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Implementation of a Pirarucu Breeding System: A Cost and Feasibility Analysis.

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Abstract
This article aims to identify the return expectations and perceived risks in the implementation of a system for rearing and fattening Pirarucu fish in the city of Canoinhas, in the northern plateau of Santa Catarina. This is an applied research in terms of its nature, descriptive and quantitative in terms of objectives, bibliographical and documentary in terms of the technical procedures for data collection. As for the approach, the research is framed as qualitative, in addition to being longitudinal, since the same aspects are studied in a certain period of time. For that, this work considers all the investments and inputs necessary for the creation of the fish, from the acquisition of land, preparation and documentation of the same, acquisition of shed and tanks for creation, contracting of consultancy on the handling of the animals until the creation itself, passing through food, water care, as well as the sale price of the animals. Based on this information , indicators of profitability and perception of risks inherent to the implementation of this business unit with the capacity to raise 1000 fish per year are estimated. Data were collected through documentary and bibliographic research. According to the data collected, the cash flow was projected for a period of five years, from a TMA3.89 aa due to inflation . The Multi-Index Methodology was used to generate and analyze the return indicators vis-à-vis the perceived risks. From the results found, the Monte Carlo simulation was used, through the Crystal Ball software, which show the average NPV of Pirarucus production around R$ 90,659.00, and the ROIA at 5.40%. The results of a 5-year cycle of arapaima breeding show that, if well planned, breeding can yield significant profits. The work also shows that the cultivation of Pirarucu fish can be very profitable, especially from the third year of cultivation, since there would be no costs with land, tanks and sheds, combined with the high acceptance of its meat by consumers and even the sale of animal hides, increasing even more the profit.
***Keywords**: Cultivation, Arapaima, Costs. Returns and Risks .*
***Thematic Area:** Costs as a tool for planning, control and decision support*

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I. Introduction

Fish is a food rich in proteins of high biological value and minerals, such as calcium, zinc, magnesium and iron, in addition to some species being a source of good fat, such as omega 3. Fish is a highly nutritious food and brings advantage of quick preparation, in a few minutes, bringing practicality to the daily lives of families.

In 2018, 179 million tons of fish were produced in the world, with an estimated value of US$ 401 billion. Among the fish-producing countries, China stands out and leads the ranking, accounting for 35% of total production. This amount exceeds the total production of Asia with 34%, the Americas with 14%, Europe with 10%, Africa with 7% and Oceania with 1% (Embrapa 2020).

Brazil was once considered the country with the greatest potential for the development of fisheries and aquaculture. Today, it ranks only 13th in captive fish production, and 8th in freshwater fish production.

According to the Brazilian Fish Farming Association (Peixe BR), Brazil produced 722,560 tons of farmed fish in 2018, up 4.5% from the 691,700 tons of the previous year.

's freshwater fish are many, there are about 25,000 species , with a wide variety of forms and habitats . All have very different characteristics from each other. Mainly, in terms of behavior, which can be the most varied.

The 2017 Agricultural Census, by the IBGE, showed the strength of aquaculture in Brazil. The activity is present throughout the national territory, in a strong and consolidated way. Also significant is the number of establishments that invest in fish, shrimp and crustacean farming in general. In total, there are 455,541 breeding units across the country. Due to the profile of small rural properties, the South region leads with 273,015 establishments (60%), followed by: Southeast (57,074), Northeast (48,881), North (48,286) and Midwest (28,285).

According to Embrapa (2017), the most common species produced in the country, by region, are: I) tambaqui, pirarucu and pirapitinga in the North region; II) tilapia and marine shrimp in the Northeast; III) tambaqui, pacu and painted in the Midwest; IV) tilapia , pacu and painted in the Southeast; and V) carp, tilapia , silver catfish, oyster and mussel in the South region.

Among the species of commercial interest that are currently being used in fish farming, the pirarucu, *Arapaima gigas* , endemic to the Amazon Basin with great potential due to its peculiar zootechnical characteristics such as: excellent quality of the meat without thorns, great acceptance by the population, rusticity for management, adaptation to aerial respiration and high growth rate, which can reach approximately 10 kilos in the first year of creation (Bard & Imbiriba , 1986).

According to the IBGE, in 2018, Brazil produced almost 2 thousand tons of pirarucu in captivity. The largest producer in the North Region is Rondônia, with 1,000 tons in 2018; followed by Tocantins, with 213 ton ; and Pará, with 206 tons. The data are from the Municipal Livestock Production (PPM/IBGE, 2019).

It is in this context that this work intends to study the feasibility of implementing the Pirarucu fish culture in the city of Canoinhas, in Santa Catarina, as a way of diversifying fish farming in the region and contributing to its development.

II. Theoretical Foundation

For the theoretical foundation of this work, bibliographic research was necessary as a way of gathering information about the characteristics of Pirarucu fish farming, its habitat, its food, its reproduction as well as some main characteristics of the fish, in addition to a cost and risk survey, as well as , of the return of the Pirarucu culture to potential producers.

2.1 FISH CULTURE CHARACTERIZATION

Pirarucu is scientifically named Arapaima Gigas Shinz 1822. It belongs to the Arapaimidae family and Osteoglossiformes order , whose origin dates back to the Jurassic period (FERRARIS JR., 2003).

It is considered a promising species for intensive cultivation, supporting high stocking densities (Cavero et al. 2003), presenting an extraordinary weight development, reaching around 10 kg in just one year of cultivation, and superior rusticity in tropical environments. (IMBIRIBA, 2001; PEREIRA-FILHO et al. 2003).

The species has distinct biological and ecological characteristics: its specimens can reach up to 3 meters in length and weigh up to 200 kg, being considered the largest scale fish in inland waters on the planet (SAINT-PAUL, 1986; IMBIRIBA *et al.,* BOCANEGRA, 2006).

