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Economic and Financial Viability of Biofortified Sweetpotato Production in Nova Soure - Bahia

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Abstract: The economic and financial viability analysis of a R$ 60,000.00 investment project was made for the production of biofortified Brazilian sweetpotatoes, in the rural community of 'Panasco', Nova Soure municipality in the northeast region of Bahia. The Minimum Attractiveness Rate varied in three scenarios: 10%, 11.50%, and 13.75%. The study used the Multi-Index Methodology to evaluate the return and risk attributes inherent to the investment project. After a detailed analysis of each attribute, investors accepted the TMA of 11.50%, and the indicators resulted in Present Value R$ 70,895.00, Net Present Value R$ 10,895.00, Annualized Net Present Value R$ 2.612,53, Cost Benefit Ratio R$ 1.18, Additional Return on Investment 2.82%, ROIA/TMA 24.52%, Internal Rate of Return 17.65%, Payback of 5 years, Payback/Horizon of 83.33% and TMA/IRR 65.16%. The Business Risk was evaluated with the cross-SWOT analysis. The Revenue Commitment Degree indicated that 68.72% of the revenue is committed to the full payment of the bills that make up the break-even point, with 31.27% of the revenue is taken as profit from the activity. Management Risk was accessed through a nine-point structured quiz so the investors pointed out that the Process and Social areas have greater control, but the Commercial and Administrative areas require greater attention in terms of business strategy. The project was approved, and the funding will be made for an agricultural work period of six years.

Keywords: Sweetpotato, Economic Analysis, Financial Analysis, Agricultural Project Feasibility, Multi-Index Methodology

1. Introduction

The set of activities that make up the Brazilian agribusiness are considered indispensable for the Brazilian economy, whether for the composition of the gross production value or in the sum of the country's gross domestic product. The elaboration of new agrilabour proposals, and the execution of projects based on agriculture, livestock and agribusiness, are relevant themes and subject to public, private or foreign investment [2, 8].

The decision related to the implementation of a new agricultural projects must take into account the economic and financial management of the rural entrepreneur and the investing agent. The financial analysis should cover the cost of land, improvements, equipment, production inputs, cultural practices, until the moment of harvest [31, 2]. Between the moment of decision-making for the execution of a project, until obtaining the final agricultural product, only the financial expenditure in the form of costs and investments is incurred. The income from the activity comes only after the harvest and sale of the product [1, 5].

This operating situation incurs a time mismatch between operating investment expense and the financial return of the activity. This is the hard reality of many rural entrepreneurs. In this sense, the economic and financial analysis of an agricultural project is essential to support the

decision-making [21, 22].

From a conceptual point of view, financial analysis and economic analysis have certain affinities and complement each other. The preparation of the proposal seeks to estimate the monetary and social advantages of an investment based on the decision, or not, to undertake the examined project [17]. In the financial decomposition, the objective is to evaluate the performance, income and adaptation of the project, considering the transactional financial values of the market, in order to examine whether the intended activity is sustained, remunerated, and guarantees a financial return that rewards the investment of capital [27, 4].

The economic analysis, on the other hand, considers the economic costs and benefits that comes from market values, subtracting the fees, contributions, taxes or liabilities that fall on revenues. However, the great importance of economic analysis lies in the fact that its document assesses project external effects, by estimating the beneficial impact on the community to which the labour is intended [7, 24].

Considering a demand-oriented work logic, the rural entrepreneur seeks not only to obtain financial advantages due to a moment of increase in a certain rural product, but also to meet the consumption needs of his target audience [26]. It is in this context that producers and consumers of sweetpotato (Ipomoea batatas (L.) Lam) are inserted.

Sweetpotato tuberous roots are worldwide produced and consumed. This nutritious food is a source of energy and dietary fiber, rich in vitamin C, vitamin A (orange pulp), and potassium. Colored pulp cultivars vary between cream, yellow, orange and purple, which have in their composition several bioactive compounds that contribute greatly to maintaining the health of the consumer. From an agronomic point of view, the plant presents a typical phenology of a hermaphrodite, dicotyledonous angiosperm, belonging to the Convolvulaceae family. It is tolerant in dry and hot environments, has a predilection for tropical climates, has naturally creeping growth, its life cycle as a mother-plant is perennial, but its plant-production has a cycle that varies from 120 to 150 days [18].

Considering the world sweetpotato production data made available by the Food and Agriculture Organization (FAO), an insightful analysis allows comparing the sweetpotato production of Brazil and Malawi, which is the world's second largest producer of the tuberous root. In 2020, Brazil produced 847,896 thousand tons of sweetpotatoes with an average productivity of 13 ton/ha-1. Malawi, on the other hand, produced 6,918,420 million tons, with an average productivity of 20 ton/ha-1. This shows that Brazil reached only 12.26% of the African 2020 country's production. For the purposes of territorial comparison, it is possible to accommodate Malawi within the state of Bahia. Both territories were located under the 13S Parallel [25, 9, 13]. Evolving to 2021, data updated by the Brazilian Institute of Geography and Statistics (IBGE) show that Brazil produced a crop of 824,680 thousand/ton of sweetpotatoes, being the second largest producer in the Americas [9, 12].

These data demonstrate that Brazil has a great potential still unexplored to expand its sweetpotato production. So, it is this perspective in which the project is inserted. The objective is to carry out an economic and financial analysis for the implementation of a new productive sweetpotato crop in the municipality of Nova Soure - Bahia. The results of the work will be able to provide support for Brazilian farmers (especially in the northeast region of Bahia), from the perspective of investment in the production of national sweetpotato cultivars, with a focus on generating greater consumption demand, and boosting the economic expression of the productive chain of that crop. It is noteworthy that this is the very first Brazilian article that uses the economic-financial analysis methodology to evaluate the viability of the sweetpotato production.

Boosting the sustainable agricultural production of nutritious foods through the use of national certified varieties of plants is relevant, and interesting topic for Brazilian agribusiness at all. Encouraging environmental and social sustainable practices in the production of food of plant origin can contribute to the positioning of the farmer in relation to the consumer market. This work values basic food and contributes to the economic development of the agricultural community established in Bahia.

