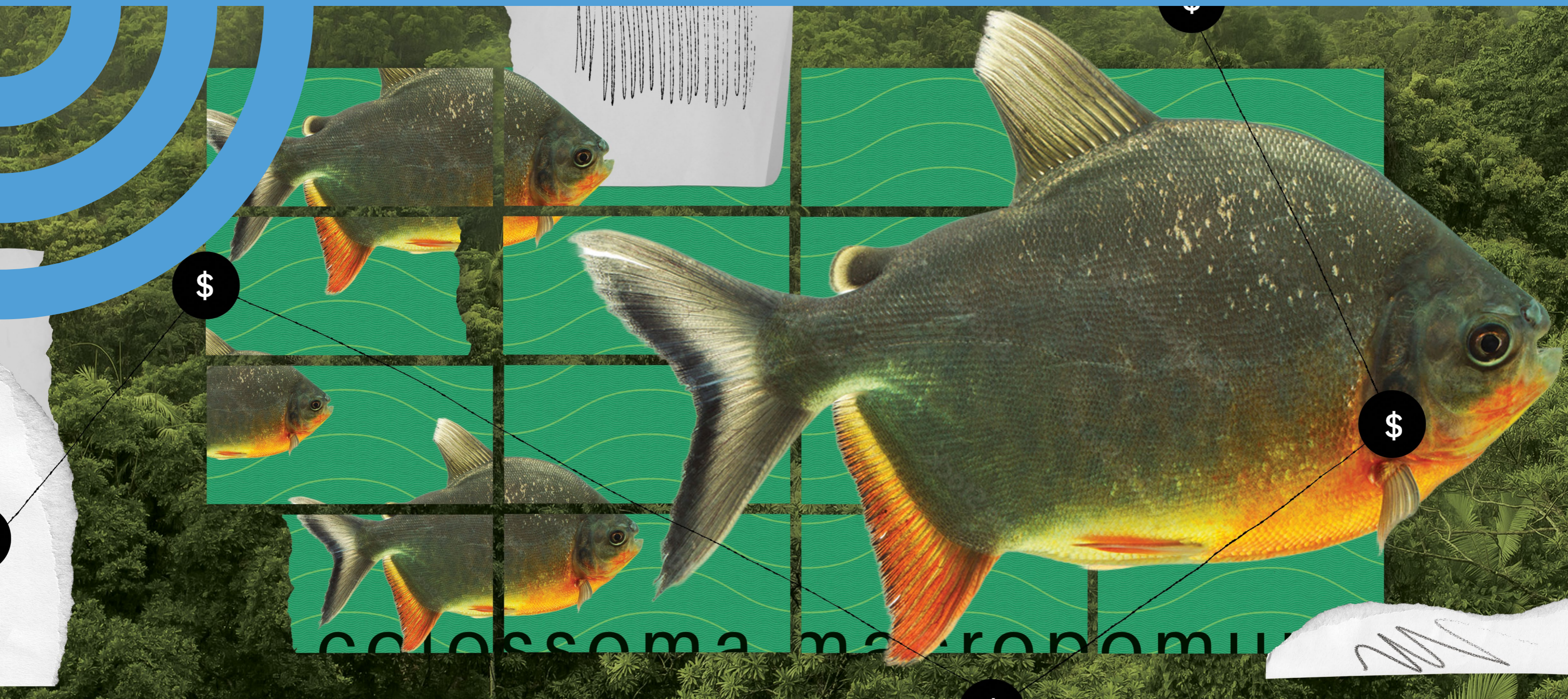




AUGUST 2024

A SUBAQUATIC SOLUTION: the forgotten potential of fish farming at Amazon

INSTITUTO
ESCOLHAS





A subaquatic solution:
the forgotten potential of
fish farming at Amazon

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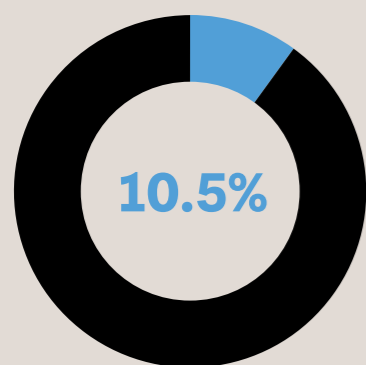
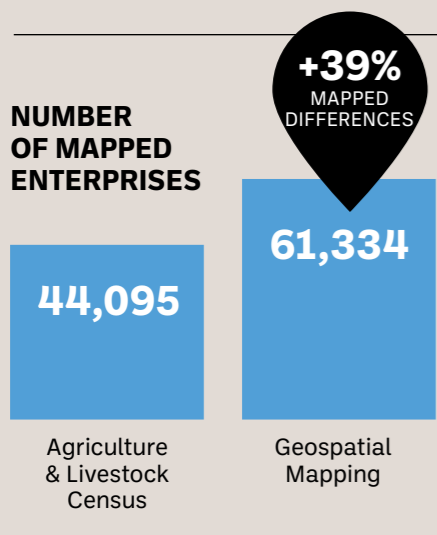
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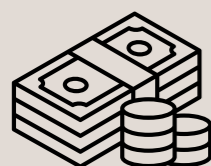
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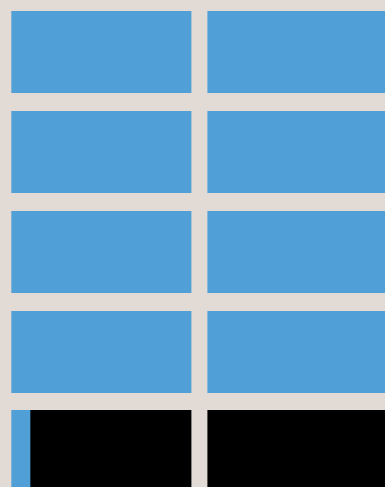
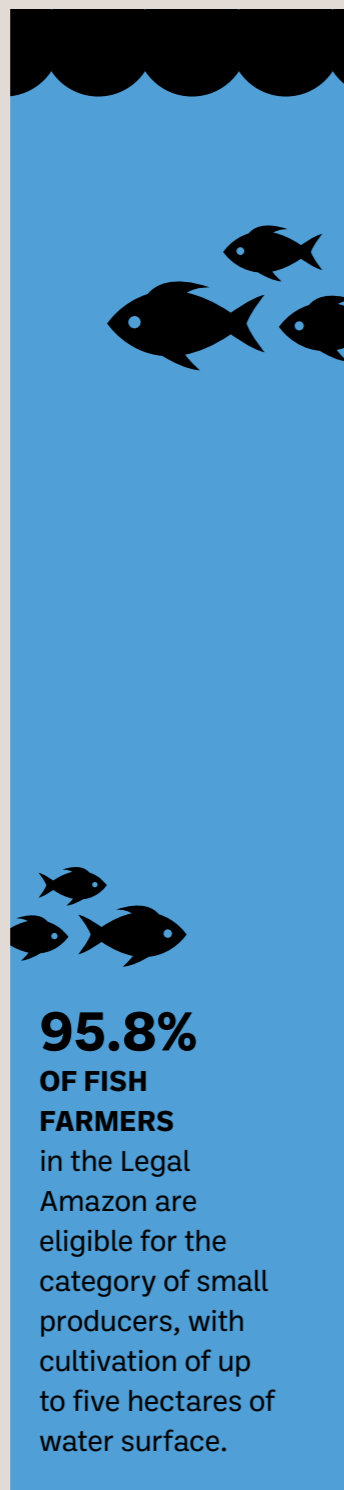
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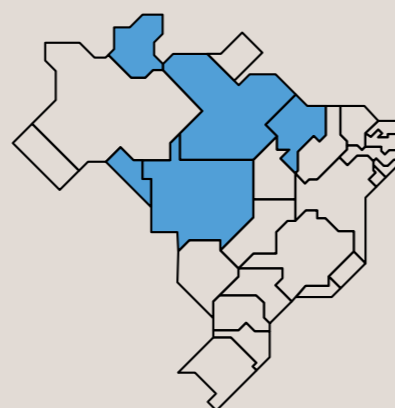
ONLY 10.5% OF FEDERAL INVESTMENT credits for fish farming, equivalent to



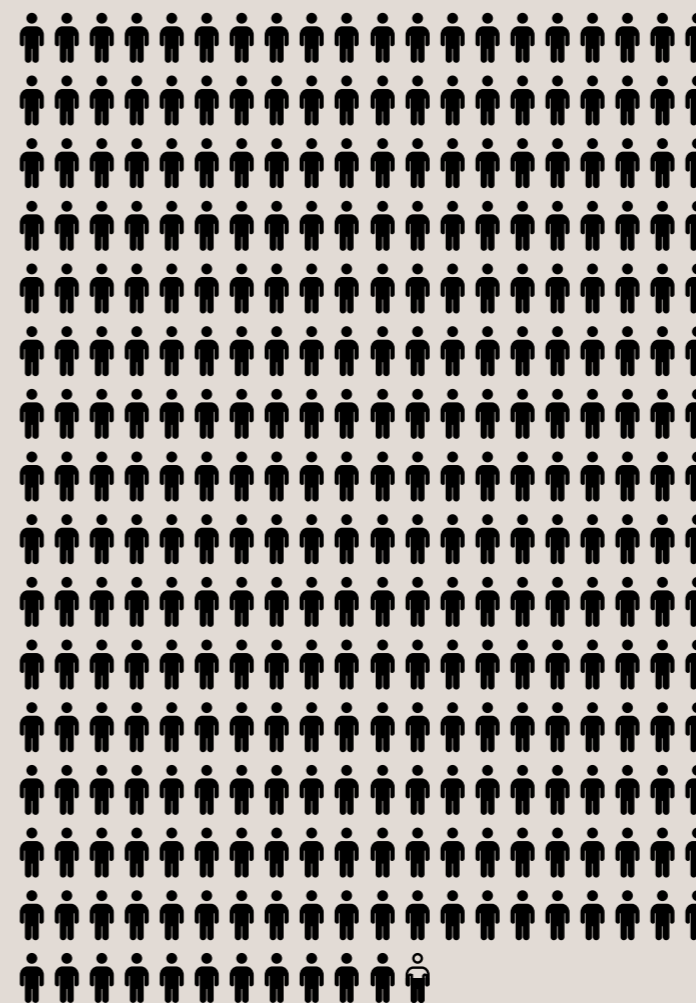
USD 965 thousand, ARE EARMARKED IN THE LEGAL AMAZON



Activation of these areas combined with productivity-enhancing strategies such as technical assistance could significantly expand fish production in the states of Mato Grosso, Pará, Rondônia, Roraima, and Maranhão.