In Brazil, the first studies on arapaima breeding were carried out by Oliveira (1944), in Belém, and Fontenele (1948), in Icó, CE, when they managed to reproduce in captivity.

These studies highlight its biological and zootechnical characteristics, in addition to its high commercial value and its importance as food in the Amazon region (SEBRAE , 2013).

Pirarucu known as the “giant of the Amazon Basin”, aerial breathing and native to the region, is one of the most important species, economically and culturally, of the Brazilian ichthyofauna (CASTELLO, 2004; ANDRADE, et al. 2007).

The term Pirarucu is of indigenous origin from the union of the expression *pira,* fish and *annatto* , red, due to the fact that it has edges and center of the scales of some regions of the body with a red shape and coloration similar to that of the seed of the "urucum", *Bixa orellana* . (FONTENELE, 1948).

Some common names of the species: Pirarucu in Brazil, Bodecos in the Amazon region, Pirosca in the state of Tocantins and Paiche in Peru and Ecuador (EMBRAPA, 2017).

The arapaima is an omnivorous animal, as it feeds on animal and plant beings. In the diet of fish, we can find fruits, worms, insects, molluscs, crustaceans, fish, amphibians, reptiles and even water birds. (Pirarucu : the giant of fresh waters).

Pirarucu cultivation lacks full development due to the scarcity of scientific information, especially on its reproductive biology, the main obstacle to the production of fingerlings on a commercial scale (CAVERO, 2003).

The species has a greater preference, compared to other species of freshwater fish, for presenting quality characteristics that differentiate it. The high carcass and fillet yield (41 to 57 %), excellent meat flavor, high nutritional value (16 to 18 % of crude protein, wet matter), low lipid content (0.2 to 5 %) and the lack of intramuscular spines, are important characteristics for the interest in its consumption (OLIVEIRA et al., 2014; ONO, 2011) .

2.2 GEOGRAPHIC DISTRIBUTION

Pirarucu has a wide distribution in the Amazon Basin, being the largest scale fish in the region. Much appreciated by the people of Amazonas, Pirarucu was, until 1970 approximately, the most important species for the fish trade in the region, however, due to the great fishing effort, the stocks suffered a great reduction (VAL and HONCZARYK, 1995).

According to Lüling (1964),

The Arapaima Gigas is distributed in the Amazon from the Orinoco - Guyana to Ucayali - Peru, however in the area of Guyana and French Guiana, it deserves proof. Bard & Imbiriba (1986) say there are no records in the Orinoco basin, being found only in the lower part of the Amazon River and its tributaries, also in the vast areas of floodplain and igapós connected to them. Even so, little is known about the limits of occurrence of this species in the upper reaches of the Amazon River and its tributaries.

The arapaima is a fish originally from the Amazon basin, although it is found
also in Guyana, Bolivia and Peru. It inhabits rivers, lakes and narrow channels mainly in the area of occurrence of the Amazon Basin ecosystem (FONTENELE, 1948).

2.3 HABITAT

The arapaima mainly inhabits floodplain areas in the Amazon and Essequibo basin , on the Guyana-Venezuela border, including flooded forests, rivers, lakes, and some coastal drainages in Brazil. The geographic distribution of the arapaima is usually determined by geographic barriers, such as waterfalls that have strong currents and prevent their passage. The arapaima inhabits environments with weak or no currents, such as lakes (QUEIROZ; SARDINHA, 1999; CASTELLO, 2008a). The arapaima lives in floodplain lakes, but can also be found on the beaches of rivers and in some channels during the dry season.

2.4 FOOD

The arapaima is a carnivorous fish. In the younger stages, up to 50 cm in length, their natural diet is basically composed of aquatic invertebrates, such as insects, molluscs and crustaceans (QUEIROZ, 2000; OLIVEIRA *et al* ., 2005). In adulthood it is piscivorous (QUEIROZ, 2000; WATSON *et al.*, 2013). Despite being a carnivore, the species has small conical teeth in the jaws and has dentigen plates in the palate region that help in the apprehension of food together with its bony tongue (FONTENELE, 1948; WATSON *et al* ., 2013).

The arapaima has been considered a top predator of the trophic chain. Therefore, it probably regulates the stability of the ecosystem it inhabits. Their prey are usually small and abundant fish, especially detritivores and omnivores (SÁNCHEZ, 1969; QUEIROZ, 2000). However, a current study has found evidence from nitrogen isotopes that the arapaima is an omnivorous fish (WATSON et al., 2013).

Carnivorous fish require foods of high nutritional value, which reflects the adaptive structure of their digestive tract, characterized by a short intestine, while omnivorous fish have a longer intestine, allowing the food to remain in contact with enzymes for a longer time, increasing effectiveness. digestion to compensate for the low nutritional value of the ingested food (ROTTA, 2003).

Carnivorous fish require high-protein diets and can range from 0 to 55% (ALVARES-GONZÁLES, 2001).

In fish farming, the use of complete rations is essential, all nutrients must be present in a balanced way and in amounts that meet the requirements of the fish, resulting in an increase in the growth, reproduction and health of the animal (KUBITZA, 1999).

2.5 GROWTH

Bard & Imbiriba (1986) mention that the arapaima is a species that presents very fast growth and, in captivity, can reach a weight of around 10 kg with one year of cultivation. In the natural habitat, the data are little known and the growth of fish that breathe atmospheric air is much faster in the first years of age.

The growth continues strong until the beginning of the reproductive period, and annual weight doubling may occur. Even after reaching the period of reproductive maturity, arapaima continues to show a high annual growth rate in weight and length (QUEIROZ, 1999).

It is a species that easily accepts extruded feed (Crescêncio , 2001) and supports high stocking densities (CAVERO, 2002).