2. Material and Methods

2.1. Project Delimitation

This is an original research project that proposes to evaluate the economic and financial aspects of the implementation of a new crop for the production of sweetpotatoes in the municipality of Nova Soure - Bahia. The sweetpotato plants that will be used for planting are originally Brazilian, registered in the National Cultivars Registry (RNC), of the Ministry of Agriculture, Livestock and Supply (MAPA). The economic-financial analysis of investment projects will be used as support for decision-making on the feasibility or not of adopting the agricultural project.

For the feasibility study, the following will be estimated: cost assessment for implementation, productive assessment and market assessment. The values of Investment, Revenue, Fixed Costs, Variable Costs, Depreciation and Income Tax will also be broken down.

2.2. Evaluation of the Minimum Attractiveness Rate of Return

The Minimum Attractive Rate of Return (MARR) for the project will be stipulated based on the Brazilian Special System of Liquidation and Custody rate (SELIC), in three trading scenarios: MARR 10%, MARR 11.50%, and MARR 13.75%.

2.3. Application of Multi-Index Methodology for Investment Analysis

The decision to invest in biofortified sweetpotato production in Nova Soure – Bahia, was estimated using the Multi-Index Methodology (MMI) [28, 29, 20]. The MMI will be calculated using estimators that deal with financial return

(Present Value, Net Present Value, Annualized Net Present Value, Cost Benefit Index, Additional Return on Investment, and Quotient of the Additional Return on Investment by the Minimum Rate of Attractiveness), and estimators of the risks inherent to the project (Internal Rate of Return, Payback, Payback/N Quotient, Quotient of Minimum Rate of Return by the Internal Rate of Return, Degree of Revenue Commitment, Business Risk and Management Risk). Each estimator and its respective equation are described below.

2.3.1. Present Value (PV)

$$PV = \sum_{j=1}^{n} \frac{CF_j}{(1+MARR)^j} \quad (1)$$

2.3.2. Net Present Value (NPV)

$$NPV = \sum_{j=0}^{n} \frac{CF_j}{(1+MARR)^j} \quad (2)$$

2.3.3. Annualized Net Present Value (ANPV)

$$ANPV = \sum_{j=0}^{n} \frac{CF_j}{(1+MARR)^j} \quad (3)$$

2.3.4. Cost Benefit Index (CBI)

$$IBC = \frac{\sum_{j=0}^{N} \frac{CF_j}{(1+MARR)^j}}{|CF_0|} \quad (4)$$

2.3.5. Additional Return on Investment (ROIA)

$$ROIA = \sqrt[n]{CBI} - 1 \quad (5)$$

2.3.6. Ratio of the Additional Return on Investment Over the Minimum Attractive Rate

$$ROIA/MARR = \frac{\text{ROIA}}{MARR} \quad (6)$$

2.3.7. Internal Rate of Return (IRR)

$$\sum_{j=1}^{n} \frac{CF_j}{(1+IRR)^j} = 0 \quad (7)$$

2.3.8. Payback

$$Payback = \sum_{j=1}^{n} \frac{CF_j}{(1+MARR)^j} \geq |CF_0| \quad (8)$$

2.3.9. Payback/N quotient

$$Payback/N = \frac{Payback}{N} \quad (9)$$

Where: N= time period proposed in the project.

2.3.10. MARR/IRR Quotient

$$MARR/IRR = \frac{\text{MARR}}{TIR} \quad (10)$$

2.3.11. Revenue Commitment Degree

In addition to the calculated financial estimators, the project also considers the Revenue Commitment Degree (RCD) as an index to estimate the percentage of the project's revenue that will be allocated to cover expenses. The RCD is estimated by the equation:

$$RCD = \frac{\text{Settlement revenue}}{\text{Maximum revenue}} \quad (11)$$

2.4. Market Management Risk

Business Risk (BR) will be used as a way of evaluating the risks inherent to the market activities that it is intends to cover. The BR will be estimated through SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats). Finally, Management Risk (MR) will be used to estimating the company's competence management of the professionals involved, through structured interview (0 to 9 scores) with the project investors and stakeholders [16].

3. Results and Discussion

3.1. Municipality and Agricultural Property Description

The preliminary implementation of the sweetpotato production project was carried out on an agricultural property established in the rural area of the municipality of Nova Soure, northeastern region of the state of Bahia. The municipality has a population of around 27,047 thousand people, distributed and allocated over a total area of 966,933 km². The local Human Development Index (HDI) is in the range of 0.555. For comparison purposes, Nova Soure has an HDI that is 26.39% below the national average, which is in the range of 0.754 [14].

Municipal economic activity is based on the provision of services and the trade of products, both inherent to activities focused on agriculture and farming. The highlight is the production of corn, forage crops, silage, passion fruit, beans, cassava, cashew, and livestock. Beekeeping is also explored in the region. However, it is estimated that only 6.0% of the population of Nova Soure is employed in a job with formal registration. The vast majority of people obtain their financial income from temporary work occupations, which are highly valued as agricultural labor [14].

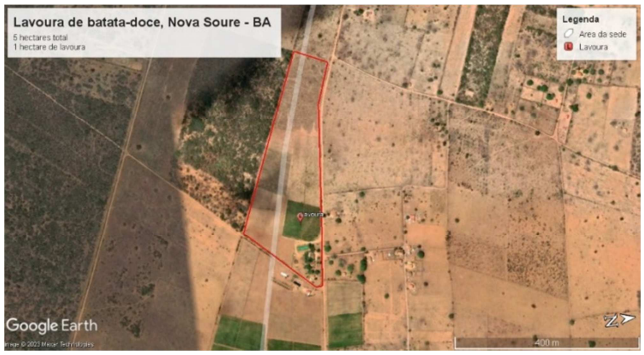

Figure 1. *Sweetpotato rural production area in Nova Soure - Bahia, Brazil. Source: Google, 2023.*

There is a great interest in composing new labour proposals aimed at rural production, which may be capable of promoting

the economic and financial development of the rural community in the place where the project was located. This aspect demonstrates the social responsibility that the sweetpotato production agricultural project entails for the selected region. Figure 1 illustrates the rural property proposed for the installation of sweetpotato farming.