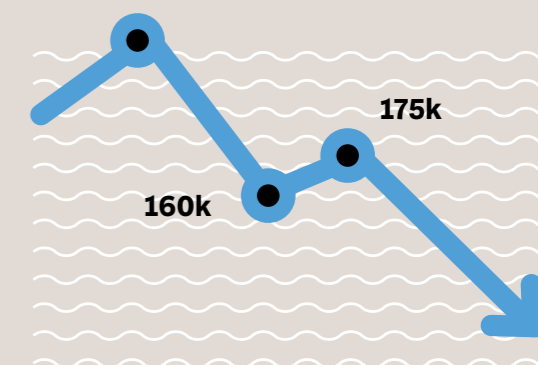


The study mapped **61,334 fish farming** enterprises located in the Legal Amazon, i.e., **39% above** the figures provided by the Agriculture & Livestock Census.



220 thousand TONS OF FISH

were produced in the Legal Amazon in 2015



but ever since, production remains stagnant – fluctuating between 160 and 175 thousand tons – while the country's yearly fish farming grows 3% to 5%, lead production of tilapia fish

ONLY **4.6%** IN THE NEXT 10 YEARS

IT IS THE PROJECTED GROWTH for fish farming in the amazon region, unless a strategic large-scale intervention is implemented immediately.



fish processing establishments located in the Legal Amazon have the Federal Inspection Service approval seal (SIF).



Introduction

An isolated black Tambaqui fish, native to the wild Amazon in Brazil, swimming in a fish farming setting. Photo: Yakov

The production of aquatic organisms – fish, crustaceans, algae – has been indicated as one of the main animal protein sources for the humanity in the coming decades¹. In this context, Brazil is a country with strong productive potential due to factors such as water abundance, tropical climate, and territorial extension. Such conditions exist, for instance, in the states of the Legal Amazon², where production of native species is stalled.

But if there are favorable conditions at global, local, and regional level, what is missing then, to boost production of native fishes in the Legal Amazon to occupy an outstanding place among the production chains of the national bioeconomy?

To respond those questions, this study by Instituto Escolhas delved into the scarce and dispersed data available regarding the fish farming chain in Brazil. And therein lies the first challenge of the sector: official data is still focused on production, leaving aside other equally relevant links in the production chain, such as the supply of inputs, fish handling, processing, and fish marketing circuits.

Statistical data on fish production by state were obtained from Ibama – *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* (Brazilian Institute of Environment and Renewable Natural Resources) and from MPA - *Ministério da Pesca e Aquicultura* (Ministry of Fisheries and Aquaculture), federal government bodies responsible for the sector's official information between 1995 and 2012. For information for the period 2013-2022, the survey by Sidra, the IBGE System of Automatic Data Recovery, regarding the Municipal Livestock Survey (PPM) between the years 2013 and 2022 and the Agriculture & Livestock Census

¹ Promoting the sustainable intensification and expansion of aquatic animal farming is the first goal of the Blue Transformation initiative, according to the vision of the United Nations Food and Agriculture Organization (FAO) regarding the strategic place of agriculture to build sustainable food structures. According to the report “The State of World Fisheries and Aquaculture 2024”, issued by FAO on June 7, 2024, in 2022, for the first time, aquaculture fishing surpassed capture fishery as the main producer of aquatic animals.

² The Legal Amazon comprises the total areas of the states of Rondônia, Acre, Amazonas, Roraima, Pará, Amapá, Tocantins, Mato Grosso, and the portion of the state of Maranhão west of Meridian 44°, as indicated in art. 2 of Complementary Law no 124 enacted by the Presidency of the Republic on January 3, 2007. In this study, figures for the state of Maranhão are statewide, i.e., they do not comply strictly with the above-mentioned article 2.

of 2017 – which quantified aquaculture enterprises in the national territory by municipality but did not include fish farming as a main activity (such as cattle raising and agriculture). Another secondary data source were the yearbooks of the Brazilian Fish Farming Association (PeixeBR), which provides unofficial production figures for the years 2016 to 2022.

The absence of detailed data and lack to update available data, make it challenging to design effective actions for the development of the fish farming sector - which, according to data in this study, employs around 311.4 people in the states of the Legal Amazon³.

The poor visibility provided for the fish farming potential and the fishery processing industry in the country can be confirmed, for instance, by the fact that the Ministry of Fisheries and Aquaculture is not even mentioned in the Action Plan for Neo Industrialization⁴. As regarding the National Bioeconomic Strategy⁵ – whose objectives include “the fostering of economic and productive activities that promote the sustainable use, conservation, regeneration and valorization of biodiversity ecosystemic services” as well as increased insertion “of bioeconomic products on the national market and global value chains” – could have incorporated fish farming and its challenges more clearly.

For all these reasons, in addition to systematizing the information available on native fish production in the Legal Amazon and its links, from supply of inputs to their commercialization, this study carried out unprecedented geospatial mapping⁶, updating the fish production scenario, which is already 39% higher than stated by official figures. In the next pages, we provide you with a broader view of how the pisciculture sector is developing in the region - essential information for defining what will become of it in the future.



Fish sale at Adolpho Lisboa Market in Manaus, Amazonas. Photo: Imago Photo

311.4 people work at fish farming initiatives in the Amazon
thousand

³ The estimate includes direct employment and informal jobs, based on the water surface in operation. It is worth noting that, according to the annual report by PeixeBR, based on an estimate by the organization's researchers, the fish farming sector employs one million people.

⁴ The document presents main actions of the New Brazilian Industry (Nova Indústria Brasil - NIB), the neo industrialization policy to be implemented by the federal government by 2033. It was released by (MDIC) Geraldo Alckmin in January 2024. VP and the Minister of Development, Industry, Commerce and Services (MDIC).

⁵ Established by Decree No. 12.044 of June 5, 2024, the National Bioeconomy Strategy is intended to coordinate and implement public policies aimed at developing the bioeconomy, in association with civil society and the private sector.

⁶ Mapping was conducted using the remote sensing technology called MaPeixe, which accurately supplied per Brazilian state: 1) the quantification of fish farming initiatives; 2) the classification of identified enterprises by size; and 3) the available water surface, divided into active and idle water surfaces. For this aim, images from Sentinel-2, Google, Bing, CBERS and Planet for 2022 and 2023 were used, as well as applying the Normalized Difference Water Index (NDWI) for detection of water bodies.

Figures of fish farming at Legal Amazon

Aerial view of fish farm in São José do Rio Claro, Mato Grosso. Photo: Uwe Bergwitz



The unprecedented geospatial mapping developed in this study included pisciculture enterprises in earthen fishpond ponds and dams⁷ which provided new data on the state of fish farming in the Legal Amazon. This region includes states with the highest per capita fish consumption in the country⁸. A total of 76,942 hectares of water surface (visible layer of water on flat, continuous surfaces) were mapped.

It is opportune to highlight that fish farming is an intensive cultivation system from the standpoint of land use. While extensive livestock farming requires 16 hectares to produce one ton of meat, fish farming uses only between 5% and 10% of the same area.

It is also worth noting that the latest Agriculture & Livestock Census (2017) indicated a total of 44,095 fish farming enterprises in the Legal Amazon, while geospatial mapping carried out for this study found 61,334 initiatives in earthen fishponds and dam ponds⁹, of which 95.8% are considered small (using up to 5 hectares of water surface), 4% medium (5 to 50 hectares) and only 0.2% large (over 50 hectares of water surface)¹⁰.

7

Earthen or semi-Earthen nursery: "a flooded area formed by excavation in natural terrain and supplied by gravity-operated or pumped channels from a watercourse, reservoir or tubular well, which has a water inlet and outlet control system." Dam nursery: "flooded area resulting from damming a watercourse intended for aquaculture, which may also have the function of water reservoir" (Amazonas state law no 5.338, Dec 11, 2020). Thus, the remote sensing survey did not consider ponds or suspended fish tanks or breeding of fish in ponds.

8

Households located in the North lead the average yearly per capita fish consumption (17.70 kg), followed by those located in the Northeast (8.25 kg), Midwest (3.69 kg), South (3.36 kg) and Southeast (2.73 kg).

9

It is worth to highlight the widespread prevalence of these breeding structures in the analyzed territory, information duly reported by the available technical-scientific literature, as cited in the bibliography of this study's technical report. Available at escolhas.org/en.

10

In terms of Conama Resolution nº 413 of June 26, 2009.



Figure 01. Fish farming enterprise in earthen fishponds with cultivation structures built outside of the original watercourse identified by geospatial mapping. Source: Data researched by the authors.

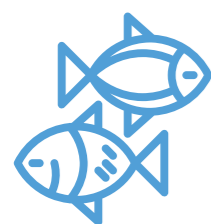
Dividing the area according to the size of the areas used, small properties account for 38,962 hectares of water surface (or 51%), medium-sized properties occupy 28,573 hectares (37%) and large properties 9,422 hectares (12%).

The study identified an average of 19% idle areas (see next page). For small properties, this rate reaches 20%, but ranges between 16% in Amapá and 25% in Mato Grosso. The average idle area of medium-sized properties is 18%, ranging from 13% in Rondônia to 29% in Amapá. On large properties, the inactive area does not exceed 13%, varying between 8% in Acre and 30% in Maranhão. The economic vulnerability trend for small producers is reflected by larger inactive areas, since the low income from the activity in a context of small production and low productivity does not always compensate the investment needed to keep fishtanks active.

Analyzing by state shows that Mato Grosso, Pará, Rondônia, Roraima and Maranhão could double their production without need to expand the used water surface. In other words, for the water surface already available, investment in technical assistance associated with contribution of resources would lead producers to double their fish yield, increasing their productivity significantly - a crucial strategy to strengthen the sector, as shown below.

