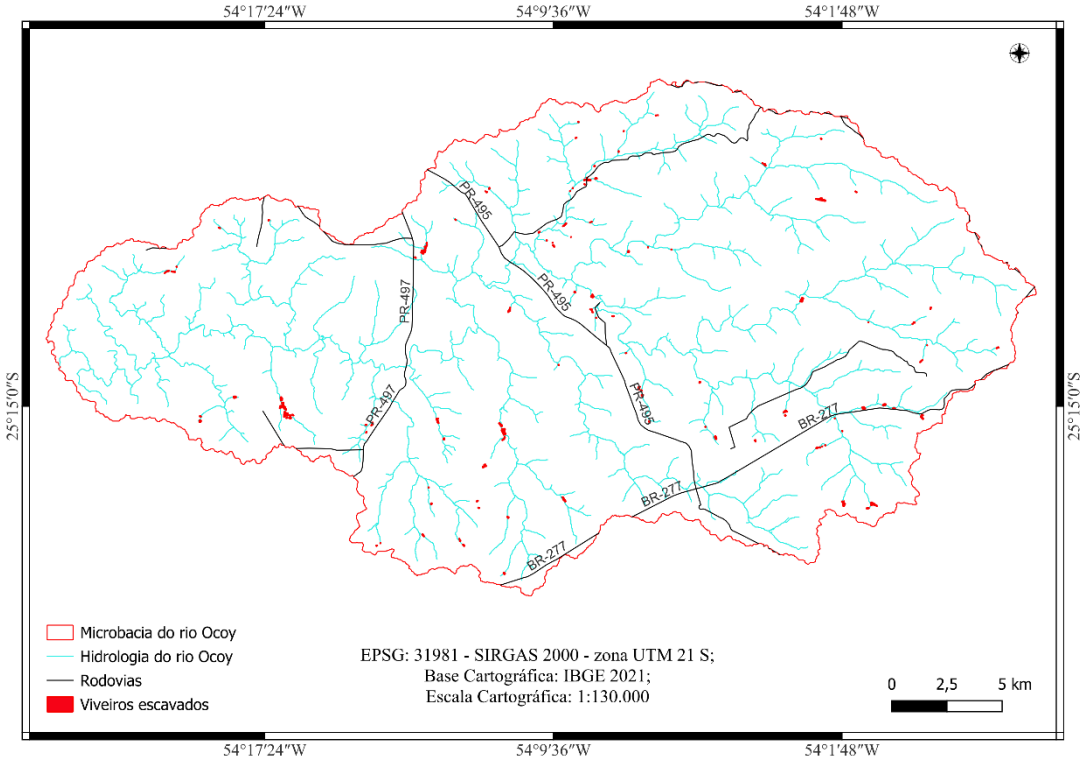
MAPPING OF HYDROLOGY, EXCAVATED PONDS AND HIGHWAYS

Table 3: Classification of ponds excavated in the Ocoy River watershed, western Paraná state, Brazil.

Class	Size (m²)	Nº Viveiros	Nurseries (%)	Area (ha)	Area (%)
I – Small	300 - 3.000	227	86.97	24.77	55.91
II – Medium	3.001 - 6.000	24	9.19	9.29	20,97
III – Large	> 6.001	10	3.84	10.24	23,12
Total		261	100	44.30	100

Fontes: adaptado de Werneck et al. (2023b).

Figure 6: Map of the hydrology and highways that cross the area of the Ocoy River watershed, western region of the state of Paraná, Brazil.



Source: prepared by the authors, 2024.

FISH PRODUCTION IN THE MUNICIPALITIES OF THE OCOY RIVER WATERSHED

Table 4: Fish production of the municipalities of the Ocoy River watershed, by year, in tons, during the decade 2014-2023.

Species	Year of Production									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Tilapia	725	795	831	956	977	1206	1.257	1.393	1.974	2.026
Other*	328	320	226	253	210	178	151	128	89	91
Total	1.053	1.115	1.057	1.209	1.188	1.384	1.408	1.521	2.063	2.117

*Outras espécies: Pacu - Piaractus mesopotamicus; Piau - Leporinus friderici; Pintado - Pseudoplatystoma corruscans; Traíra - Hoplias spp. Fonte: adaptado de IBGE, 2024.