2.6 REPRODUCTION

Most of the records available in the literature indicate that arapaima in captivity generally reach sexual maturity at 4 or 5 years of age, weighing between 40 and 60 kilograms (FONTENELE, 1953).

The arapaima is ovuliparous , that is, it presents fertilization and the development of external oocytes. According to LÜLING (1964) and Flores (1980), the maturity of pirarucu gonads, in studies of the gonad stage , occurs after the fourth or fifth year of life, when the fish is between 1.60 and 1.85 m.

It is known that a female arapaima is capable of producing about 11,000 fingerlings per spawning (Bard & Imbiriba , 1986), which is a low number when compared to other fish species, however there are controversies among authors regarding fecundity estimates. of arapaima.

Aspects of the reproductive behavior of *Arapaima gigas* were verified and are complex involving the formation of monogamous couples, nest building and parental care for the progeny, in addition to fights and food rejection (MONTEIRO, 2005).

The pirarucu breeding season in the Eastern Amazon begins with the first rains in the region, and takes place between January and May, in shallow places.

Bard & Imbiriba (1986) mention that the nests are built by the couple in places with clayey bottoms and without vegetation. They have the shape of a spherical cap, having a depth of about 0.20 m and a diameter of approximately 0.50 m. In the nests, the females lay eggs, which receive the male's seminal fluid for fertilization to occur. After the eggs hatch, the larvae remain in the nest for five days until the yolk sac is absorbed (FONTENELE, 1948).

2.7 COST

The definition of cost in the agricultural area is still very vague. According to SHUH (1976), "conventional theory suggests seven different concepts and, in principle, each of them can be measured for each time extension. When a set of factors is disaggregated to specify more than two or three factors, the number of different `costs' for a given level of output, at a set of factor prices, can grow considerably. Much controversy concerning costs, particularly in the context of economic policy, can arise from not recognizing this simple point. "

According to MARION (1996), the classification of costs depends on factors such as identification with the production or relationship with the volume of this production and are classified as:

Direct Costs, “are those accurately identified in the finished product, through a system and a measurement method, and whose value is relevant, such as hours of labor, kilos of seeds or rations; operating and maintenance costs for tractors.

Indirect costs, “are those necessary for the production, usually of more than one product, but arbitrarily allocable, through a system of apportionment, estimates and other means. Example salaries for technicians and managers, food , hygiene and cleaning materials and products (staff and facilities).

Fixed Costs are those that remain unchanged in physical terms and in value, regardless of the volume of production and within a relevant time interval. They usually come from the possession of assets and the ability or readiness to produce. Example depreciation of facilities, improvements and machineryagriculture, property insurance, salaries of rural technicians and managers”.

Variable costs, “are those that vary in direct proportion to the volume of production or area planted. Example direct labor, direct materials (fertilizers, seeds, feed), machine hours”.

Decision-making costs provide information of strategic relevance, such as those that allow fixing sales prices, changing the product line, fixing product volumes, fixing production volumes, establishing indirect and fixed costs. The definition of cost can be understood as: “the use of goods (materials or not) and services, aiming at the generation of a product or services that will be offered to the consumer” (MARION, 1996).

2.8 RISK AND RETURN

Risk, according to Assaf Neto et al (2009), can be understood by the ability to measure the state of uncertainty of a decision by knowing the probabilities related to the occurrence of certain results or values.

For Groppelli et al (2006) risk is the measure of the sensitivity of stock or portfolio returns and the uncertainty of future results.

Lemes Junior et al (2010), in turn, defines risk as the possibility of financial losses or, more formally, expectations of return associated with a given asset. He states that it is natural to expect that the greater the risk taken, the greater the return generated by the asset.

Risk has a relationship with return, which is defined by Gitman (2010) as the total gain or loss that is earned by an investment over a period of time.

Lemes Junior et al (2010) describe return as the total gains or losses of an owner or investor on investments made at some point in the past.

According to (Souza and Clemente, 2008), the understanding of business risks is associated with conjunctural and non-controllable elements and the understanding of the return to the expected value in return for the investment made.

So the return in monetary unit is simply the total received in that currency for the investment, minus the amount invested, mathematically it can be represented in this way: Return in monetary unit = Amount received – Amount invested. (BRIGHAM et al; 2006).

2.9 MULTI INDEX METHODOLOGY

multi -index methodology demonstrates the economic and financial viability of an investment project, through the analysis of two sets of indicators, the first being composed of return indicators: Present Value (PV); Net Present Value (NPV); Annualized Net Present Value (NPV); Benefit Cost Index (IBC) and IBC and Additional Return on Investment (ROIA) and the second containing risk indicators: TMA/IRR Index; Pay-back Ratio /N, Degree of Revenue Commitment (GCR); Management Risk and Business Risk (SOUZA; CLEMENTE, 2012).

This analysis evidences the project's ability to bring financial returns, which is what drives the opening of a business, seeking to minimize risks (GITMAN, 2004).

Multi-index Methodology proposed by Souza; Clemente (2008) positions the analysis of investment projects as an integral part of the strategic process that aims to place the firm in a new competitive position. Specifically, they refer to the analysis process as the simulation of financial results and the risks involved in a certain business strategy, thus characterizing itself as an instrument that aims to subsidize the decision-making process in the risk and return dimensions.