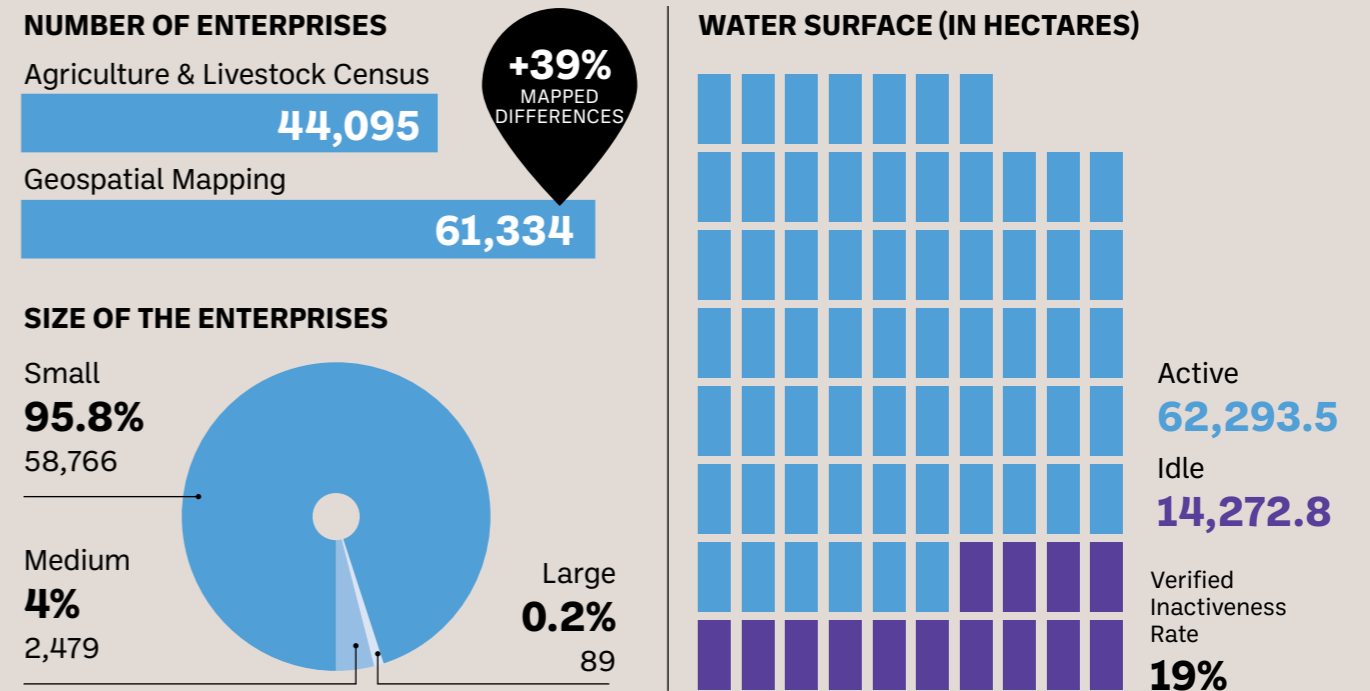
In the analysis broken down by state, a significant difference remains between the number of enterprises mapped as compared with data from the 2017 Agriculture & Livestock Census. This is noticed especially in Mato Grosso, Rondônia, and Tocantins. In those cases, the study assumes that the initiatives were not declared by the owners for not being regular, concerning environmental compliance, either due to lack of license or the grant of the right to use the water resources. Concerning the states of Amapá, Amazonas and Pará, which showed negative evolution, it is likely that the census included extensive fish farming enterprises¹¹, usual occurrence of pisciculture conducted in ponds (Table 01).

¹¹ Conama Resolution no 413/2009 defines extensive production systems as those where "cultivated specimens depend mainly on available natural food and coexist with a medium or low density of specimens". For additional information on the subject, refer to page 25.



Analyzing by state shows that the states of Mato Grosso, Pará, Rondônia, Roraima and Maranhão could double their production without need to expand the used water surface.

Pisciculture overview in the Legal Amazon based on geospatial mapping.



Source: Agriculture & Livestock Census 2017 by IBGE - Brazilian Institute of Geography and Statistics and data collected by the authors.

TABLE 01

Number of Fish Farming Enterprises in the Legal Amazon.

States	Agriculture & Livestock	Geospatial Mapping	Variation (%)
Acre	4,064	5,011	+ 23.3
Amapá	285	223	- 21.8
Amazonas	1,989	1,842	- 7.4
Maranhão	11,101	12,451	+ 12.2
Mato Grosso	6,662	10,168	+ 52.6
Pará	10,838	8,242	- 24
Rondônia	6,674	19,396	+ 190.6
Roraima	1,113	1,354	+ 21.7
Tocantins	1,369	2,647	+ 93.4
Total	44,095	61,334	+ 39.1

Source: Agriculture & Livestock Census 2017 by IBGE - Brazilian Institute of Geography and Statistics and data collected by the authors



I. Production, Productivity and Profitability

According to data from the Municipal Livestock Survey - PPM (*Pesquisa da Pecuária Municipal*), fresh-water fish farming is the Brazilian aquaculture's most developed segment. In 2022, it accounted for a total production of 617,300 tons of fish. The exotic tilapia fish species represented 66.1% of this total, followed by tambaqui (17.7%), and by the hybrids tambatinga/tambacu (7.3%). The second and third in the ranking are characterized as round fish and their production is mainly based on data from Rondônia, Mato Grosso, Maranhão, Roraima and Pará.

Strengthening fish farming with species native to Amazon requires expanding the consumer market, currently concentrated in the region's states, which are already saturated with fish (whether from fishing or fish farming). To expand the market requires increasing the production scale sufficiently to make it feasible to supply the industry and, through industrialization, reach the national market. However, this means making fish farming attractive and profitable, especially for small producers - who, as shown above, are the overwhelming majority.

Here it is in place to recall the history of Amazonian fish farming, which has already seen better times. Between 2010 and 2015, fish production in the region registered a significant increase, reaching 220,000 tons in 2017. Rondônia was placed first in the national ranking, with a production of 84,491 tons in 2015. During this period, the region adopted a growth strategy focused on the Amazonian market and the good reception of Amazonian species in their region of origin, especially tambaqui.

Some regional peculiarities, such as the fact that Amazonian consumers prefer to buy whole fish for being acquainted with bonefish handling, were not considered. In general, these products are bought at informal sale places, such as street markets and not in supermarkets. As a result, both the producers and other players in the chain were not prepared to invest in processed products - such as frozen fillets - which would cater to a larger share of the national market.

After saturation of the Amazonian market, from 2017 on the production dropped to 160,000 tons, having since that time fluctuated between 160 and 170 thousand tons, and while production of native fish to the region stagnates, national fish farming is growing yearly by 3% to 5%, impelled by tilapia production (see page 35): in 2022, Brazil produced 617.3 thousand tons of this species, according to the Municipal Livestock Survey - PPM, and 860.3 thousand tons, according to the Brazilian Pisciculture Association (PeixeBR) - with the state of Paraná as largest producer, with 150 thousand tons (according to PeixeBR) or 167 thousand tons (according to PPM).

Credits for fish farming in the Legal Amazon

According to data from the Brazilian Central Bank, of the total national credit operations for fish farming funding (USD 121.2 million),

28.4%

(or USD 34.4 million) were spent in the states of the Legal Amazon, with highlight for Rondônia, Roraima, and Mato Grosso.

In terms of investment operations, the Legal Amazon states had a share of

10.5%

(or USD 965 thousand) in relation to the national total (USD 9.2 million), with highlight for Roraima and Maranhão.

Rondônia still leads production in the North, but, depending on the source, Rondônia is placed fourth (PeixeBR) or second (PPM) in the national ranking. The table in the page 18 shows the difference between PPM and PeixeBR data for the states of the Legal Amazon. The percentages on the right show that PeixeBR figures tend to be higher than those by PPM, with differences reaching 79% in Maranhão and Pará and over 147% in Amazonas.

While the production has been subject to highs and lows, productivity was always a challenge, especially for small producers who invest in fish farming as a source of income and food security. Fish farmers in this segment often carry out other activities, such as agriculture or livestock farming, for lack of resources to invest in equipment and technical assistance¹².

Without proper guidance and structure, these producers are unable to correctly meet requirements that influence productivity directly, such as management of the water quality in earthen fishponds, the quantity of fish per hectare and the amount of feed. This same segment will find it more difficult to access credit programs, as access to these resources depends on the regularization of the enterprises in the Rural Environmental Registrar (*Cadastro Ambiental Rural* - CAR), environmental licensing and grant of rights to use water resources.

Another problem is the low genetic quality of the matrices used to produce fry. Despite advances in this field¹³, for a long time, there has been little research conducted to develop species used in fish farming or to avert crossings between individuals of the same lineage – which entails a progressive loss of productivity (up to 30%) and high fry mortality rates¹⁴.

Low productivity, in turn, aggravates the challenge of raising profitability, which varies from 3% for the pintado, 8% for tambaqui and 11% for matrinxã. In this situation, small and medium-sized producers find it difficult to prioritize fish farming, which partly explains the higher percentage of inactive ponds among these segments.

¹² Strategic Plan for fish farming in the state of Acre. Available [here](#) (only in Portuguese).

¹³ A step forward in this regard is the TambaPlus tool, a genomic test developed by Embrapa Recursos Genéticos e Biotecnologia in partnership with teams from Embrapa Pesca e Aquicultura and Embrapa Informática Agropecuária. This tool determines parameters for genetically differentiating hybrid fish from pure lineage fish species. Additional information [here](#).

¹⁴ PEDROZA FILHO, M. X. et al. - Tambaqui - Benefícios econômicos do TambaPlus parentesco – (Economic benefits from TambaPlus parentage). Comunicado técnico no 4. Tocantins: Embrapa, Dec. 2020.

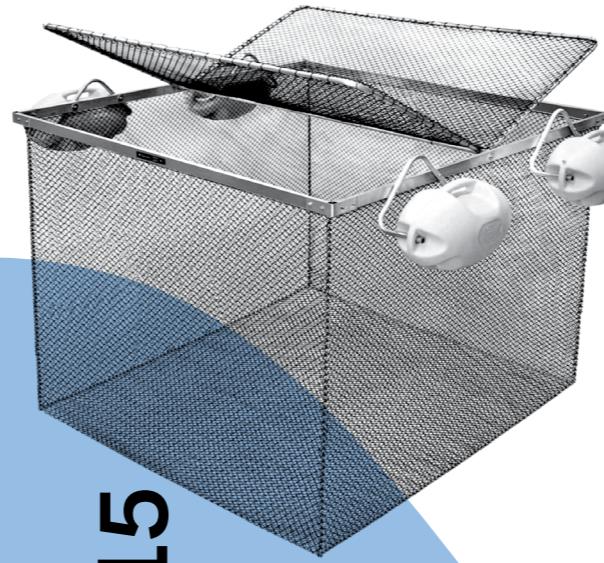
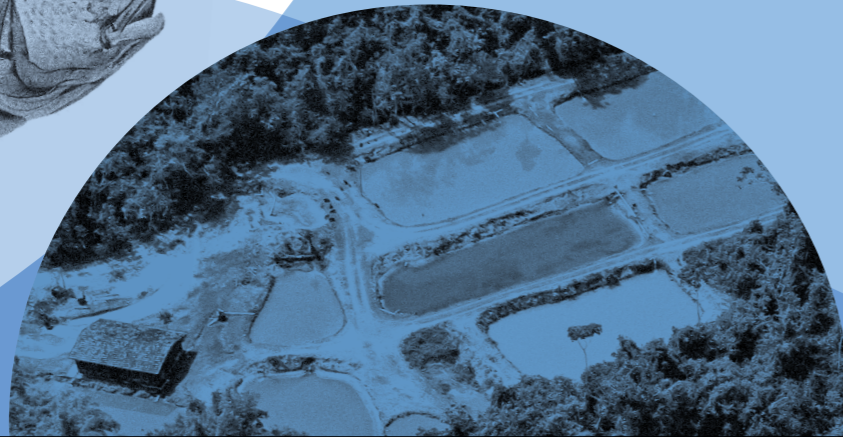
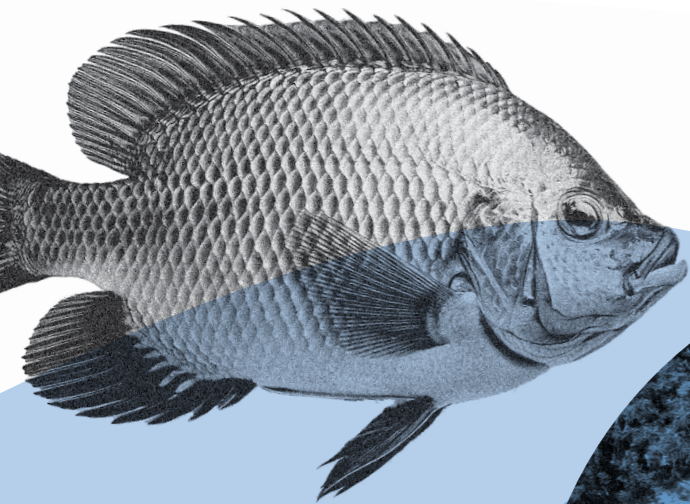
Fish farming production by Legal Amazon state, showing the variation in the data provided by IBGE and by PeixeBR.