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NUTRIENT DISCHARGE FROM EXCAVATED PONDS.

Table 5: Contribution of Total Nitrogen (N) and Total Phosphorus (P) during the rearing and harvesting phase for the different classes of ponds excavated from the Ocoy River watershed, located in the west of the state of Paraná – Brazil, considering an average density of 5kg of fish per m² of water depth, in a rearing for a period of 9 months.

Class	Biomass (Ton/ha)	Area (ha)	Creation		Fishing	
			N (Tone)	P (Tone)	N (Tone)	P (Tone)
I	11,35	227	464,83	59,45	12,40	3,74
II	1,20	24	46,82	4,73	2,90	0,63
III	0,50	10	20,56	2,61	0,81	0,12
Total	13,05	261	532,21	66,79	16,11	4,49

Fonte: adapted from Coldebella (2020).

DISCUSSIONS

MAPPING OF THE PHYSICAL AND NATURAL RESOURCES OF THE OCOY RIVER WATERSHED

In the watershed of the Ocoy River, the flat and gently undulating relief predominates, as shown in Figure 2. These types of relief are considered to have good characteristics for the implementation of new aquaculture enterprises, as observed by Francisco et al. (2019).

In the watershed of the Ocoy River, 5 hypsometric ranges ranging from 200 to 700 meters of altitude were found (Figure 3). The hypsometric range from 200 to 300 meters of altitude occupies an area of 26,337.082 ha, corresponding to 37.27% of the total area of the microbasin. These altitudes have good characteristics for the installation of fish farms, as observed by Francisco et al. (2020).

Four different types of soils were observed in the watershed, namely: Red Nitosol with 45.80%; Regolitic Neosol with 28.37%; Red Latosol with 25.71%, and Haplic Gleisol with 0.12% of the total area of the microbasin, as shown in Figure 4. The most suitable types of soils for the construction of nurseries are those with a high clay content, as they reduce water infiltration. What happens in the micro-basin of the Ocoy River.

As for the use and occupation of the land in the hydrographic watershed of the Ocoy River, agriculture occupies most of the area, with 70.26% of the total of the micro-basin. The second largest area found in the watershed was the forest area with 20.43%, as shown in Figure 5. The study area is located in the Upper Paraná Forests Ecoregion, which has an Atlantic Forest biome, denoting an area of forest that is still prominent, in the eastern part of the micro-basin, despite the advances of agriculture (Di Bitetti et al., 2003).

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MORPHOMETRY

The watershed has an area of 705 km² in extension, the main course of the Ocoy River is 73.41 km long and the total length of the canals totals 600 km in length. The Ocoy River watershed, according to Conceição Dornellas (2020), has compactness coefficient, form factor, and circularity index indexes, according to Table 2. The watershed has a long shape and low tendency to flooding, indicating good characteristics for the implementation of fish farms.

The drainage density of the Ocoy River watershed was 0.88 km/km2. This value indicates low surface runoff and greater soil infiltration, according to Raiol et al. (2022). Drainage density modifies soil conditions, favoring the formation of erosion (Júnior et al., 2023). The concentration time is the time it takes for a hydrological event to travel through the entire watershed, until it arrives at the mouth of the basin (Targa et al., 2023), and this time was calculated at 14h07min for the microbasin.

The sinuosity index of the canals has its importance in differentiating between sinuous and meandering canals, as defined by Bertolini et al. (2023). The watershed of the Ocoy River was considered sinuous (Table 2) according to the classification of Romero et al. (2017). The elongation index relates the shape of the basin to a rectangle. The length when considered narrow reduces the possibility of rain covering the entire watershed, the lower this index, the lower the risk of flooding (Santos Alves et al., 2023). The elongation ratio (0.67) indicates that the watershed is considered elongated.

The relative relief ratio indicates that terrains with low relative relief values have a lower propensity for erosion compared to terrains with higher relative relief values Baioni et al. (2023).