According to Xavier Jr (2015), Harzer et al (2013) and Harzer (2014), the main characteristics of the Multi-Index Methodology can be summarized as follows:

a) The basis for preparing the cash flow of the enterprise is the projection of the income statement calculated by Direct Costing, allowing the a priori identification of fixed disbursements that do not depend on the level of activity;

b) The TMA must reflect the best investment alternative with a low level of risk and almost immediate liquidity, available at the time;

c) In addition to the traditional NPV and VPLa return indicators , the project's profitability is expressed by the ROIA (Additional Return on Investment) which expresses the real gain of the project over the one that would be obtained by investing the same capital in investments in low-quality securities. risk;

d) The five risk indicators (TMA/IRR Ratio; Pay Back/N Ratio; Operational Risk; Management Risk and Business Risk) are all measured on a scale from zero (virtually zero risk) to 1 (very high risk) , identifying the most plausible ones and facilitating management's action with regard to their mitigation. Except for Financial Risk, the scale proposed by the Multi-Index Methodology is: Low for 0 to 0.2; Low/Medium from 0.2 to 0.4; Average from 0.4 to 0.6; Medium/High from 0.6 to 0.8 and High from 0.8 to 1;

e) The return and risks are mapped (Perceptual Map) and subsidize the decision to invest in a certain project;

f) By working with information from projections from the Income Statement under Direct Costing, it is possible to express the Operating Risk as the percentage of Operating Revenue that is committed to the payment of costs and expenses as shown by SOUZA; CLEMENTE (2008, p.125);

g) It retrieves the information already dealt with in the strategy analysis phase to compose the Management Risk (Generic and Specific Competencies and Resource-Based Management) and the Business Risk (Specific Risks of the activity vis-à-vis the environmental analysis);

h) It is possible to express the Financial Risk through the TMA/IRR ratio and also infer the probability of NPV ≤ 0.

III. Research Methodology

As for its nature, this article is an applied research. For Gil (2010), “[...] research aimed at acquiring knowledge with a view to applying it in a specific situation”.

As for the objectives, it is a quantitative descriptive research, due to the detailing of the necessary investments, the initial costs of the investment and the main activities necessary for the exploitation of fish farming, with the objective of analyzing the expectation of risk and return of the same. According to Gil (2010), descriptive research aims to describe the characteristics of a given population. They can also be elaborated with the aim of identifying possible relationships between variables”.

The research still fits as bibliographic and documentary regarding the technical procedures of data collection, since it was carried out through research in articles published in journals on the internet.Documentary research, according to Gil (1999), (...) is based on materials that have not yet received an analytical treatment or that can be re-elaborated according to the research objectives, as the information for setting up the initial project was collected. of several articles published and arranged in an Excel spreadsheet for their analysis, where initially, investments and costs were raised for the exploration of the fish farming activity.

According to Lakatos and Marconi (2001), documentary research is the collection of data from primary sources, such as written or unwritten documents belonging to public archives; private archives of institutions and households, and statistical sources.

As for its approach, the research is framed as qualitative. According to Bogdan & Biklen (2003), the concept of qualitative research involves five basic characteristics that configure this type of study: natural environment, descriptive data, concern with the process, concern with meaning and inductive analysis process.

According to Triviños (1987), the qualitative approach works with data seeking its meaning, based on the perception of the phenomenon within its context. The use of qualitative description seeks to capture not only the appearance of the phenomenon but also its essences, trying to explain its origin, relationships and changes, and trying to intuit the consequences.

This research is longitudinal, since the same aspects are studied in a certain period of time. They are intended to study a process over time to investigate changes, that is, they reflect a sequence of facts (HADDAD, 2004).

Initially, investments and costs were raised for the exploration of the Pirarucu culture activity, such as the acquisition of land, sheds and tanks. Next, the costs of carrying out the activity were listed, such as the acquisition of fingerlings and their inputs, in addition to labor and its labor provisions: vacation, 13th salary and charges.

After that, the selling price of Pirarucu in fillets and skin and its respective recipe were identified.
The data were tabulated in an Excel spreadsheet, followed by the analysis of risk and return indicators.

IV. Presentation And Analysis Of Results

4.1 PRESENTATION AND SYSTEMATIZATION OF INFORMATION

This chapter is intended to present the process of raising and fattening the arapaima fish, the initial costs of structuring the fish culture from the acquisition of the land, sheds, tanks, fingerlings and all the inputs related to the process.

4.2 SPECIFICATION OF THE INITIAL STRUCTURE FOR FISH BREEDING

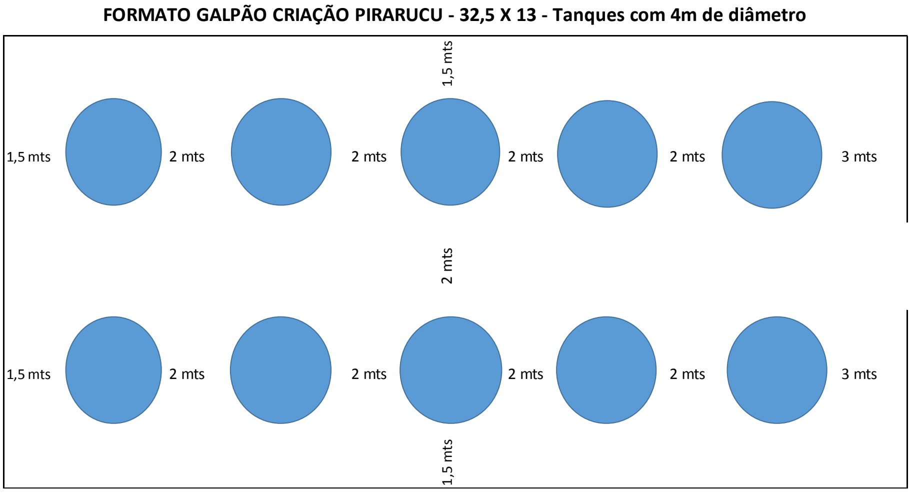
The proposal to implement the fish farming system was developed for the city of Canoinhas, in the northern plateau of Santa Catarina. For this purpose, the proposal proposes the acquisition of a suit around R$120,000.00, for the construction of a shed where the fish tanks can be housed, with an approximate value of R$4,000.00 for documentation of the same and R$4,000.00 for landscaping.