The rural property in question has as its main access point a local road starting on the BA-084 road, in the area that connects the municipalities of 'Biritinga' to 'Nova Soure'. Technical considerations regarding access to a rural property can be a significant factor for the flow of the productive crop, in this case the sweetpotato tuberous root crop.

The total area is 5 hectares, including improvements typical of a rural property, but with limitations that are inherent to the region. There is a small mixed brick and wattle house, an older external room that was already unused and was adapted to be used as a storage room for supplies. There is another external room that is intended to be adapted for transit storage of tuberous root production in the future.

Regarding the irrigation sector, the property has a reservoir measuring 1.70 m deep, 3 m wide, and 7 m long, sealed with a canvas and suitable for storing water. The artesian well has a total depth of 60 m, with 40 m of static level and 20 m of dynamic level. The well pump is a pen type, with 3 hp of power, which transfers the water to the reservoir and, once stored there, there is a frog-type pump with centrifugal power of 5 hp, which carries out the irrigation directed to the crop area.

The plots intended for planting crops are delimited in half a hectare, and have a system of individual registrations on the streets, and drip tapes in the planting area. The drip tapes are from the Rivulus brand, with a 30 mm slot opening, which deliver both water and water-soluble inputs via a fertigation system coupled at the beginning of irrigation.

3.2. Production Technical Variables

Decision-making regarding the implementation of the project is based on four aspects that have the greatest influence on the agricultural production process: physical aspects, human aspects, financial and economic aspects.

The physical factors were weighted through the environmental soil and climate conditions of the region, as well as the characteristics of the soil for implementing the cultivation. The rural area is located in the dry 'caatinga' biome, with a predominant semi-arid tropical climate. The most striking climatic characteristic are the dry spells, that is, periods of prolonged drought with low rainfall and strong heat, mainly in the month of May of the agricultural year, affecting the off-season planting window. According to data from the National Institute of Meteorology of Brazil (INMET), available in the time frame between 1991-2020, the annual accumulated precipitation in Nova Soure is in the range between 600 and 850 mm of rain [15].

As it is a rustic crop, sweetpotato plants have a basic water requirement of minimum consumption in the order of 500 mm to 800 mm of rainfall during their productive period. The greatest demand for water occurs during the plant installation phase, until the first 45 days of emergence [32]. These conditions mean that sweetpotato cultivation in the Nova Soure region meets the minimum physiological needs of the plant's development.

The soil in the area was initially subjected to a physical-chemical analysis to characterize its initial composition. This action is essential for effective management recommendations to be made, regarding possible necessary corrections. Table 1 illustrates the results obtained from the analysis of soil macro and micronutrients.

Table 1. *Physicochemical analysis of soil from crop field.*

Soil sample	Maconutrient properties*												
	pH	P	K	Ca+Mg	Ca	Mg	Al	H+Al	Na	S	CTC	V	M. O.
		mg/dm^3		$Cmolc/dm^3$								%	g/dm^3
1331	4,40	30,00	63,00	1,40	0,90	0,50	0,30	2,76	0,04	1,60	4,36	36,69	12,40
1332	5,30	38,00	78,00	2,00	1,50	0,50	0,10	2,56	0,04	2,24	4,78	46,86	11,80
	Micronutrient properties*												
	Zn	Fe	Mn	Cu	B								
	Mg/Dm3 –Mehlich												
1331	1	5,4	1,1	0,8	0,4								
1332	0,9	4,3	0,8	0,5	0,3								

*pH: hydrogen potential, P: phosphorus, K: potassium, Ca: calcium, Mg: Magnesium, Al: aluminum, Na: sodium, S: sulfur, CTC: cation exchange capacity, V%: base saturation, M. O.: content of organic matter, Zn: zinc, Fe: iron, Mn: manganese, Cu: copper, B: boron. Source: Original research data.

To compose the human work parameters in the project, technical factors related to intellectual management for the implementation of the production proposal were considered, together with the need for collaborators for the local workforce destined for operational labour actions. It is worth highlighting that the agricultural project was designed based on a doctoral thesis defended and approved in 2022 which highlighted, through high-impact scientific publications, the productive, nutritional and benefiting potential that national sweetpotato cultivars have [18, 19].

Recommendation reports for soil nutrition, together with production management, were established based on the data illustrated in Table 1. Temporary operational collaborators were hired from the local community called "Panasco". The purpose of this action is to establish the project as a positive catalyst for the economy of the village in which the project is located.

The financial aspects were estimated based on regional

market characteristics, and the fact that these respective sweetpotato cultivars had never before been produced in the state of Bahia. These attributes indicate that there is potential for market growth for this type of food. Bear in mind that a period of time is necessary during the preliminary implementation phases in which the project needs to transit with negative profit. Only after harvesting and marketing some crops is that production can be financially sustainable, and provide return income to investors and local collaborators.

The economic dimension of the project is based not only on the financial benefits that those involved will be able to achieve, as in addition to the capital factor, the nutritional and sensory benefits related to the opportunity to consume a biofortified food, highly nutritious and beneficial to consumers health [19].

3.3. Relationship of Project Costs, Investments and Cash Flow

The development of a project based on agriculture requires full attention to production and fiscal aspects. The risks inherent to the sector require that rural producers have a fiscal organization to fully manage the financial resources that are spent on activities, with a focus on the search for the profitability of their crops [10].

The calculation of the financial results of the rural company must be based on financial calculation tools applied to agribusiness. Cash flow fiscal spreadsheets support producers in assessing working capital, monetary resources, financing opportunities, and controlling expenses inherent to work [6, 23].