State	Fish farming Production in 2022 (tons)		Variation (%)
	IBGE	PeixeBR	
Acre	2,572	3,860	+ 50.1
Amazonas	8,614.5	21,300	+ 147.3
Amapá	1,014.1	1,280	+ 26.2
Maranhão	28,085.5	50,300	+ 79.1
Mato Grosso	36,738.2	42,800	+ 16.5
Pará	14,035.1	25,120	+ 79
Rondônia	56,431.5	57,200	+ 1.4
Roraima	12,043.3	19,200	+ 59.4
Tocantins	11,450.1	17,350	+ 51.5
Total	170,914.3	238,410	+ 39.5

Source: PPM and PeixeBR.

Timeline

THE DEVELOPMENT OF FISH FARMING IN THE LEGAL AMAZON CAN BE DIVIDED INTO THREE PHASES:



1990-2015

HOWEVER, FROM THE 2000s ONWARDS, FISH FARMING IN PARÁ LOST MOMENTUM

due to legal restrictions on the cultivation of exotic species, such as tilapia, in open systems causing environmental impacts. As a result, tilapia cultivation declined and, as breeding and cultivation techniques developed, production turned to tambaqui and other Amazonian species.

This was a determining factor in Amazonian fish farming following a different path from national fish farming in terms of the species grown and the consumer market.

1970-1990

IN THE EARLY 1970s, FARMERS TOOK TILAPIA TO PARÁ, after visiting the aquaculture center of the National Department for Construction Works Against Droughts (Departamento Nacional de Obras contra as Secas - DNOCS) in Ceará. Initially, these farmers raised tilapia in earthen fishpond tanks on land as well as irrigation ponds, only for own consumption and recreation.

COMMERCIAL AQUACULTURE REALLY BEGAN TO DEVELOP IN THE FOLLOWING DECADE, when extension workers from the Institute for Technical Assistance and Rural Extension - Emater brought new varieties of tilapia to the state after training their cultivation at DNOCS.

BETWEEN THE 1970s AND THE EARLY 2000s, THE STATE OF PARÁ WAS AT THE FOREFRONT OF AMAZONIAN FISH FARMING, adopting technologies to develop production systems, disseminating new varieties of fish, and investing in training for producers.

IN THE 1990s, TILAPIA FARMING IN CAGES ESTABLISHED ITSELF AS PREFERRED AMONG PRODUCERS, overcoming the bad reputation of tilapia farming in earthen fishpond tanks. In 1995, production in the region reached 3,962 tons and in 2000, jumped to 17,314 tons.

2015-2024

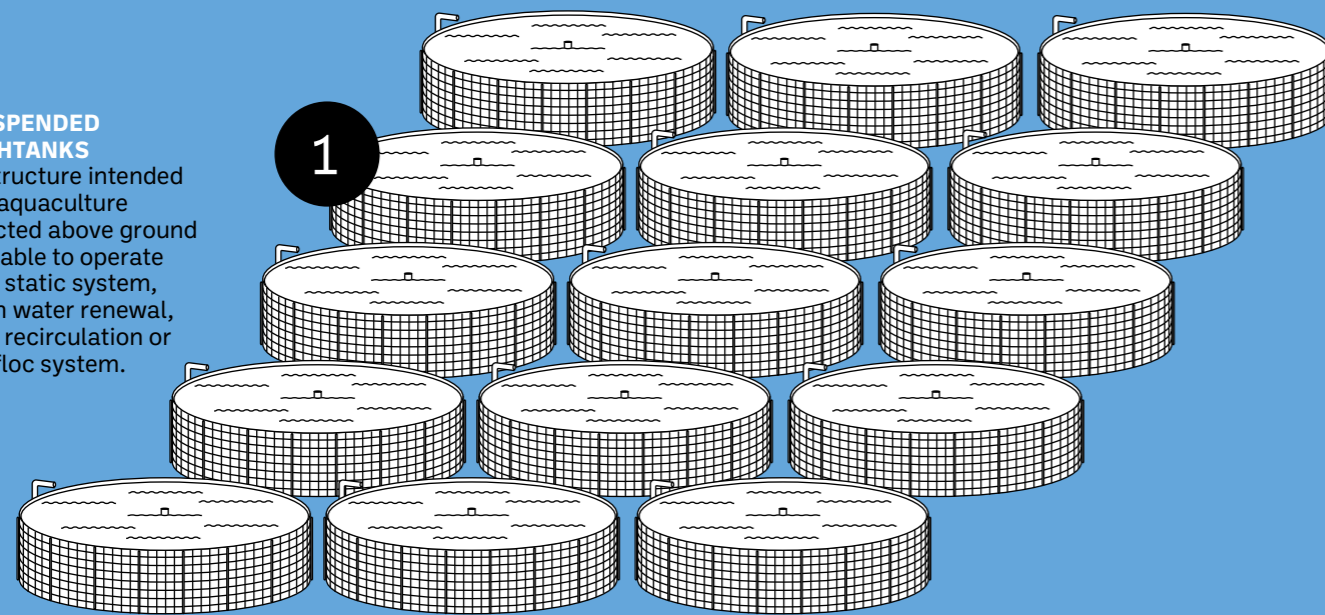
STARTING IN 2015, AMAZONIAN PRODUCTION OF NATIVE FISH HAS DROPPED and continues to fluctuate between 160,000 and 170,000 tons. The discontinuation of government projects and programs to support the activity are directly to for this situation.

MEANWHILE, NATIONAL FISH FARMING IS GROWING BY 3% TO 5% A YEAR, driven by the production of gift tilapia, a genetically improved variety introduced in Brazil in 2005. Currently, gift tilapia accounts for 60% of national production, and the outlook is for this percentage to reach 80% by 2030 (PeixeBR, 2024).

II. The pathways of the Legal Amazon fish

CULTIVATION STRUCTURES

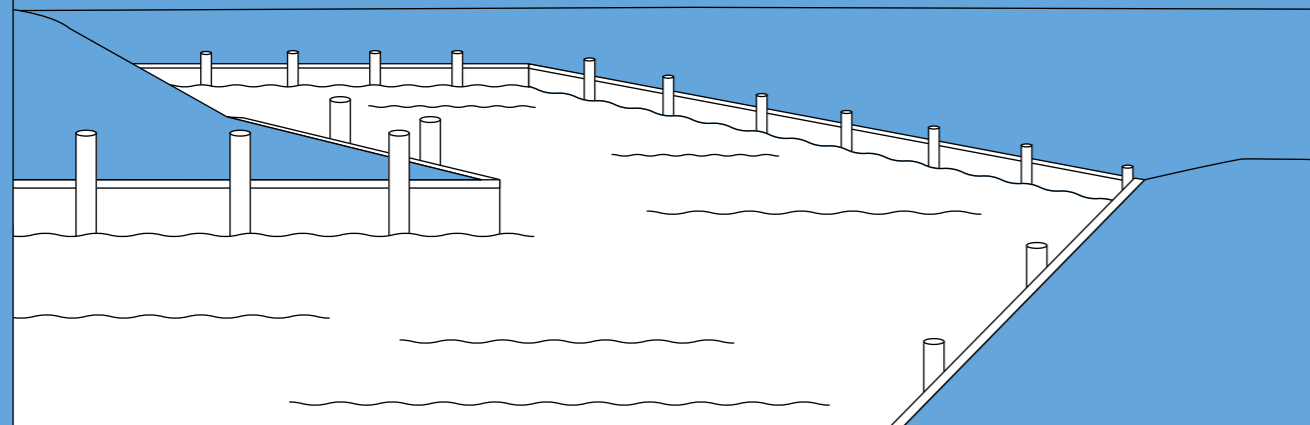
SUSPENDED FISHTANKS
A structure intended for aquaculture erected above ground capable to operate in a static system, with water renewal, in a recirculation or biofloc system.



1

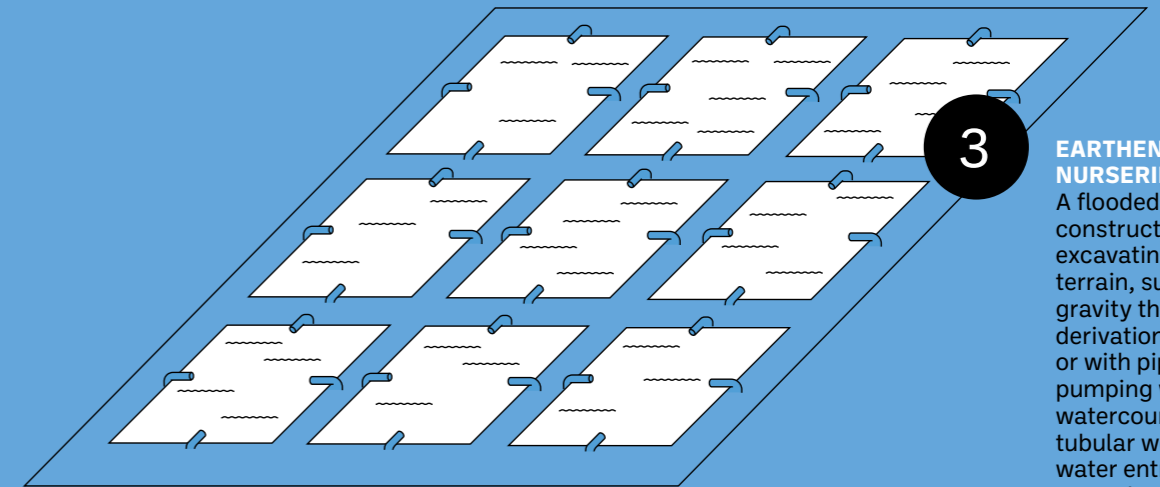
IGARAPÉ CHANNEL
Production of aquatic organisms in small watercourses, comprising modules, mounted in the bed of the waterbody itself with sufficient flow that ensures an ongoing water flow in the system. It is a genuinely Amazonian type of fish farming method.