The shed to house the tanks will have a pre - assembled structure with a half wall of masonry and half a plastic wall, type greenhouse and concrete floor, being 32.5m x 13m, totaling 422.5m² and covering type zinc , with an initial cost of R$600.00 per m², totaling R$253,500.00. A monthly expense of around R$120.00 is estimated for the shed's electricity costs.

For fish farming, it is proposed to use 10 metal tanks with a useful volume of 10,000 l each, in a circular shape with 4m in diameter, arranged in two rows of five tanks separated by 2m distance between them and 1.5m distance between them. from the walls. Each tank will have an approximate value of R$4,500.00, totaling R$45,000.00.

water heating system will be built to use solar energy, as well as the water recirculation system. The heating system featuresan initial budget of R$3,000.00 for each tank, totaling R$30,000.00.

Figure 1: Model Shed Breeding Fish



Source: authors/2022

The water for supply and recirculation of the animal breeding tanks will come from a purchase from the local company, with an approximate value of R$9.11 om ³ , totaling R$911.00 to supply the 10 tanks.

Table 1:Structure for implantation of pirarucu culture

CYCLE 1 - STRUCTURE FOR IMPLEMENTATION OF PIRARUCU CULTURE			
STRUCTURES			
GROUND			
DESCRIPTION	THE AMOUNT	PRICE R$)	TOTAL (BRL)
GROUND	1.00	120,000.00	120,000.00
DOCUMENTATION	1.00	4,000.00	4,000.00
LAND PREPARATION	1.00	4,000.00	4,000.00
SUBTOTAL LAND			**128,000.00**
SHED			
DESCRIPTION	THE AMOUNT	PRICE R$)	TOTAL (BRL)
Structure + Coverage (13x32.5 = 422.5 m 2)	422.50	600.00	253,500.00
ELECTRICITY	12.00	120.00	1,440.00
SHED SUBTOTAL			**254,940.00**
TANK			
DESCRIPTION	THE AMOUNT	PRICE R$)	TOTAL (BRL)
10000 L TANK	10.00	4,500.00	45,000.00
WATER m3	100.00	9.11	911.00
WATER RECIRCULATION SYSTEM	1.00	3,000.00	3,000.00
WATER HEATING SYSTEM	10.00	3,000.00	30,000.00
SUBTOTAL TANK			**78,911.00**
TOTAL STRUCTURES			**461,851.00**

Source: authors/2022

The fingerlings can be purchased from Pirarucus Paraná at the price of R$28.00 each unit measuring 15cm in size, without freight costs, together with the rations that can cost up to R$4.50kg. Considering that the project provides for the consumption of 03 bags of 25 kg feed per day for fingerlings for a period of 90 days in measures between 1.8 and 2.5 mm, 03 bags of 25 kg feed per day for 60 days in measures between 3, 0 and 4.0 mm and 03 bags of 25 kg feed per day for 215 days measuring around 10.00 mm, totaling R$153,687.50 in feed and fingerling expenses for the 01-year cycle.

Table 2: Costs with fingerlings

FRYINGS			
1st MONTH OF IMPLEMENTATION OF PIRARUCU CULTURE (03 meals per day)			
DESCRIPTION	THE AMOUNT	PRICE R$)	TOTAL (BRL)
FRYINGS	1,000.00	28.00	28,000.00
TRANSPORT FRIES	1.00	-	-
Starter Rations - 1.8 to 2.5 mm (25 kg) Pcts	270.00	112.50	30,375.00
CONSULTANCY	1.00	2,500.00	2,500.00
SUBTOTAL 1st TO 3rd MONTH PIRARUCU CULTURE			**60,875.00**

Source: authors/2022

The project also provides for the hiring of a person to operate the entire treatment and care system for the animals, totaling an expense of R$28,750.00, considering salary, charges, attendance premium, admission and dismissal exams and provisions for 13th salary and vacation.

Table 3: Operating Costs

OPERATIONAL			
LABOR			
DESCRIPTION	THE AMOUNT	PRICE R$)	TOTAL (BRL)
LABOR (hour/man) (considering 1 year)	12.00	1,500.00	18,000.00
VACATION PROVISION (Salt + 1/3)	1.00	2,000.00	2,000.00
13th SALARY PROVISION	1.00	1,500.00	1,500.00
SUBTOTAL OPERATING COST			**21,500.00**
CHARGES			
DESCRIPTION	THE AMOUNT	PRICE R$)	TOTAL (BRL)
INSS SHEET	1.00	-	3,600.00
FGTS	1.00	-	1,720.00
INSS VACATION	1.00		400.00
INSS 13th SALARY	1.00		300.00
FGTS 13th SALARY	1.00	-	120.00
SUBTOTAL CHARGES			**5,320.00**
ADMINISTRATIVE COSTS			
DESCRIPTION	THE AMOUNT	PRICE R$)	TOTAL (BRL)
ATTENDANCE AWARD	12.00	150.00	1,800.00
ADMISSIONAL EXAM (Clinic + Doctor)	1.00	65.00	65.00
SUBTOTAL ADMINISTRATIVE COSTS			**1,865.00**
TOTL OPERATING COST			**28,685.00**
TOTAL FINAL 1ST YEAR CYCLE COSTS			**644,223.50**

Source: authors/2022

Therefore, at the end of the first cycle/year of the arapaima breeding project, the project foresees an expense totaling R$644,223.50.