These accounting practices applied to the agricultural sector serve as a basis for evaluating the situation of the company's monetary resources, and contribute to the consideration of the return on invested capital. In the context, the costs, expenses and investments made for the preliminary implementation of sweetpotato farming were aggregated into categories such as: agricultural inputs, fuel for machinery, electricity, irrigation, labor food, and employee health. Table 2 presents the project's Cash Flow (CF), with the amounts invested and expected between July 2022 and June 2023, which are adjusted to the period of the 2022/2023 Brazilian agricultural year.

Table 2. *Cash Flow of the preliminary sweetpotato production project in the municipality of Nova Soure - Bahia.*

Investment	Agricultural year 22/23 costs (R$)												Total
	Jul/22	Aug/22	Sep/22	Oct/22	Nov/22	Dec/22	Jan/23	Feb/23	Mar/23	Apr/23	May/23	Jun/23	
Initial Cash Balance													
Money Invested	,000,00												
Operational Inputs													
Crop Sale										20,000.00			
Operational outputs													
Soil analysis		140.00											
Local community labors			100.00	550.00		400.00	600.00		300.00	300.00	600.00	200.00	
Fence			120.00										
Water truck			180.00										
Electricity Account		56.78		399.38		254.14	421.37		604.04	612.14	408.09	310.11	
Fixed irrigation maintenance			183.00	2,013.00									
Tractor fuel			350.00	939.00								200.00	
Tractor and operator rental										1,500.00		300.00	
Moving equipment				443.01	1,180.00								
Medicines				257.74									
Workers' food				686.35	31.10	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
Tractor oil				136.90									
Planting Inputs				1,650.00	1.420.00								
Electrical panel maintenance				189.90									
Total Output		6.78	3.00	265.28	531.10	4.14	121.37	0.00	004.04	512.14	108.09	110.11	
Period Net Balance	20,000.00	-196.78	-933.00	-7,265.28	-2.631.10	-754.14	-1,121.37	-100.00	-1,004.0	17,487.86	-1,108.09	-1,110.11	
Total Project Cost													18,736.05
Total entries													40,000.00
Final cash balance													21,263.95

Source: Original research data.

The estimated amounts realized in the period were recorded through invoices and tax coupons obtained for each

tax transaction. All investment items were grouped into the same set according to the nature of the activity.

Electricity bills in the area were paid directly to the Electricity Company of the State of Bahia (COELBA), through invoices linked to the area energy clock. However, due to local issues, the account was often lost, and payment was made one month late, which was added together with the subsequent amount. This procedure can be identified in Table 2.

Pre-planting work, to adapt the production site, included primary operations such as soil analysis, multiplication of branches, cleaning of the water storage tank, adaptation of part of the perimeter fence, and the use of a truck kite for general cleaning. Local labor was selected during this period, previously trained, and began operational work. The Figure A1 illustrates the cleaning activity of the water tank and two operational collaborators.

As the area was developed, certain problems with the irrigation sector appeared as it was activated. The area's irrigation system is subdivided by sectors, with one hectare corresponding to two sectors. It was necessary to start with the digging of trenches and the maintenance of irrigation pipes and canicules that feed the sectors. Therefore, the solenoid valves that open and close the automated irrigation were cleaned and reviewed. These steps made the implementation of cultivation more expensive, but it could be diluted as investment for the future growth.

There was an incident involving an overload of electrical power, which caused a power relay on the panel and the 3 hp well pump to burn out. Both were replaced and their values allocated to the irrigation maintenance and electrical panel maintenance group.

Production inputs involve investments made in the purchase of nitrogen, phosphorous and potassium chloride fertilizers. No pesticides or herbicides were used in the farming, with the aim of encouraging cultivation with organic agricultural production characteristics.

Regarding the use of the tractor for ploughing, harrowing and windrow formation services, the cost of renting the equipment was estimated based on the time of the harvest, with the final value of this service being calculated in the month of harvest (May/23). The project's operational labor was paid monthly, and the receipts are added together and displayed in the investment values. Figure A2 illustrates the tractor used to prepare the land.

Thus, the values of investments made during the agricultural year, with the implementation of the sweetpotato production project in Nova Soure were corrected according to the Brazilian General Market Price Index (IGP-M) computed in the project period. Table 3 illustrates the corrected value.

Table 3. *Correction of the total project cost according to the variation in the IGP-M index in the period.*

Index	Period											Total
	Jul/22	Aug/22	Sep/22	Oct/22	Nov/22	Dec/22	Jan/23	Feb/23	Mar/23	Apr/23	May/23	
General Market Price Index (IGP-M)	-0.70%	-0.95%	-0.97%	-0.56%	0.45	0.21	-0.06%	0.05%	-0.95%	-1.84%	-1.93%	
Total project cost for the period												R$18,736.05
Correction index												0.9295195
Correction percentage												-7.0480%
Corrected value												R$17,415.52

Source: Central Bank of Brazil, 2023.

By correcting the total value of the project by the IGP-M base index, it is possible to observe the inflationary fluctuation movement and its influence on the adjustment of the total result of the amount invested. For this calculation, the index accumulated in the period from the beginning of the implementation of the crop to the present moment was considered.

The percentage change in the index in the period was negative, and stood at -7.05%. This means that there was deflation in the evaluated period, which resulted in a drop in the updated value of the project to the present moment.

It is extremely important to correct project values based on an inflation indicator so that the financial statement, as well as the viability of the project, are reliable for making investment decisions.

To develop the financial feasibility study, costs and investments were detailed according to investment groups. Thus, in the month of harvesting the crop and its commercialization for the correct calculation of sales results, the cash flow considered all fixed costs, variable costs, as well as machinery rental and the rural producer's income tax estimate.

The harvest was carried out in April 2023, and a small plot area was replanted, which was considered the off-season window of the 2022/2023 agricultural year. It is worth highlighting that sweetpotatoes are a crop that can be reproduced through plant propagation using the branches. The costs of the off-season were omitted so that the study of the economic and financial viability of production can estimate the results of an independent harvest. Therefore, the project is also suitable for the production characteristics of a temporary culture.