2



The production chains of the so-called round fishes are the most relevant ones, with presence in all states of the Legal Amazon, especially tambaqui and the hybrids tambacu and tambatinga, with the entire production being absorbed by the regional market.

The following pages present an overview of native fish farming in the states of the Legal Amazon with indications of the movement and interaction of the pertinent fish farming production chain.

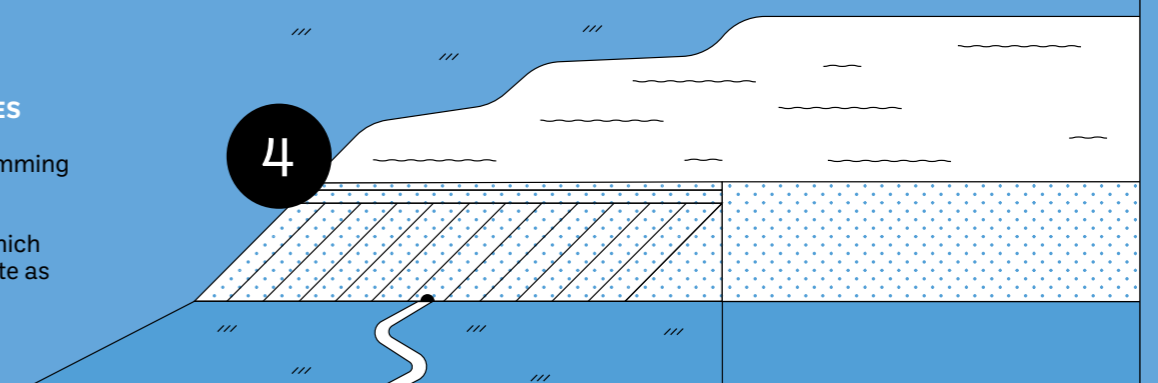


3

EARTHEN FISHPOND NURSERIES
A flooded area, constructed by excavating the natural terrain, supplied by gravity through open derivation channels, or with pipes to enable pumping water from a watercourse, reservoir or tubular well, fitted with a water entrance and exit control system

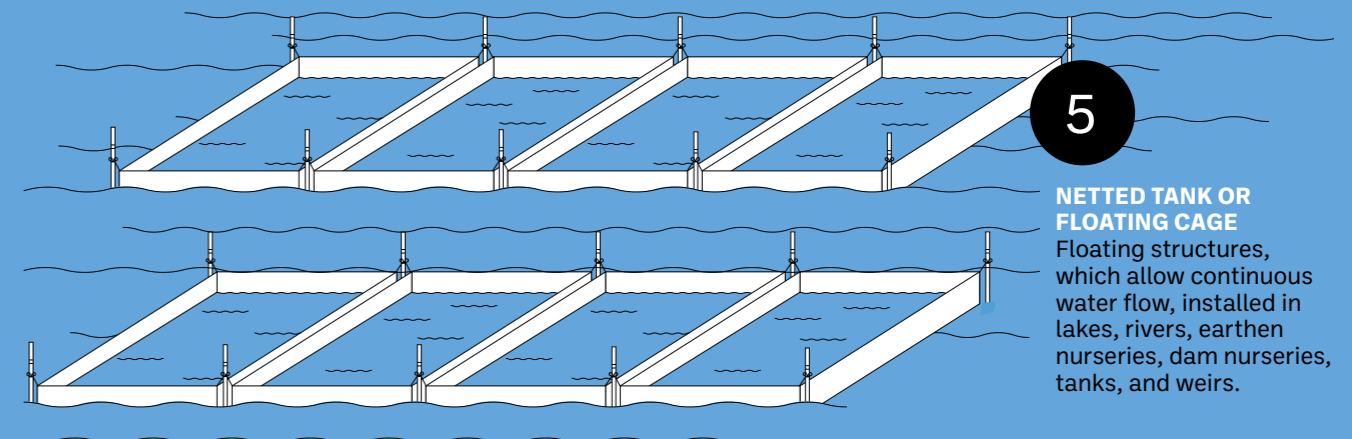
DAM NURSERIES
Flooded area, resulting by damming a watercourse intended for aquaculture, which may also operate as reservoir.

4

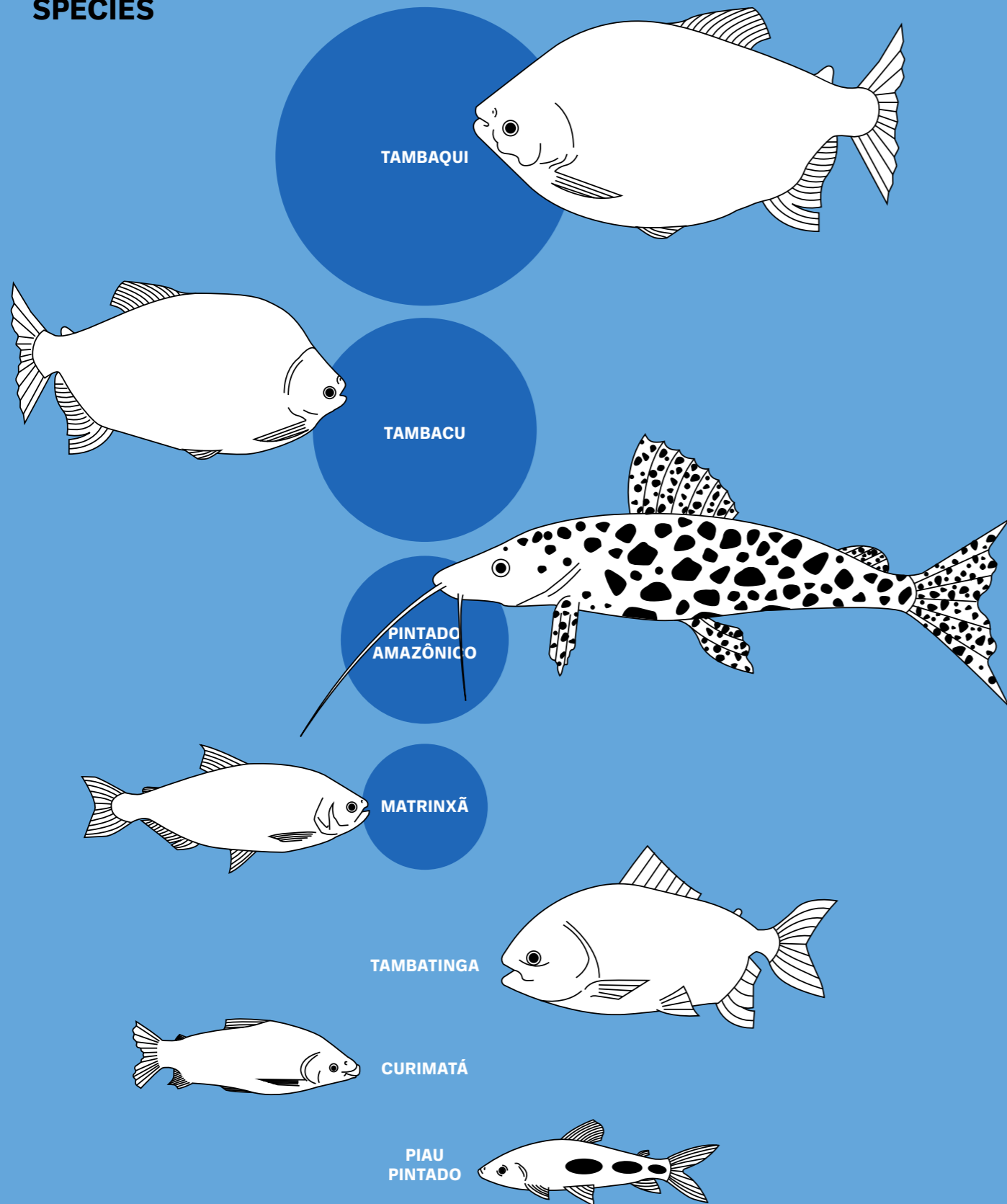


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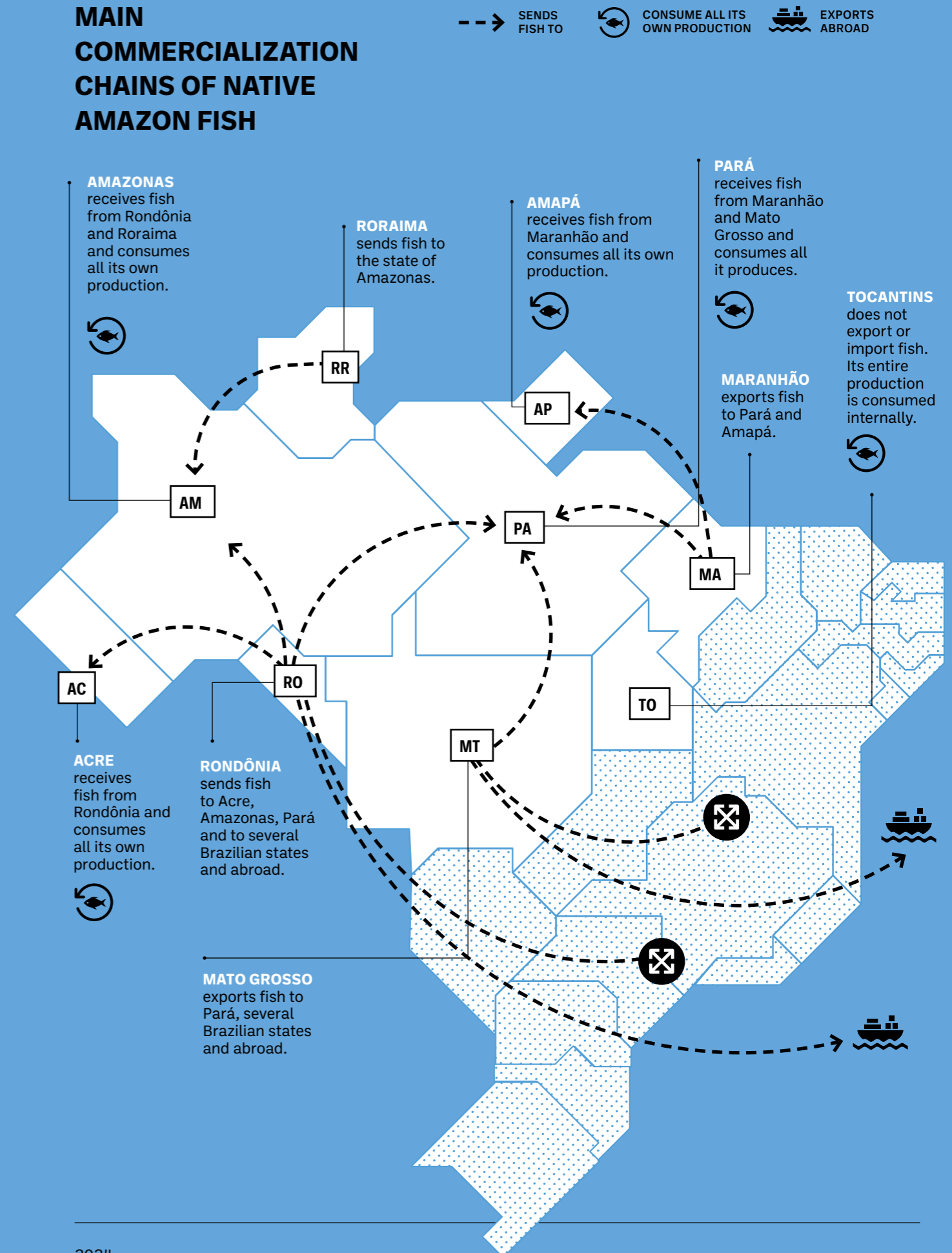
NETTED TANK OR FLOATING CAGE
Floating structures, which allow continuous water flow, installed in lakes, rivers, earthen nurseries, dam nurseries, tanks, and weirs.