Table 4 : Raising and Fattening Pirarucu

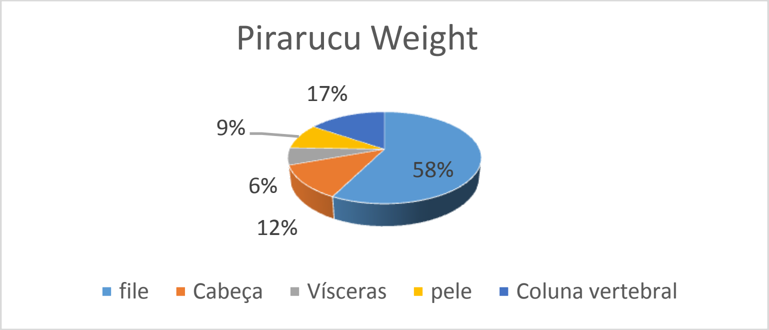
4th MONTH OF IMPLEMENTATION OF PIRARUCU CULTURE (03 meals a day)			
DESCRIPTION	THE AMOUNT	PRICE R$)	TOTAL (BRL)
INTERMEDIATE RATIONS - 3.0 to 4.0 mm (25 kg)	180.00	112.50	20,250.00
SUBTOTAL 4TH TO 5TH MONTH PIRARUCU CULTURE			**20,250.00**
6th MONTH OF IMPLEMENTATION OF PIRARUCU CULTURE (03 meals a day)			
DESCRIPTION	THE AMOUNT	PRICE R$)	TOTAL (BRL)
FATTENING RATIONS - 10.0 mm (25 kg)	645.00	112.50	72,562.50
SUBTOTAL 6TH TO 12TH MONTH PIRARUCU CULTURE			**72,562.50**
TOTAL BREEDING AND FATTENING PIRARUCU			**90,812.50**

Source: authors/2022

As a source of revenue for this entire process, at the end of a year of cultivation, the fish would be slaughtered and sold. At the end of this first cultivation cycle, the possibility of the animals reaching up to 10 kg is great. It has high growth rates, reaching from 7 to 10 kg in the first year of creation (IMBIRIBA, 2001; PEREIRA-FILHO *et al.*, 2003 *)* .

Considering a 10kg animal, there would be a total meat of 5.7kg. IMBIRIBA (2001) states that specimens between 30 and 40 kg have a meat yield of 57%. DIAS (1983) confirmed these data, obtaining with arapaima weighing between 14 and 21kg the following yield indices in relation to live weight: fillet 57.5%; head 12%; viscera 6%; skin with scales 9% and spine 15.5%.

Graph 1: Pirarucu Weight Training



Source: authors/2022

Its by-products (scales, head, tongue and skin) have high added value. The bony tongue is used to scrape guarana sticks, and the scales are used as nail files or in handicrafts. Leather corresponds to 9% of the weight and can be used as raw material in the bags, shoes and belts industry (IMBIRIBA *et al* ., 1994).

A 10 kg fish has 5.7 fillets which, at an average value of R$ 66.21, generates a revenue per fish of R$ 377.42, if we add to this the value of the skin sold and R$ 9.80 the kg and considering the proportional weight of its skin, we arrive at the value of R$ 386.24 for each fish. This income starts from the 13th month of creation, assuming that this month the fish have already reached at least 10 kg each.

Considering 1000 animals at the end of the first year of cultivation, we would reach a revenue of R$ 386,239.80, representing 59.95% of the total investments.

Table 5: Revenue Statement 1st Year of Creation Cycle

PRODUCT	kg fish	BRL kg	AVERAGE PRICE	VALUE
FILES WITHOUT SKIN	5.7	5.7	66.21	377,419.80
SKINS	1	0.9	9.8	8820
			GROSS REVENUE	**386,239.80**

Source: authors/2022

For the second year, considering some readjustments of values from the value of fingerlings, feed, energy and labor, considering that there would be cost with sheds, tanks and land and, also considering the annual inflation of 3.89%, the cost of fish breeding for that year would be around R$201,106.06 with a revenue of R$401,264.53, with an approximate profit of R$200,158.47.

Table 6: Revenue Statement 2nd Year of Creation Cycle

PRODUCT	kg fish	BRL kg	AVERAGE PRICE	VALUE
FILES WITHOUT SKIN	5.7	0.712	68.79	392,101.43
SKINS 2021	1	0.9	10.18	9163.098
			GROSS REVENUE	**401,264.53**

Source: authors/2022

In the third year of cultivation, still considering the annual inflation of 3.89% and adjusting expenses with the creation of Pirarucu fish, it would generate a profit of 204,128.09 first years of creation in a total of R$146,302.86.

Table 7: Revenue Statement 3rd Year of Creation Cycle

PRODUCT	kg fish	BRL kg	AVERAGE PRICE	VALUE
FILES WITHOUT SKIN	5.7	0.712	71.47	407,354.18
SKINS	0	0.9	10.58	9,519.54
			GROSS REVENUE	**416,873.72**

Source: authors/2022

The fourth and fifth years of fish farming were considered with the same projection of revenue and costs, adjusted for inflation of 3.89%, where the numbers show positive revenues in the two years with net profits of R$208,458.94 and R$213,682.60 , respectively, demonstrating the profitability of the culture.

Table 8:Revenue Statement 4th Year of Creation Cycle

PRODUCT	kg fish	BRL kg	AVERAGE PRICE	VALUE
FILES WITHOUT SKIN	5.7	0.712	74.25	423,200.25
SKINS	0	0.9	10.99	9,889.85
			GROSS REVENUE	**433,090.11**

Source: authors/2022

Table 9: Revenue Statement 5th Year of Creation Cycle

PRODUCT	kg fish	BRL kg	AVERAGE PRICE	VALUE
FILES WITHOUT SKIN	5.7	0.712	77.13	439,662.74
SKINS	0	0.9	11.42	10,274.57
			GROSS REVENUE	**449,937.31**

Source: authors/2022

The results show that if well planned breeding can yield significant profits. The work also shows that the cultivation of Pirarucu fish can be very profitable, especially from the third year of cultivation, since there would be no costs with land, tanks and sheds, combined with the high acceptance of its meat by consumers and even the sale of animal hides, increasing even more the profit.