3.4. Financial Viability Indicators and Estimates

The biofortified sweetpotato production project in the rural community “Panasco” of Nova Soure is unprecedented for the region. Before it, there was no data or study that could be used as a witness for the composition of production costs.

Therefore, it was necessary to make an initial investment of R$ 20,000.00 to carry out the preliminary project, which included soil adaptation work, improvements in the area,

implementation of farming, harvesting and marketing. With the costs carried out on site, it was possible to project the future financial estimates necessary for the design of the lasting project. With the sale of 10 tons of sweetpotatoes at an average price of R$2.00 per kilogram, it was possible to pay off the preliminary investments and thus obtain the possibility of negotiating for the great project (Table 2).

Based on this preliminary information, an investment amount of R$60,000.00 was estimated for the implementation of the larger project and the execution of the necessary operational steps, such as the generation of a mother-plant bed, rental of machinery and operator, renovation of the farm and planting the new crop. Management tends to seek to increase productivity, with the aim of generating an average of 13 tons of sweetpotatoes, in a harvest period of 120 to 150 days. Table 2 illustrates the composition of the effective cash flow for a complete harvest, with the amount of R$20,000.00 per harvest. It is worth highlighting that, with the preliminary development of the project, there is an interest in generating new tie-in sales agreements with the minimum sales price locked at R$ 2.00 per kilo, so that there is greater reliability for the producer regarding minimum income from agricultural services.

The negotiation of a new capital contribution resulted in the MARR being anchored in three possible future scenarios, based on the current rate of the Special Settlement and Custody System (SELIC), currently at 13.75% (period of the project). Thus, the minimum attractiveness rate for the investor varied between 10%, 11.50%, and 13.75%, considering a personal capital investment, with a time frame of six years of agricultural work. Furthermore, the calculations estimated the payment of 15% on the gross profit as Personal Income Tax for the rural producer.

Thus, Figure 2 illustrates the financial movement of the sweetpotato cultivation project's cash flow, and Table 4 demonstrates the financial movements, including estimates of the project's payback considering the capital discount depending on the different minimum rates of attractiveness.

Table 4. *Input, capital movement and payback period discounted from the project's minimum attractiveness rates.*

Years	Investment	Gross Cash Flow	Income Tax Amount	Capital Deducted from Income Tax	Decapitalized Cash Flow ARR 10%	Accumulated Decapitalized Cash Flow ARR 10%	Decapitalized Cash Flow ARR 11.50%	Accumulated Decapitalized Cash Flow ARR 11.50%	Decapitalized Cash Flow ARR 13.75% Accumulated	Decapitalized Cash Flow ARR 13.75%
0	-60,000,00	-60,000.00		-60,000.00	-60,000.00	-60,000.00	-60,000.00	-60,000.00	-60,000.00	-60,000.00
1		20,000.00	3,000.00	17,000.00	15,454.55	-44,545.45	15,246.64	-44,753.36	14,945.05	-45,054.95
2		20,000.00	3,000.00	17,000.00	14,049.59	-30,495.87	13,674.11	-31,079.25	13,138.51	-31,916.44
3		20,000.00	3,000.00	17,000.00	12,772.35	-17,723.52	12,263.78	-18,815.47	11,550.34	-20,366.10
4		20,000.00	3,000.00	17,000.00	11,611.23	-6,112.29	10,998.91	-7,816.57	10,154.14	-10,211.95
5		20,000.00	3,000.00	17,000.00	10,555.66	4,443.38	9,864.49	2,047.92	8,926.72	-1,285.23
6		20,000.00	3,000.00	17,000.00	9,596.06	14,039.43	8,847.08	10,895.00	7,847.67	6,562.43

Source: Original research data.

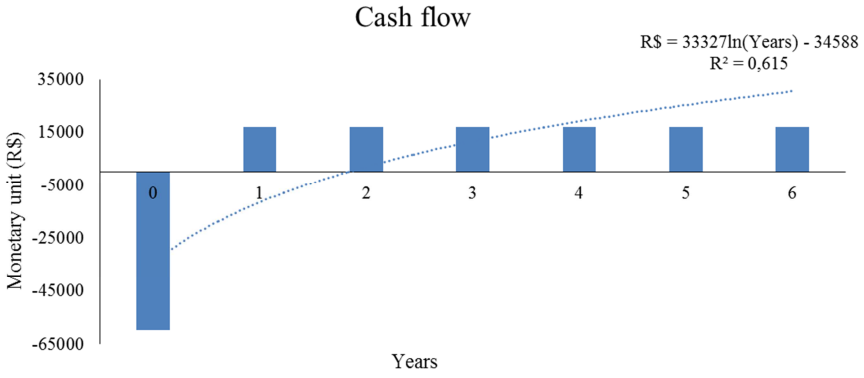

Figure 2. *Cash flow of the sweetpotato project. Source: Original research data.*

The results presented in Table 4 illustrate three scenarios for recovering capital invested depending on the cost linked to different MARR. Considering the MARRs of 10% and 11.50%, the Discounted Payback of the project occurs from the fourth to the fifth year with the return of the initial investment, where from the fifth year onwards it is possible to achieve greater profitability with the proposed agricultural activity. This temporal perspective is corroborated by Figure 2, which demonstrates the tendency for a turning point in cash flow precisely in the fourth year. However, once the minimum attractiveness rate of return is anchored at 13.75%, this will result in a longer discounted payback, occurring only from the fifth to the sixth year, with a smaller profitability margin to the farmer.

Discounted payback estimates are of great value for the perspective of returning the initial investment to run the project, thus giving greater credibility to the investor. The return-on-investment time is crucial for reliability in the initial capital expenditure. From these results, the attributes for evaluating the sweetpotato cultivation investment project

in the municipality of Nova Soure were estimated. Table 5 presents the results obtained for the financial return on investment indicators.