MAPPING OF HYDROLOGY, EXCAVATED PONDS AND HIGHWAYS

The most observed nurseries in the watershed were class I, small ponds, totaling 227 ponds corresponding to 86.97 % and a water depth of 24.77 ha (55.91%) of the total water depth. Table 3 describes the classification of the excavated ponds and the geographic locations are illustrated in Figure 6, most of the excavated ponds are located in the central region of the watershed. In the area of the Ocoy River watershed, there are several highways, including the federal highway BR - 277, three state highways (PR - 495, PR - 497 and PR - 590) and side roads, totaling 116.64 km in length, as illustrated in Figure 6.

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FISH PRODUCTION IN THE MUNICIPALITIES OF THE OCOY RIVER WATERSHED

The fish production of the municipalities of the Ocoy River watershed, in the period between 2014 and 2023, monitored by the Municipal Livestock Production, of the Brazilian Institute of Geography and Statistics - IBGE, are shown in Table 4. Nile tilapia (Oreochromis niloticus), the most bred species in the region, has had a steady growth during the last decade, while the other species have lost space and consequently decreased production.

NUTRIENT DISCHARGE FROM EXCAVATED PONDS

The results of nutrient inputs (Total Nitrogen and Total Phosphorus) during the rearing and harvesting phases showed that all class I ponds are responsible for the highest nutrient discharge in the watershed (Table 5). The concentration of N/P found during the rearing phase was 8/1 and in the harvest was 4/1. Both concentrations are considered low. Nutrients such as Nitrogen and Phosphorus can become limiting elements for aquatic ecosystems, which can stimulate eutrophication processes when they are introduced into the environment and causing a decrease in the quality of water resources, as discussed by Macedo and Sipaúba-Tavares (2010). Environments that have low N/P ratios can be indicative of eutrophication and can favor cyanobacterial blooms, since phytoplankton growth is dependent on the relative availability of nitrogen, providing growth of species capable of fixing atmospheric nitrogen (Vidal Neto, 2013).

CONCLUSION

The watershed of the Ocoy River has a predominance of gently undulating relief, in the hypsometric range between 200 and 300 meters, and the morphometric indices indicate that the watershed has adequate environmental conditions for the development and expansion of sustainable fish farming in excavated ponds. Most ponds are considered small, and occupy the central part of the micro-basin, and allow the expansion of production, either by grouping ponds or by expanding the number of large ponds in the micro-basin, requirements for agro-industrial production aimed at fish warehouses. The concentrations of the N/P ratios observed of 8/1 during harvesting and 4/1 are considered low, showing that fish farming causes low impacts on eutrophication of watercourses in the Paraná 3 watershed.

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REFERENCES

1. BERNARDI, L. A. (2000). Manual de plano de negócios: Fundamentos, processos e estruturação. São Paulo: Atlas.

2. BERTOLINI, W. Z., LIMA, A. G., PRINA, B. Z., & BOETTCHER, N. (2023). Indicadores morfométricos da bacia da Várzea (RS) como marcadores do desequilíbrio fluvial da paisagem. Revista Brasileira de Geografia Física, 16(6), 3298-3311.

3. COLDEBELLA, A., et al. (2020). Nitrogen and phosphorus dynamics in Nile tilapia farming in excavated rearing ponds. Research, Society and Development, 9(11), e1319119699.

4. DA CONCEIÇÃO DORNELLAS, P., et al. (2020). Análise morfométrica da bacia do Alto Rio Paraíba, região semiárida do estado da Paraíba. Revista Brasileira de Geomorfologia, 21(3).

5. DI BITETTI, M. S., PLACCI, G., & DIETZ, L. A. (2003). Uma visão de biodiversidade para a Ecorregião Florestas do Alto Paraná – Bioma Mata Atlântica: Planejando a paisagem de conservação da biodiversidade e estabelecendo prioridades para ações de conservação. World Wildlife Fund.

6. FEIDEN, A., et al. (2018). A cadeia produtiva da tilápia no oeste do Paraná: Uma análise sobre a formação de um arranjo produtivo local. REDES: Revista do Desenvolvimento Regional, 23(2), 238-263.

7. FRANCISCO, H. R., CORRÊIA, F. A., & FEIDEN, A. (2019). Classification of areas suitable for fish farming using geotechnology and multi-criteria analysis. ISPRS International Journal of Geo-Information, 8(9), 394.