MAIN CULTIVATED SPECIES



MAIN COMMERCIALIZATION CHAINS OF NATIVE AMAZON FISH



Production systems and strategies

In Amazonian fish farming, the semi-intensive production system predominates, with the animals depending mainly on processed food supply in an environment with medium or low density of specimens. However, there are also intensive systems, in which the animals depend entirely on the supply of processed food and live in environments with high density of specimens¹⁵.

Regarding production strategies, these can be divided into monoculture – with only one species being produced, or polyculture – when two or more species with different feeding habits and which generally occupy different spaces in the water column are produced simultaneously in the same breeding structure¹⁶.

In the states of the Legal Amazon, 48 fish processing establishments are registered in the Federal Inspection System (SIF)^{17,18}. Pará, Amazonas, Amapá and Mato Grosso comprise most establishments, with the first three processing raw fish from fisheries in their industrial parks, while fish farming is the main activity that provides processed fish in Mato Grosso.





¹⁵ Concepts defined in Conama Resolution no 413/2009.

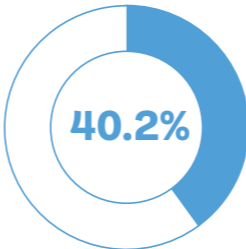
¹⁶ FARIA, R. H. S.; MORAIS, M. Manual de criação de peixes em viveiros. Brasília: Companhia de Desenvolvimento dos Vales São Francisco e do Parnaíba, 2019.

¹⁷ Federal Inspection Service, linked to the Department of Inspection of Animal Products – is the entity in charge to ensure the quality of products of animal origin both used as food or otherwise, aimed at the national or international markets.


¹⁸ Ministry of Agriculture, Livestock and Food Supply. Processing Establishments Report - SIGSIF. Available [here](#).

Acre

PRODUCT  Fresh Fish	MARKET  Local	MAIN DESTINATION  Municipality of Rio Branco	SALE MARKETS  Public Fairs, markets, and supermarkets
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TAMBAQUI REPRESENTED 40.2% OF THE PRODUCTION IN THE STATE OF ACRE, which has no fish processing establishments in operation registered at SIF. Almost all fresh fish production is marketed as whole fish.



IN PAST TIMES, ACRE WAS AN EXPORTER OF FISH TO PERU, but the current production does not even meet the domestic market demand.



Species/Hybrid	Production (tons)	Percentage (%)
Tambaqui	1,035.1	40.2
Pirapitinga	394.8	15.3
Curimatã	339.9	13.2
Piau	310.6	12.1
Matrinxã	190.8	7.4
Other Fish Types	300.8	11.8

MAIN SPECIES AND HYBRIDS produced by fish farming in the state of Acre in 2022.

TOTAL IN TONS
2,572

Source: Municipal Livestock Survey (PPM) – Brazilian Institute of Geography and Statistics (IBGE).

The semi-intensive production system is the most widely used in the state of Acre, with prevalence of earthen and dam fishponds as cultivation structures.

Species/Hybrid	Production System	Cultivation System	Production Strategy
Tambaqui	 Semi-intensive	 Dam Nurseries/ Earthen fishpond nurseries	Monoculture
Pirapitinga			
Piau			
Matrinxã	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Polyculture
Curimatã			

Source: Research data by the authors.

IN THE STATES OF THE LEGAL AMAZON, THERE ARE

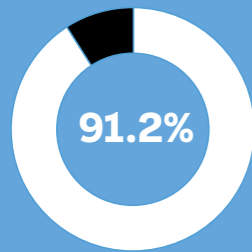
48

processing establishments are registered in SIF

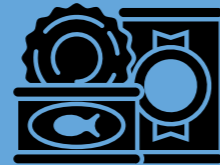


Amapá

PRODUCT Fresh Fish **MARKET** Local **MAIN DESTINATION** Macapá Metropolitan Area **SALE MARKETS** Public Fairs, markets, and supermarkets



ROUND FISH ACCOUNTED FOR 91.2% OF THE TOTAL FISH PRODUCTION IN 2022, mainly tambaqui and the hybrid tambatinga. The state has the lowest production in the region, but its fish consumption is significant in regional context.



Despite the presence of some fish processing establishments, **THERE ARE NO INITIATIVES FOR PRODUCT TRANSFORMATION FROM PISCICULTURE**, entailed by the small production that is unable to meet industrial scale.

MAIN SPECIES AND HYBRIDS produced by fish farming in the state of Amapá in 2022.

Species/Hybrid	Production (tons)	Percentage (%)
Tambaqui	601.4	59.3
Tambacu, Tambatinga	197.4	19.5
Pirapitinga	125.8	12.4
Tilápia	82.1	8.1
Pirarucu	7.4	0.7

TOTAL IN TONS
1,014.1

Source: Municipal Livestock Survey (PPM) – Brazilian Institute of Geography and Statistics (IBGE).

The semi-intensive breeding system prevails among fish farmers in Amapá, with earthen fishponds being the most common cultivation structures. There are few intensive system initiatives, but those that exist use netted tanks and, more recently, suspended fish tanks.

MAIN PRODUCTION SYSTEMS AND CULTIVATION STRUCTURES used by relevant species or hybrids for fish farming in the state of Amapá.

Species/Hybrid	Production System	Cultivation System	Production Strategy
Tambaqui			
Tambacu			 Monoculture
Tambatinga	Semi-intensive	Earthen fishpond nurseries	
Pirapitinga			
Tilápia			
Pirarucu			

Source: Research data by the authors.

Amazonas

PRODUCT Fresh Fish **MARKET** Local **MAIN DESTINATION** Manaus Metropolitan Area **SALE MARKETS** Public Fairs, markets, and supermarkets

TAMBAQUI AND MATRINXÃ ACCOUNT FOR ALMOST THE ENTIRE STATE'S FISH PRODUCTION, which even so still needs to import fish to meet the high demand. While the yearly average per capita fish consumption in Brazil is 9 kg¹⁹, in Manaus, it reaches 33 kg and tops 40 kg in capital cities of other municipalities. In the state's riverside communities, the yearly per capita fish consumption can reach 180 kg, according to an estimate by the Amazonas State Institute for Sustainable Agricultural and Forestry Development (IDAM)²⁰.

YEARLY PER CAPITA FISH CONSUMPTION

- 33 kg Manaus
- 9 kg Brazilian average

180 kg Amazonas riverside communities

¹⁹ Ministry of Fisheries and Aquaculture. Available [here](#).

²⁰ Jaraqui is the most popular fish consumed in the state of Amazonas, according to surveys by G1. Available [here](#). Accessed: July 3rd, 2024.

MAIN SPECIES AND HYBRIDS produced by fish farming in the state of Amazonas in 2022.

Species/Hybrid	Production (tons)	Percentage (%)
Tambaqui	6,210.1	72.1
Matrinxã	2,048.4	23.8
Pirarucu	319.7	3.7
Tucunaré	15	0.2
Pirapitinga	12.8	0.1
Other Fish Types	10.7	0.1

TOTAL IN TONS
8,616.7

Source: Municipal Livestock Survey (PPM) – Brazilian Institute of Geography and Statistics (IBGE).

The predominant production mode is using a semi-intensive system, but the state has the particularity of raising matrinxã in igarapé channels, a genuinely Amazonian form of fish farming characterized as intensive and provided for in the state legislation.

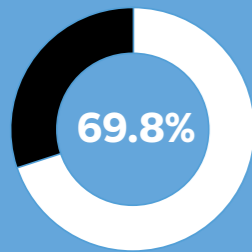
MAIN PRODUCTION SYSTEMS AND CULTIVATION STRUCTURES used by relevant species or hybrids for fish farming in the state of Amazonas.

Species/Hybrid	Production System	Cultivation System	Production Strategy
Tambaqui			 Monoculture
Pirarucu	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	
Tucunaré			
Pirapitinga			
Matrinxã	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	
	Intensive	Igarapé channels	

Source: Research data by the authors.

Maranhão

PRODUCT	MARKET	MAIN DESTINATION	SALE MARKETS
Fresh Fish	Local/ Pará/ Amapá	Metropolitan Area of São Luís, Belém, Macapá and Baixada Maranhense. Municipalities of Tucuruí, Marabá and the region	Public Fairs, markets, and supermarkets



TAMBAQUI AND THE HYBRID TAMBATINGA ACCOUNT FOR THE LARGEST share of fish production, with 69.8% of the state's total.



THE STATE DOES NOT HAVE ANY FISH PROCESSING ESTABLISHMENTS with a SIF seal of approval, despite having sufficient scale and competitive prices. As a result, fish products are sold mainly in the form of whole fresh fish.

MAIN SPECIES AND HYBRIDS produced by fish farming in the state of Maranhão in 2022.

Species/Hybrid	Production (tons)	Percentage (%)
Tambaqui	10,945.6	39
Tambatinga	8,651.9	30,8
Tilápia	2,928	10,4
Curimatã	2,198.4	7,8
Pacu	1,684.3	6
Other Fish Types	1,677.3	6

TOTAL IN TONS
28,085.5

Source: Municipal Livestock Survey (PPM) – Brazilian Institute of Geography and Statistics (IBGE).

The local production concept is the semi-intensive system, generally in earthen fishpond or dam ponds. The curimatã is the only species among the most produced fish that mainly proceed from initiatives that adopt polyculture in their breeding structures, mostly with tambaqui, tambatinga or tilapia.

MAIN PRODUCTION SYSTEMS AND CULTIVATION STRUCTURES used by relevant species or hybrids for fish farming in the state of Maranhão.