Table 5. *Financial return indices for the sweetpotato project.*

Financial return indicators	Minimum Attractiveness Rate of Return		
	10%	**11.50%**	**13.75%**
Present Value (R$)	74,039.43	70,895.00	66,562.43
Net Present Value (R$)	14,039.43	10,895.00	6,562.43
Annualized Net Present Value (R$)	3,223.56	2,612.53	1,676.04
Cost Benefit Index (R$)	1.23	1.18	1.11
Additional Return on Investment (%)	3.57%	2.82%	1.74%
ROIA/MAR quotient (%)	35.66%	24.52%	12.69%

Source: Original research data.

According to Table 5, considering the initial contribution of R$60,000.00, the return on the agricultural activity of producing and selling sweetpotatoes may vary depending on the MARR signed in the agreement. With the MARR of 10%, 11.50%, and 13.75%, the return on capital decreases from R$74,039.43, R$70,895.00, and R$66,562.43, with a net return between R$14,039. 43, R$ 10,895.00, and R$ 6,562.43, respectively.

In the 6 years in which the activity will be carried out, the Annualized Net Present Value varied from R$ 3,223.56, R$ 2,612.53, to R$ 1,676.04. The Cost Benefit Index, which represents the projection of monetary profit for each real invested in the implementation of the intended activity, which resulted in R$ 1.23 with MARR 10%, R% 1.18 with MARR 11.50%, and R$1.11 with the MARR at 13.75%. These values are in line with the additional return on investment, which was 3.57%, 2.82% and 1.74%, with this percentage being achieved more than the minimum attractiveness rate for each financial scenario in question.

Thus, the quotient that results from the division between the additional rate return on investment and the minimum attractiveness rate reveals that the return on capital measured by making the decision to implement the project is around 35.66%, 24.52 %, and 12.69%, for each of the TMA evaluated. This specific indicator is a base factor for decision-making regarding agreements for investment in the project, considering the expenditure of equity capital.

After analyzing the values related to return attributes, it is necessary to address indicators regarding the risk that the sweetpotato planting project in Bahia may pose to investors. Therefore, Table 6 presents the results of the calculations regarding the project risk.

Table 6. *Financial risk indices for the sweetpotato project.*

Project financial risk indicators	Minimum Attractiveness Rate of Return		
	10%	**11.50%**	**13.75%**
IRR (%)	17.65%	17.65%	17.65%
Payback (years)	5 years	5 years	6 years
Payback/N Index (%)	83.33%	83.33%	100.00%
TMA/IRR index (%)	56.66%	65.16%	77.91%

Source: Original research data.

Based on the data presented in Table 6, it is possible to assess the project's risk perspective. The Internal Rate of Return from a risk perspective reveals the maximum limit value that can be adopted in relation to the Minimum Attractive Rate of Return that results in the project's Net Present Value being zero, this limit being 17.65%. As for the project's Payback, the 10% and 11.50% MAARs have a payment horizon for the contribution in the harvest sold in the fifth year, but the 13.75% MARR only makes payment in full in the sixth year.

This risk related to the recovery period of the capital contribution is corroborated by the index obtained by dividing the Payback by the period in which the project is intended to be carried out, in this case 6 years. This index is 83.33% for MARR 10% and 11.50%, and 100% for MARR 13.75%, indicating that the project must promise at least 83.33% of the entire period to be paid off.

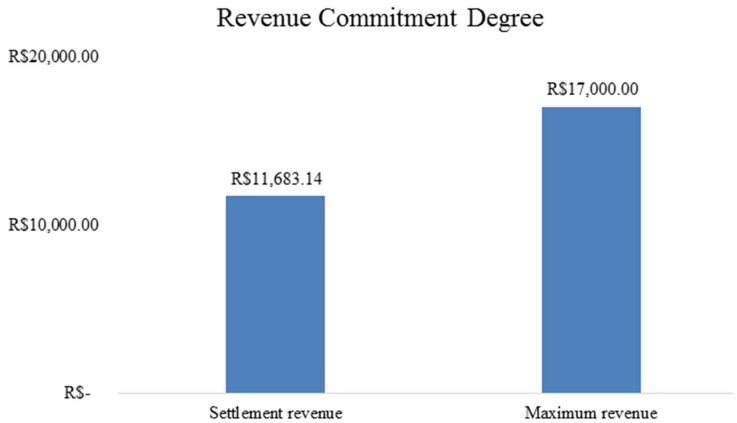

Figure 3. *Revenue Commitment Degree. Source: Original research data.*

The results of the ratio between MARR and IRR indicate that the risk of non-settlement regarding the investment varied between 56.66% (MARR 10%), 65.16% (MARR 11.50%), and 77.91% (MARR 13.75%). The greater the increase in the value to be agreed to attract and obtain the investment, the greater the associated risk of insolvency regarding the discharge of this commitment. Figure 3 presents the graph for the item Revenue Commitment Degree.

The Revenue Commitment Degree was estimated based on two indicators: settlement revenue and maximum revenue. The settlement revenue is obtained with the sum of the investments necessary for the production cycle, with values for pre-planting, planting and management, harvesting and renovation, with the inclusion of values for machinery, fuel, labor, fixed accounts and variable accounts, which were determined during the preliminary implementation of the project. For the balanced revenue, partial costs measured between October 2022 and February 2023 were allocated.

The maximum revenue derives from the capital received with the sale of the sweetpotato crop, deducting from the gross value (R$ 20,000.00) the rural producer's income tax rate (15%). Thus, the degree of revenue commitment contributes to the perception of operational risk embedded in the project.

From the payment of all expenses during the production period, it is possible to observe that the Revenue Commitment Degree is 68.72%. In this way, the agricultural activity that the project proposes has a profitability margin of 31.27%, which guarantees greater security for investors and project collaborators.

Consideration of operational risk indicators can provide support regarding the perception of uncertainties associated with decision-making for investment in the biofortified sweetpotato growth project in Nova Soure - Bahia, Brazil. In this context, it is necessary to pay attention to activities aimed at greater efficiency in the process, aiming to lower fixed costs and postpone the increase in variable costs over time.