8. IBGE - Instituto Brasileiro de Geografia e Estatística. (2012). Manual técnico da vegetação brasileira. Edição 2. Rio de Janeiro: IBGE.

9. IBGE – Instituto Brasileiro de Geografia e Estatística. (2023). Portal de mapas. Disponível em: https://portaldemapas.ibge.gov.br/portal.php#homepage. Acesso em: 28 nov. 2023a.

10. IBGE – Instituto Brasileiro de Geografia e Estatística. (2024). Produção Pecuária Municipal 2023. Disponível em: https://sidra.ibge.gov.br/Tabela/3940.

11. JÚNIOR, A. M. F., et al. (2023). Caracterização morfométrica das microbacias hidrográficas do Parque Estadual Nova Baden, MG. Revista Brasileira de Geografia Física, 16(3), 1263-1271.

12. KLEIN, W. L., et al. (2023). Características ambientais da microbacia hidrográfica do rio São Luiz para subsidiar o planejamento sustentável da piscicultura. Cuadernos de Educación y Desarrollo, 15(10), 10139-10158.

13. KÖPPEN, W., & GEIGER, R. (1928). Köppen-Geiger: Klimate der Erde. Gotha: Verlag Justus Perthes.

Revista ARACÊ
ISSN: 2358-2472

14. MACEDO, C. F., & SIPAÚBA-TAVARES, L. H. (2010). Eutrofização e qualidade da água na piscicultura: Consequências e recomendações. Boletim do Instituto de Pesca, 36, 149-163.

15. MACEDO, H. R., et al. (2024). Use of geotechnologies to promote the sustainable expansion of fish farming: An analysis for the municipality of Chopinzinho, Brazil. Concilium, 24(6), 31-43.

16. MAPBIOMAS. (2022). Coleção 4.1 da série anual de mapas de cobertura e uso de solo do Brasil. Disponível em: https://mapbiomas.org/colecoes-mapbiomas-1?cama_set_language=pt-BR

17. MORSOLETO, F. S., et al. (2022). Geographic information system as a tool for assessing ponds and the potential for environmental impact caused by fish farming. Boletim do Instituto de Pesca, 48.

18. MORSOLETO, F. S., et al. (2024). Sustainable planning geotechnologies for fish farming expansion in small municipalities: A case study of Pato Bragado/PR-Brazil. Latin American Journal of Aquatic Research, 52(4), 563-574.

19. QGIS Development Team. (2021). QGIS Geographic Information System. Open-Source Geospatial Foundation Project.

20. RAIOL, L. L., et al. (2022). Caracterização morfométrica da bacia hidrográfica do rio Caripi, zona costeira amazônica. Revista Brasileira de Geografia Física, 15(5), 2354-2370.

21. RODERJAN, C. V., et al. (2002). As unidades fitogeográficas do estado do Paraná, Brasil. Ciência & Ambiente, 24(1), 75-92.

22. ROMERO, V., FORMIGA, K. T. M., & MARCUZZO, F. F. N. (2017). Estudo hidromorfológico de bacia hidrográfica urbana em Goiânia/GO.

23. SILVA, G. S. da, et al. (2010). Avaliação da qualidade das águas do Rio São Francisco Falso, tributário do reservatório de Itaipu, Paraná. Eclética Química, 35, 117-122.

24. TARGA, M. S., et al. (2023). Aplicação de diferentes equações para cálculo do tempo de concentração em bacias hidrográficas. Revista Técnica Ciências Ambientais, 1(7).

25. WERNECK, P. R., et al. (2023a). Caracterização da microbacia do Rio Branco e análise das unidades de produção piscícolas, através do uso de geotecnologias. Observatório de la Economía Latinoamericana, 21(5), 2749-2773.

26. WERNECK, P. R., et al. (2023b). Uso do georreferenciamento como ferramenta de planejamento sustentável da produção aquícola em pequenos municípios: Estudo de caso para Ouro Verde do Oeste/PR. Research, Society and Development, 12(3), e17012338683.

Revista ARACÊ
ISSN: 2358-2472

27. VIDAL NETO, F. das C., & FREIRE, E. C. de. (2013). Melhoramento genético do algodoeiro.