4.3 CASH FLOW

The annual net cash flow is one of the methods that most agricultural businesses should use, given its simplicity in considering only receipts and payments, where the profit for the year (or month) is obtained by subtracting the sales received from the expenses. paid (MARION, 2007).

As shown in table 10, the annual cash flow from the creation of Pirarucu fish was analyzed over five years, its initial investments were R$ 461,851.00. During the period, the cost of maintenance increased reasonably: it started with R$ 182,372.50 and ended with R$ 236,254.71. Gross revenue at the end of the first year of creation reached R$ 386,239.80, with variations over the years, reaching the end of the period with an increase totaling R$ 449,937.31. Comparing the balance of the first year with the last, it was possible to identify a significant increase from R$ 203,867.30 to R$ 213,682.60.

Table 10:Annual Cash Flow Pirarucu Fish Breeding

Year	disbursements	Revenue	cash flow
0	-461,851.00	0.00	-461,851.00
1	-182,372.50	386,239.80	203,867.30
2	-201,106.06	401,264.53	200,158.47
3	-212,745.63	416,873.72	204,128.09
4	-224,631.17	433,090.11	208,458.94
5	-236,254.71	449,937.31	213,682.60

Source: authors/2022

4.4 FEASIBILITY ANALYSIS THROUGH THE MULTI-INDEX METHODOLOGY

Initially, the return and risk indicators of the Multi-Index Methodology were presented for the cash flows in the production of Pirarucu fish over a period of 05 years. The results of the indicators are presented in table 11 and commented below.

Table 11:Feasibility analysis by the multi -index methodology

	indicators	
Return	Present Value of Cash Flow from Investments	-1,269,794
	Present Value of Cash Flow from Benefits	1,651,683
	Net present value	381,889
	Equivalent NPV ha/year	90,659
	Benefit/Cost Index	1.30
	annual ROIA	5.40%
Risk	Annual Internal Rate of Return	34.08%
	TMA/IRR Index	18%
	annual payback	35
	Pay -Back/N Ratio	1.0
	Management Risk	0.5
	Business Risk	0.8

Source: Source: authors/2022

In order to interpret the indicators and with the main objective of deepening the perception of the return and the risks involved in the production of Pirarucu fish on a small property in the region of Canoinhas - SC, they are arranged as follows :

Net Present Value (NPV) - By explicitly considering the time value of money, Net Present Value is considered a sophisticated technique for analyzing capital budgets. This type of technique, in one way or another, discounts the company's cash flows at a specified rate. This rate, often called the discount rate, opportunity cost, or cost of capital, refers to the minimum return that a project must earn in order to keep its market value unchanged. When the investment in Pirarucus production is chosen, expectations are that the investments made of R$461,851.00 will be recovered, as well as what would be measured if this capital had been invested in the financial market at 10% per year and still on , in today's monetary values, the amount of R$ 381,889.00 for the production of Pirarucus.

Annualized Net Present Value (NAPV) - *Mutatis mutantis* , the NAPV has the same interpretation as the NAV, however, expressed in a time unit that is easier to analyze. In this case, the VPLa only represents the annual equivalent of the NPV and remains estimated at R$ 90,659 for the production of Pirarucus. According to Souza and Clemente (2012), this indicator facilitates the decision-making process as it is more practical for the decision- maker to reason in terms of annual gains than in terms of accumulated gains over several periods. “The common deficiency of the NPV and the VPLa resides in the fact that both express the return in absolute monetary values and not in relative values, as is usual in the market” (KREUZ; SOUZA; CLEMENTE, 2008, p. 56).

Benefit/Cost Index (IBC) - The IBC of R$ 1.30 for raising Pirarucu fish, expressed in today's monetary values, the expected real return, after 05 years, for every R$ 1.00 of invested capital. In other words, a 30% return is expected in 5 years for Pirarucus production. Souza and Clemente (2012) emphasize that this is a return beyond the one that would have been had if the investment capital had been applied at the rate of 10% pa (TMA) during the period considered. “The IBC aims, in part, to correct the deficiency of the NPV and the VPLa , which is to express the return in absolute values” (KREUZ; SOUZA; CLEMENTE, 2008, p. 57). Taken in isolation, the IBC does not allow, immediately, to say about the recommendation or not of the project under analysis, since the expressiveness of its value may be masked by the time horizon of 05 years.

Additional Return on Investment (ROIA) - For Souza and Clemente (2012, p. 76) ROIA represents “the best estimate of profitability for an investment project”. According to these authors, it is an indicator that facilitates the analysis because it is in the same time unit as the TMA. In the case of this project, the ROIA of 5.40% pa for the production of Pirarucus is a surplus over what would have been gained if the investment capital had been applied at 10% a year, that is, when investing in this agribusiness, the expectations are that the opportunity cost will be recovered (10% per year) and still result in a real additional of around 5.40% per year.

Minimum Attractive Rate / Internal Rate of Return (TMA/IRR) - It is the percentage rate of return on an investment based on the amount of capital initially invested (represented in negative values) and the subsequent generated revenues (represented in positive values). The proximity or distance of the IRR in relation to the TMA may represent the risk or safety of the project. The risk is being interpreted as the possibility of earning more, leaving the capital invested at 10% per year than investing in the creation of Pirarucus. The TMA/IRR ratio of 18% represents a good possibility of return.

***Pay-back* Index /N - This** project showed that the time required for the recovery of invested capital corresponds to 3.5 years. This index accentuates the risk perception of the project, for this type of agribusiness, a faster recovery of the invested capital was expected, that is, two to two and a half years.