It is also worth considering the likely benefits that sweetpotato production may confer on the environment, and describing the importance of the project under social conditions. All of these factors contribute to the greatest adjustment of information for the development of the project within the estimated time horizon of six years.

3.5. Economic Viability Indicators and Estimates

The strategic management of an agricultural company is essential for maintaining its activities, including its market survival. In addition to the stochastic indicators considered from the financial analysis of the biofortified sweetpotato production agricultural project, the activities inherent to the success of that enterprise must be aligned with broader. economic attributes. Within this perspective, the proposed Business Risk (BR) was examined with the help of the SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis tool.

Decisions to operationalize the agricultural business must be anticipated and exercised rationally, based on the movement of the retail market for basic inputs (link that precedes production), as well as the marketing of horticultural products (product shipping link).

The SWOT analysis is based on the culture implemented in the company, and serves as a tab for strategy tools. These actions encourage the construction of a competitive advantage, both in the production process and in commercial positioning.

The project's essence is to offer consumers the opportunity to eat a genuinely Brazilian, nutritious and biofortified sweetpotato cultivars, which is the result of a national genetic improvement program for the crop. Tuberous roots have been used as a research object for over eight years. Its nutritional quality is corroborated by cutting-edge scientific research, including the publication of high-impact scientific articles in renowned scientific journals. Thus, the product provided by the project is capable of contributing positively to maintaining the health of its consumer.

But from a market point of view, it is necessary to consider the influences on the internal and external environment. For the external environment, the evaluation was carried out under the action of suppliers and competitors. Suppliers are seen as partners in the project, with the aim of negotiating better prices for purchasing inputs, while competitors may be interested in the production and commercial exploitation of these foods.

It is worth highlighting that this is the first time that an agricultural project based in Bahia seeks to promote the specific production of these national sweetpotato cultivars, which corroborates the originality of the work.

From an internal perspective, the resources and capabilities intrinsic to the project were appreciated. With the technical quality for developing the harvest management plan (Table 1), operational collaborators are hired from the local community, who have the empirical qualities of the rural producer. These requirements make the project suitable for agricultural management.

Based on this information, the SWOT table was constructed, but with the grace of cross-referencing the results so that new information is revealed. And so, the project's guidelines were described and an action strategy was established. Table 7 illustrates the cross-SWOT analysis proposal dedicated to mitigating the BR of the project.

Table 7. *Cross SWOT analysis chart of the sweetpotato production project.*

Environments	Opportunities	Threats
External	Sales agreements	New producers
Internal	Unreleased product	Increase in supply
	Consumption predilection	Remuneration

Environments	Opportunities	Threats
Strengths Technical Quality Originality Social commitment	Growth orientation	Defense guidance
Weakness Scarce infrastructure Commercial middleman Costs	Interest in strengthening	Fragility condition

Source: Original research data.

The information presented in Table 7, under the nuances of the SWOT analysis tool, were only possible to be assessed after the preliminary implementation of the project which resulted in a better adjustment of the services. From the SWOT composition, it was possible to cross-reference the independent variables, and their results indicate guidelines for action.

The strategy's orientation is established based on the best alternatives available to the project, with the clear objective of creating a competitive market advantage. This information is crucial for improving perceptions regarding investment decision-making and process development.

The competitive dynamics to be implemented within the six-year time horizon of the work is aligned with the levels of the horticultural agricultural market, which demands a greater control in internal and external implementation. In this aspect, strategic implementation was subdivided into two levels, which are responsible for organizing the actions that proved to be assertive, so that what worked can improve even further. On the other hand, the actions that present failures and that can increase the perception of risk must be reassessed with a focus on adjusting actions.

The two distinct levels formed with the preliminary activities were the administrative levels and the operational levels. The administrative level is responsible for working with guidelines for growth and interest in fortification, with the aim of generating new sales contracts, improving the infrastructure available to operators, as well as evaluating critical control points that can mitigate process costs.

The operational level tends to work with aspects focused on defense guidance and supporting the condition of vulnerability, through the search for employee engagement, management of field work, operations, distribution and assessment of consumption preferences for tuberous roots, and partnerships with future producers, as well as vendors who sell the harvest.

Thus, with continuous monitoring of the implementation of work strategies at administrative and operational levels, the aim is to achieve greater quality, which should be reflected in increased internal and external efficiency of the project, within the work planning horizon (six years).

In this context, the aspects for controlling management risks were evaluated by carrying out a structured 9-point survey, in which four questions related to the commercial, process, administrative and social areas can be addressed. Figure 4 illustrates the results obtained.

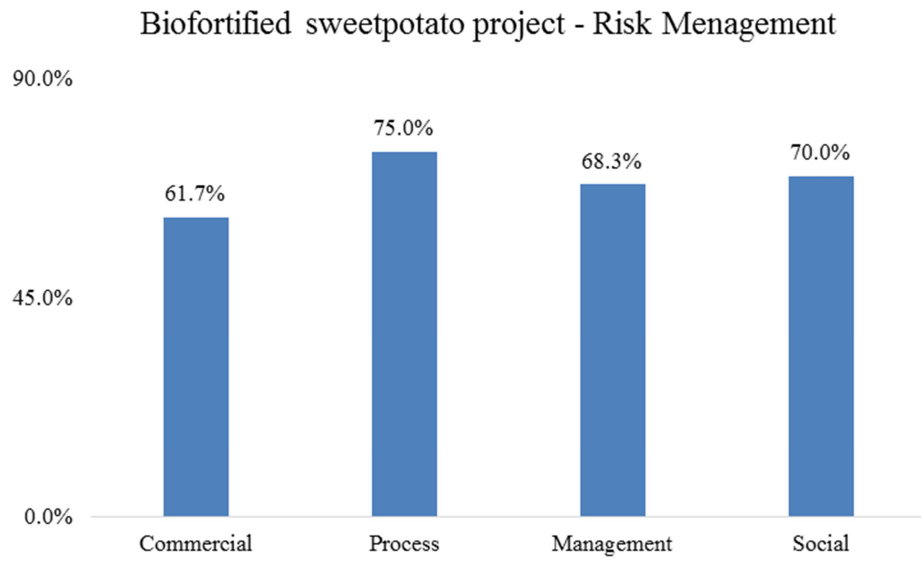

Figure 4. *Investors' perception regarding project management risk. Source: Original research data.*

Based on the analysis of the results presented in Figure 4, the assessment of management risk was approached in detail in the areas in which investors demonstrated greater risk perception. The evaluation form used in this stage is presented in Table A1.