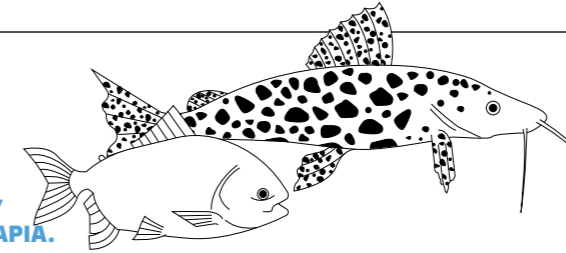
Species/Hybrid	Production System	Cultivation System	Production Strategy
Tambaqui			Monoculture
Tambatinga			
Tilápia	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Polyculture
Pacu			
Curimatã			

Source: Research data by the authors.

Mato Grosso

PRODUCT	MARKET	MAIN DESTINATION	SALE MARKETS
Fresh Fish/ Frozen	Local/ Pará/ Several Brazilian States/ Export	Metropolitan Area of the Cuiabá Valley River, Altamira & Region. Municipality of Santarém & Region	Public Fairs, markets, and supermarkets

THE HYBRIDS TAMBATINGA AND AMAZONIAN PINTADO ARE THE MOST PRODUCED FISH, FOLLOWED BY TAMBAQUI AND TILÁPIA.



THE SEMI-INTENSIVE SYSTEM ²¹, EMPLOYING EARTHEN FISHPONDS AND/OR DAM NURSERIES, prevails in the production of tambatinga, pintado amazônico, tambaqui and piau, while tilapia is cultivated in the intensive system, mainly in cages installed in waters under of the Federal Union.

²¹ A production system in which cultivated specimens depend mainly on the supply of artificial food, but with the possibility of supplementing them with available natural food. Its characteristic is the medium or low specimen density, depending on the species cultivated.

MAIN SPECIES AND HYBRIDS produced by fish farming in the state of Mato Grosso in 2022.

Species/Hybrid	Production (tons)	Percentage (%)
Tambatinga	24,838.2	67.6
Pintado amazônico	5,322.7	14.5
Tambaqui	3,185.5	8.7
Tilápia	1,969	5.4
Piau	394.9	1.1
Other Fish Types	1,027.9	2.7

TOTAL IN TONS
36,738.2

Source: Municipal Livestock Survey (PPM) – Brazilian Institute of Geography and Statistics (IBGE).

There are fish industrialization initiatives in the state of Mato Grosso, dedicated to processing of fish farming products – a different scenario from that observed in Amapá and Amazonas, whose industrial parks focus on fishing production.

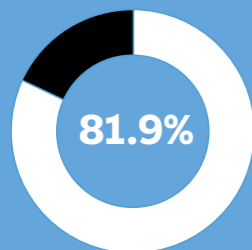
MAIN PRODUCTION SYSTEMS AND CULTIVATION STRUCTURES used by relevant species or hybrids for fish farming in the state of Mato Grosso.

Species/Hybrid	Production System	Cultivation System	Production Strategy
Tambatinga	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Monoculture
Pintado			
Tambaqui			
Piau			
Tilápia	Intensive	Netted Tanks	

Source: Research data by the authors.

Pará

PRODUCT	MARKET	MAIN DESTINATION	SALE MARKETS
Fresh Fish	Local	Metropolitan Area of Belém	Public Fairs, markets, and supermarkets



THE TAMBAQUI AND ITS HYBRIDS TAMBACU AND TAMBATINGA COMPRISE 81.9% OF THE TOTAL PRODUCTION. The semi-intensive cultivation in earthen fishponds or dam nurseries prevails, but netted tanks have been used for tambaqui, matrinxã and tilapia.

The industrial park aimed at fresh fish processing is unable to meet the fish farming production, since the prices practiced by processing units and the reduced production scale hinder industrialization of this market segment. **BESIDES, THE STATE IS NOT SELF-SUFFICIENT FOR PRODUCTION OF BASIC INPUTS FOR FISH FARMING, AS FINGERLINGS AND INDUSTRIAL RATIONS.**

MAIN SPECIES AND HYBRIDS produced by fish farming in the state of Pará in 2022.

Species/Hybrid	Production (tons)	Percentage (%)
Tambaqui	8,003.6	57
Tambacu, tambatinga	3,492.9	24.9
Tilápia	845.8	6
Matrinxã	408.4	2.9
Pirapitinga	342	2.4
Other Fish Types	942.4	6.8

TOTAL IN TONS
14,035.1

Source: Municipal Livestock Survey (PPM) – Brazilian Institute of Geography and Statistics (IBGE).

In the last five years, the production of tilapia in suspended tanks increased significantly in a growing number of initiatives, thanks to the popularization of the technology and the existent consumer market for the species.

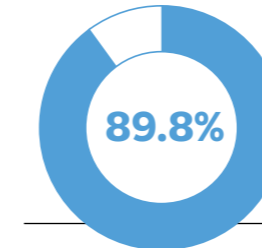
MAIN PRODUCTION SYSTEMS AND CULTIVATION STRUCTURES used by relevant species or hybrids for fish farming in the state of Pará.

Species/Hybrid	Production System	Cultivation System	Production Strategy
Tambaqui	Semi-intensive/Intensive	Earthen fishpond nurseries/ Dam Nurseries/ Netted Tanks	Monoculture
Tambacu, tambatinga	Semi-intensive	Earthen fishpond nurseries/Dam Nurseries	
Tilápia	Semi-intensive/Intensive	Earthen fishpond nurseries/Dam Nurseries/ Netted Tanks/ Tanques suspensos	
Matrinxã	Semi-intensive/Intensive	Earthen fishpond nurseries/ Dam Nurseries/ Netted Tanks	
Pirapitinga	Semi-intensive	Earthen fishpond nurseries/Dam Nurseries	

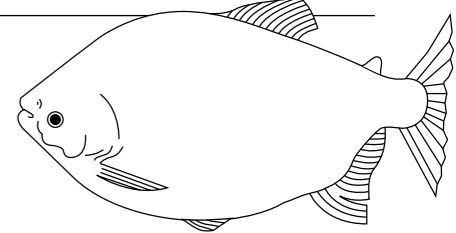
Source: Research data by the authors.

Rondônia

PRODUCT	MARKET	MAIN DESTINATION	SALE MARKETS
Fresh Fish	Local/Acre	Porto Velho & Belém Metropolitan Area/ Municipalities of Ariquemes, Rio Branco, Manaus, Altamira, Santarém & Region	Public Fairs, markets, and supermarkets



THE STATE IS CURRENTLY THE LARGEST FISH PRODUCER IN THE LEGAL AMAZON, WITH TAMBAQUI AT THE FOREFRONT, ACCOUNTING FOR 89.8% OF THE TOTAL PRODUCTION. Most pisciculture initiatives adopt the semi-intensive system of earthen fishpond nurseries and dams, generally in the monoculture mode.



MAIN SPECIES AND HYBRIDS produced by fish farming in the state of Rondônia in 2022.

Species/Hybrid	Production (tons)	Percentage (%)
Tambaqui	50,671.4	89.8
Pintado	2,781.4	4.9
Pirarucu	1,164.3	2.1
Tambacu, tambatinga	1,144.5	2
Pacu	199.8	0.4
Other Fish Types	470.1	0.8

TOTAL IN TONS
56,431.5

Source: Municipal Livestock Survey (PPM) – Brazilian Institute of Geography and Statistics (IBGE).

PRODUCTION OF AMAZON FISH IN RONDONIA



IN 2010, THE GOVERNMENT OF RONDONIA BEGAN TO INVEST IN THE CULTIVATION OF NATIVE FISH SPECIES. Actions such as loan credit programs for machinery to build earthen fishpond tanks, provision of technical courses and business roundtables between producers and cold-storage plant owners have seen the state's production jump from 10,000 tons in 2010 to 84,000 tons in 2015.

This emphasizes the role of the state in the development of fish farming and reaches far beyond the regulatory framework. It is no coincidence that the slump of fish production in Rondônia that began in 2016, is linked to the discontinuation of the local fish farming support program.

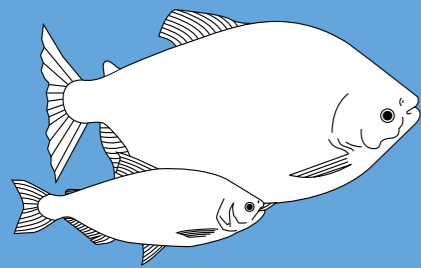
MAIN PRODUCTION SYSTEMS AND CULTIVATION STRUCTURES used by relevant species or hybrids for fish farming in the state of Rondônia.

Species/Hybrid	Production System	Cultivation System	Production Strategy
Tambaqui	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Monoculture
Pintado			
Pirarucu			
Tambacu, tambatinga			
Pacu			

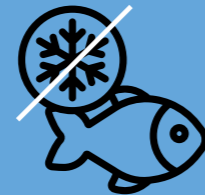
Source: Research data by the authors.

Roraima

PRODUCT	MARKET	MAIN DESTINATION	SALE MARKETS
Fresh Fish	Local/ Amazonas	Metropolitan Area of Boa Vista & Manaus	Public Fairs, markets, and supermarkets



RORAIMA ONLY PRODUCES TAMBAQUI AND MATRINXÃ, WITH THE FORMER PREVAILING.



THE STATE HAS NO FISH PROCESSING ESTABLISHMENTS WITH THE SIF APPROVAL SEAL.

MAIN SPECIES produced by fish farming in the state of Roraima in 2022.

Species	Production (tons)	Percentage (%)
Tambaqui	11,628	96.5
Matrinxã	415.3	3.5

TOTAL IN TONS
12,043.3

Source: Municipal Livestock Survey (PPM) – Brazilian Institute of Geography and Statistics (IBGE).

Large-scale enterprises that adopt dam nurseries as cultivation mode is a particularity of the state, adopted due to the extensive water surfaces available.

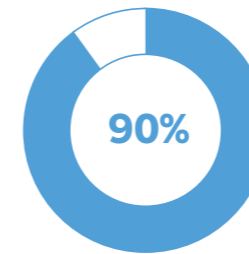
MAIN PRODUCTION SYSTEMS AND CULTIVATION STRUCTURES used by relevant species for fish farming in the state of Roraima.

Species	Production System	Cultivation System	Production Strategy
Tambaqui	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Monoculture
Matrinxã	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Monoculture

Source: Research data by the authors.

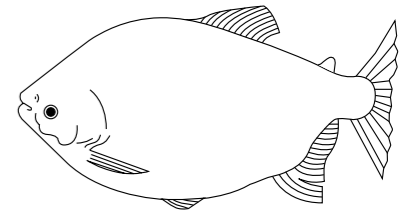
Tocantins

PRODUCT	MARKET	MAIN DESTINATION	SALE MARKETS
Fresh Fish	Local	Metropolitan Area of Palmas	Public Fairs, markets, and supermarkets



TAMBAQUI AND THE HYBRIDS TAMBACU, TAMBATINGA AND PINTADO REPRESENT 90% OF THE STATE'S PRODUCTION.

TAMBAQUI ACCOUNTS FOR MORE THAN HALF OF THE VOLUME PRODUCED. Despite having two fish processing initiatives with the SIF approval seal, there is wide predominance of whole fresh fishes from fish farming.