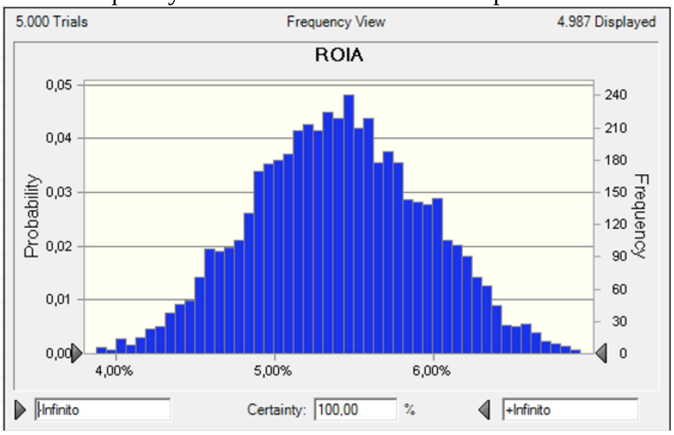
4.5. MONTE CARLO SIMULATION

In the Monte Carlo simulation, the amount of fish assigned in the initial calculation in the period of 5 years was considered as uncertain variables, or input variables for the simulation.

After running the simulation, it was possible to obtain the frequency graphs with the minimum, average and maximum values of the variables, median, variance or standard deviation, among other variations. For forecast variables, the NPV (Net Present Value) and ROIA (Additional Return on Investment) were chosen.

Figures 2 and 3 show that the average for the NPV (Net Present Value) of fish production is R$381,316.00. The minimum amount was R$254,763.00 and the maximum amount was R$512,974.00.

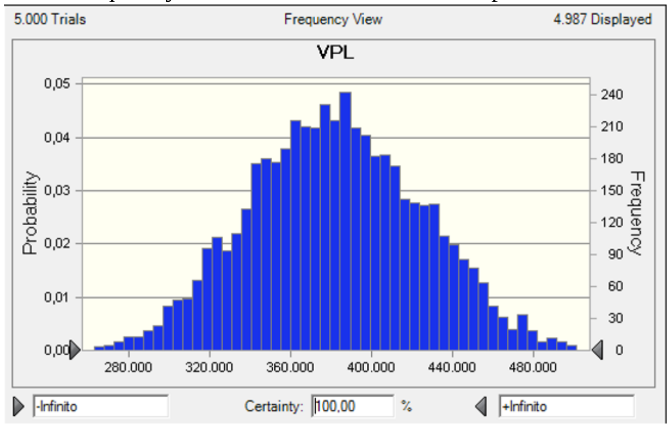
Figure 2: Frequency chart and statistics of the output variable ROIA - Additional Return on Investment



Forecast: ROIA	
Statistic	Forecast values
Trials	5.000
Mean	5,40%
Median	5,39%
Mode	'---
Standard Deviation	0,54%
Variance	0,00%
Skewness	-0,00329
Kurtosis	2,72
Coeff. of Variability	0,1006
Minimum	3,72%
Maximum	7,02%
Mean Std. Error	0,01%

Source: authors/2022

Figure 3: Frequency chart and statistics of the output variable ROIA - Additional Return on Investment



Forecast: VPL	
Statistic	Forecast values
Trials	5.000
Mean	382.177
Median	381.316
Mode	'---
Standard Deviation	42.552
Variance	1.810.669.098
Skewness	0,04999
Kurtosis	2,72
Coeff. of Variability	0,11134
Minimum	254.763
Maximum	512.974
Mean Std. Error	602

Source: authors/2022

V. Final Considerations And Recommendations

From the information gathered as investment, costs and indexes and, considering the characteristics of this culture, not suitable for the region, in addition to other determining factors such as market, climatological conditions suitable for the various stages from the creation of the fish, fattening to the sale, associated with the intensities of winter in the region, a not very expressive return is expected to level the risks associated with it, being possible to verify a return that can be considered as medium/high as opposed to a low/high risk.

Analyzing the viability indicators for the creation of Pirarucu, there was an average/high return, confirmed by the ROIA (Additional Return on Investment), estimated here at 5.40% pa The financial risk verified in this culture is low/high, as shown by the TMA/IRR index, estimated at 0.18. The risk of non-recovery of invested capital is medium/low, confirmed by the Pay Back/N ratio of 0.35. However, the Equilibrium Revenue represents 50% of the Company's Normal Revenue.

Management and business risks were considered medium-sized, since public or private technical guidance is available for the fish farming segment and such agribusiness is exposed to interference from the climate and the market.

Crystall Ball tool , from the input variables as uncertain variables, or input variables for the simulation, the quantity of fish, the production of meat in kg and the sale price and the NPV (Net Present Value) forecast variables , IRR (Internal Rate of Return) and ROIA (Additional Return on Investment), it is possible to see that the probability of occurrence of the calculated values is average, proven by the proximity of the values, confirmed by the percentage of certainty between the minimum and average values of each predictor variable. The simulation also made it possible to identify the probability that the NPV > 0 is 100%, as well as the probability that the IRR < TMA.

The research concludes that caution is needed when analyzing the return of Pirarucu breeding in the North Plateau of Santa Catarina. It is recommended that further research be carried out given the difficulty in obtaining information that portrays the reality of the region with regard to fish farming, especially when it comes to a non-specific culture.

For this, measures are needed that add greater differentiation to Pirarucu, such as excellence in the production process for a higher quality of the final product, allied to the dissemination of the benefits brought by it, both for being a culture that does not use chemical products, as for its highly beneficial property to human health.

It should be noted that, with regard to the structuring of the project, if the investor already has a structure, it may have a positive influence on the results, as well as there may be a negative influence if there is a reduction in the estimated production.

The project also highlights that a simulation should only be used as a support and not as an absolute truth. These simulations are used for more detailed analysis of business risks, facilitating their management.

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