The sectors managing the sweetpotato production process, as well as the analysis of the social area that involves hiring local employees as labor, were the areas with the best

evaluations in the questionnaire. These data can be corroborated by the technical experience of managers regarding theoretical knowledge about agricultural management.

From a social aspect, residents of the 'Panasco' rural community were able to improve their income composition, and also demonstrated appreciation for the new varieties of sweetpotatoes, especially regarding the opportunity to consume a healthy and nutritious food.

Regarding administrative and commercial management attributes, it must be considered that low scores reflect specific decision-making in the commercial relationship of product sales. This perception can be crossed precisely with the SWOT analysis (Table 7), in which the activities intrinsic to these sectors were aligned with the sectors of weakness and threats.

Therefore, the administrative and operational strategy for the time horizon of project activities (six years) must consider the information obtained from the SWOT analysis, and carry out monitoring capable of mitigating risks and improving the management environment as a whole. It is worth to observe that these activities can even improve the future performance of the project (Table 4).

Therefore, management risk analysis is crucial so that there is greater control over the qualities and capabilities of the group, which is premised on monitoring and developing the project. Furthermore, it is necessary to take into account the development of a concept of positive externality regarding the continuous supply of healthy, safe, nutritious and sustainable food.

Finally, the wisdom that comes from the work suggests that the agricultural project is capable of generating future value for financial investors, collaborators, consumers, and for the rural community in which the development of the biofortified sweetpotato production crop takes place, in this work at Nova Soure – Bahia, Brazil.

4. Conclusion

The development of studies that were based on the assessment of the economic and financial viability of an investment project is a crucial factor for the concise qualification of the challenges and market opportunities in which the work activity is proposed in its exercise.

Agriculture is an activity that stands out for its ability to provide basic food for the human population, whether for consumption or processing. The sweetpotatoes were a nutritious food, capable of contributing positively to maintaining the health of its consumer. However, commercial activity requires a thorough analysis due to the high risk inherent in agricultural work. This is the first economic and financial feasibility study for the production of biofortified sweetpotatoes in Nova Soure - Bahia, Brazil. The fiscal premise was adopted via the Multi-Index Methodology, with the aim of evaluating the feasibility of future development of the proposed works.

To this end, an investment of R$60,000.00 was established, in which the minimum attractiveness rate of return was considered in three scenarios: MARR 10%, MARR 11.50%, and MARR 13.75%. For each case, respectively, the financial return indices varied from: PV R$ 74,039.43, R$ 70,895.00, R$ 66,562.43; NPV: R$ 14,039.43, R$ 10,895.00, R$ 6,562.43; ANPV: R$ 3,223.56, R$ 2,612.53, R$ 1,676.04; CBI: R$ 1.23, R$ 1.18, R$ 1.11; ROIA: 3.57%, 2.82%, 1.74%; and ROIA/MARR quotient: 35.66%, 24.52%, and 12.69%. Likewise, the investment project's risk indicators resulted in: IRR: 17.65%; Payback 5 years (MARR 10% and 11.50%), and 6 years (MARR 13.75%); Payback/N Index 83.33% (MARR 10% and 11.50%), and 100% (MARR 13.75%); and MARR/IRR Index of 56.66%, 65.16%, and 77.91%, respectively.

According to the basis provided by the financial analysis of return and risk, and based on the results of the indicators that make up the evaluation of the investment project, the study recommends the approval of the work based on the MARR of 11.50%. This perception brings together the best alternative of financial attractiveness that the works can settle, taking on the lowest market and default risk.

Regarding economic indicators, business risk was weighted using indicators from the cross-SWOT analysis, just as management risk considered the perception of the group of investors. The Revenue Commitment Degree shows that the proposed activity is healthy, being able to pay for itself at its break-even point (68.72% of revenue), and generate profit (31.27% of revenue) for employees and investors. These indicators were able to contribute to improving risk perception regarding management capacity and assertive development of the work strategy proposal. The decision makers' conclusion regarding the project's financial investment is positive, and they recommend the use of the strategies described here for the smooth progress of future work.

Suggestion for Future Work

Brazil has excellence in activities linked to the agriculture, livestock and agribusiness segments. Financial investment in sweetpotato agricultural production is justified by both the climate and the available soil, which are conducive to the development of the crop. As a suggestion for future work, it is necessary to expand the economic and financial analysis model to encompass new scenarios of production, commercialization and use of tuberous roots and their by-products, in order to contribute positively to the strengthening and expansion of the brazilian sweetpotato production chain. Thus, Brazil will be able to benefit not only from the generation and delivery of excellent food, but also from the use of a rich raw material, capable of adding value in different segments of the national industry.

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Appendix

Figure A1. *Cleaning the water tank and local 'Panasco' community collaborators.*

Figure A2. *Soil preparation of the planting area of the preliminary sweetpotato production project.*

Table A1. *Risk management assessment form judged by the project investor team.*

Assessment of investors' perception regarding the management risk of the sweetpotato production project in the municipality of Nova Soure – Bahia.	
Name:	Age:
Please rate on a scale of 1 to 9 what is your assessment of the project management risk, according to the following questions:	
9 – Extremely good; 8 – Very good; 7 – Regularly good; 6 – Slightly good; 5 – No opinion; 4 – Slightly bad; 3 – Regularly bad; 2 – Very bad; 1 – Extremely bad.	Your analysis regarding the competence of the project's Commercial management: (___) What is your assessment regarding the conduct of the Process carried out in the preliminary phase? (___) Was the management of internal and external issues of the project? (___) What was your assessment of social relations with project collaborators? (___)

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