MAIN SPECIES AND HYBRIDS produced by fish farming in the state of Tocantins in 2022.

Species/Hybrid	Production (tons)	Percentage (%)
Tambaqui	6,035.5	52.7
Tambacu, tambatinga	2,818.5	24.6
Pintado	1,295.9	11.3
Matrinxã	301.1	2.6
Piau	281.8	2.5
Other Fish Types	717.3	6.3

TOTAL IN TONS
11,450.1

Source: Municipal Livestock Survey (PPM) – Brazilian Institute of Geography and Statistics (IBGE).

Recently, the state's regulatory framework authorized the use of tilapia, including in netted tanks, in the hope of attracting investors to the sector.

MAIN PRODUCTION SYSTEMS AND CULTIVATION STRUCTURES used by relevant species or hybrids for fish farming in the state of Tocantins.

Species/Hybrid	Production System	Cultivation System	Production Strategy
Tambaqui	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Monoculture
Tambacu, tambatinga	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Monoculture
Pintado	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Monoculture
Matrinxã	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Monoculture
Piau	Semi-intensive	Dam Nurseries/ Earthen fishpond nurseries	Monoculture

Source: Research data by the authors.



AND WHAT ABOUT TILAPIA?

Native to Africa, the tilapia – the generic name of more than one species of cichlid fish – was introduced in Brazilian fish farming in the 1970s. Since then, it has dominated the domestic market, accounting for 60% of production with an annual growth rate of 5%. Abroad, the situation is similar, with export demand growing yearly between 10% to 15%.

Such good figures do not come by chance. Tilapia production in the country represents a continuous innovation and development process, ranging from the production of rations to the use of leftovers by the industry, including attractive prices and a wide variety of products, such as fresh and frozen fish fillets, as well as smoked and salted fish.

All this makes tilapia attractive to the 1,116 producers of the species registered in the Amazon region, according to the latest Agricultural Census. However, so many economic advantages come at a cost. There are environmental problems linked to the tilapia cultivation²² and arguments for and against the species as an inducer of local development.

In any case, the advance of tilapia cultivation shows that everything missing in the native fish farming chain to achieve the same success, is present in the tilapia fish farming activity.

²² Arguments against tilapia and real examples of the danger the species represents for the Brazilian biodiversity can be found [here](#), [here](#), and [here](#). Accessed on June 11, 2024

Power Outage: The Invisible Enemy

Between the ongoing expansion of tilapia cultivation and the stagnation of native fish farming, there is a fundamental element, but with little visibility: the availability of electricity.

In the study *'From Trash to Treasure: Biogas in Amazonas State's Bioeconomy Agenda'*²³, elaborated by Instituto Escolhas, experts have already drawn attention to the fact that the aeration of the tanks and fish processing and cooling operations – crucial to conquer new markets for native Amazonian fish – require a permanent supply of electricity.

Unstable electricity supply is still a barrier to the socioeconomic development of the North of Brazil and to the full establishment of bioeconomy production chains. For this aim, the study brings solutions such as the use of fish waste to generate biogas and, thus, combine sources of electrical and thermal energy to ensure access to refrigeration by the fishing and fish farming markets in the region.

The study *'Biogas: clean energy for the Amazon'*²⁴, also elaborated by Instituto Escolhas, showed that fish farming rejects could be used to produce up to 6.1 million cubic meters of biogas per year in all states of the Legal Amazon, generating 13 GWh of clean electricity for fish processing use.

Together, municipal solid waste, fish farming and manioc waste would have the yearly potential to produce 537 million cubic meters of biogas, generating 1.1 TWh of electric energy – sufficient to supply 556.000 homes benefitting 2.2 million people throughout Amazon.

²³ Download the study [here](#).

²⁴ Download the study [here](#).

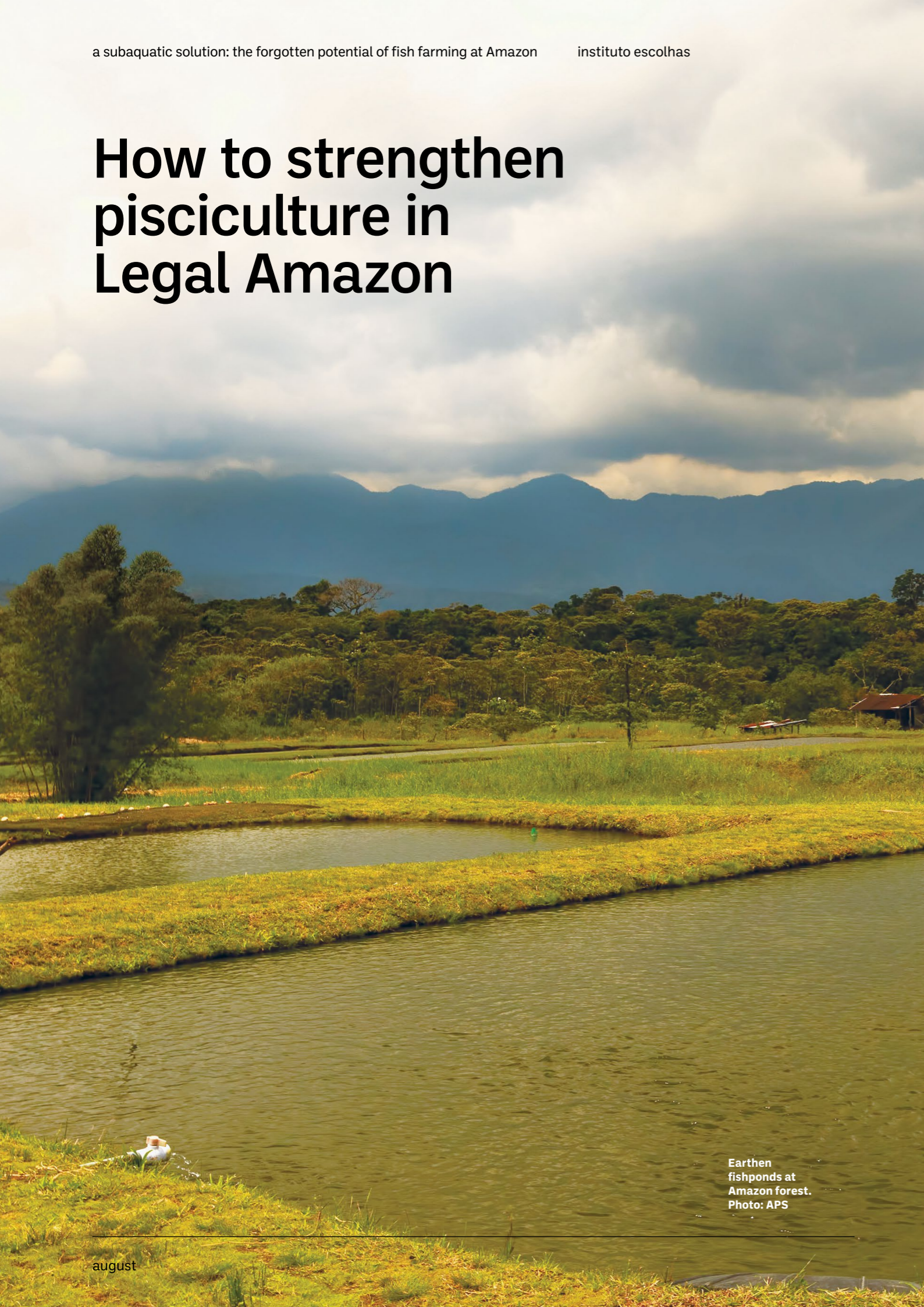
FISH FARMING REJECTS COULD BE USED TO PRODUCE UP TO

6.1 million

cubic meters of biogas per year in all states of the Legal Amazon.



How to strengthen pisciculture in Legal Amazon



Earthen fishponds at Amazon forest.
Photo: APS

As shown so far, Amazonian fish farming is viable, but needs to tap new markets to remain regionally relevant and reach competitiveness on the national stage. Ideally, this should happen over the next ten years for fish farming to become one of the mainstays of the Amazonian bioeconomy. According to projections of the study conducted, at the end of this ten-year period, the market conditions that promoted the expand of fish farming and to maintain its growth rates in the region will reach a production ceiling, after which the sector will begin to shrink.

Simulations by the study show that without large-scale strategic intervention Amazonian fish farming will continue stagnant, shrinking from 172,000 tons to 180,000 tons in 2034 (a mere growth of only 4.6% in a decade). Roraima and Mato Grosso would register the highest growth rates - 23% and 28%, respectively - as a reflection of the investments made in the sector (see highlight regarding credit on [page 16](#)).

To transform this scenario, the first step is to train small and medium-sized producers who comprise most fish farmers in the Legal Amazon. This makes technical assistance essential for growth resumption in the sector²⁵.

An example is the Technical and Management Assistance (ATEG), of the National Confederation of Agriculture and Livestock (CNA), which guides fish farmers with a five-stage program: 1) individualized production diagnosis; 2) strategic planning 3) technological adaptation; 4) complementary professional training; and 5) systemic evaluation of results.

²⁵ Additional information regarding technical assistance can be found in the study "Technical assistance for the bioeconomy in Amazon: from challenges to solutions," which analyzed five production chains in the Region, including for the pirarucu fish. Available [here](#).

Simulations show that in a decade Amazonian fish farming will grow only

4.6%



Tambaqui sale at street market in Manaus. Photo: Imago Photo

²⁶ A new economy for the Amazonas state: Manaus Free Trade Zone and Bioeconomy. Access [here](#).

This strategy must be associated to the dissemination of consistent and constantly improving technical production packages (fry, feed, life cycle management).

Once production challenges to raise it are overcome, marketing will also need to be expanded. And to gain the national market, Amazonian fish need to be available to the end consumer in different versions, with different cuts and processing formats (frozen, breaded, smoked, etc.).

It is worth noting that all this effort will only succeed if there are marketing strategies in place, given that tambaqui and other Amazonian native fishes are not well known by consumers in large urban centers outside Amazon.

Instituto Escolhas had already emphasized the relevance of this dissemination front for Amazonian fishes in a previous study²⁶, in which the organization suggests the creation of the brand “Fish from Amazon” and the performance of national culinary festivals with Amazonian fish and ingredients.

The above-mentioned actions - as well as the creation of a consistent database on fish farming and the solution of bottlenecks related to the supply of electricity in the Amazon region - converge on a common element: public management. Without the action of the federal and state governments, the sector will wane until it loses all relevance.

In short, only with the adoption of immediate and large-scale strategies, led by the federal and state governments, will Brazil benefit from the strength of a production chain capable of fostering biodiversity, contributing to the food security of Amazonian populations and opening space for the recovery of the forest - a unique opportunity the country is letting slip through its hands like a fish.

Study conducted by Instituto Escolhas.

Access full version of technical report [here](#) (available only in Portuguese).

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<https://escolhas.org/en/publicacoes/studies/>

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