International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 8 Aug 2021, pp: 316-322 www.ijaem.net ISSN: 2395-5252

Economic Analysis of Coffee Production: A Feasibility Study for Coffea Canephora Pierre Ex Froehner in Espírito Santo, Brazil.

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Submitted: 01-08-2021 Revised: 07-08-2021 Accepted: 10-08-2021

ABSTRACT: The aim of the study was to analyze the economic viability of a culture of conilon coffee (Coffea canephora Pierre ex Froehner) located in the city of Pines in the state of Espírito Santo. The methodology used in this study performed the calculation of cash flow where net present value indicators, internal rate of return, cost / benefit and risk premium was calculated. The study indicated the economic viability of farming conilon a hurdle rate of 8.5% per annum coffee, with an Internal Rate of Return of 13.1% and a risk premium of 4.6%, in order to generate a positive net revenue in its production phase. Thus, this culture can be considered an attractive option for producers in the city of Pinheiros in the state of Espírito Santo, Brazil.

KEYWORDS: Economic viability. Conilon coffee. Indicators. Brazil.

I. INTRODUCTION

Brazil is the world's largest producer and exporter of coffee and the second in terms of its consumption [14]. Coffee growing is one of the most important activities in the agricultural sector, contributing to the country's socioeconomic development. According to Ferrão et al. [8] coffee growing is an important social and economic activity worldwide. In Brazil it presents itself as an essential business, reflecting positively on the trade balance [18, 8].

Espírito Santo is the second largest coffee producer in Brazil. Since the end of 2010, the weather conditions have been frankly favorable and the total production of the state (Arabica + Conilon) closed the 2011 harvest with an increase of 15%, 709,496 tons (11.8 million bags), due to the average yield 25.3 bags per hectare, the largest in the country, considering the two species together [14]. In Espírito Santo, Brazil, there was a decrease in the harvested area (-1.3%) and the value of production in the state increased by 68%, from R$ 1.8 billion in 2010 to R$ 3.7 billion in 2011 [14].

The Brazilian Coffee Industry Association [3] mentions that 73.9% of the Brazilian coffee production is of the Coffea arabica species and 26.1% of Coffea canephora. The varieties that make up the Coffea canephora species, known as robustas or conilon coffee, have their highest production in the state of Espírito Santo, corresponding to 71% of the national production (ABIC, 2011). Conilon coffee, although of a slightly lower quality than Arabica in relation to the drink, competes in the international market because it is quoted at a lower price and because it is used in blends and in the soluble coffee industry, as it allows high extraction of soluble solids [4].

The decision to invest in any productive activity is based on mathematical criteria, agroclimatic aptitude, market factors and knowledge of the market situation, which indicate the potential of a certain crop to generate gains over the life of the facilities. According to Santana [23], the use of investment project feasibility indicators aims mainly to reduce the risks associated with a given production, so that the entrepreneur has a forecast of profit or loss that the project can generate.

Given this panorama of economic feasibility investigation in the agroindustry environment, this study carried out an economic analysis of a conilon coffee plantation (Coffea canephora Pierre ex Froehner), located in the municipality of Pinheiros in the state of Espírito Santo. To achieve this objective, the analysis structure of Matos [13] was adopted, where the cash flow for the production of conilon coffee was elaborated and the economic indicators were obtained: Net Present Value (NPV), the Internal Rate of Return (TIR), the Benefit/Cost Ratio (Rc/b), and the Risk Premium (PR).

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Research with this profile is justified insofar as: it enables the knowledge of costs and revenues of activities per year, in order to favor the planning of these activities that involve culture and its prevention against cash imbalances; represents an effort towards improving the application of the indicators used; and clarifies to the farmer the returns and risks related to the conilon coffee culture.

II. THEORETICAL FRAMEWORK

Quantitative and qualitative analyzes are of great importance in the evaluation of economic activities with undertakings in general. Numerous studies seek to improve these analyzes and achieve the maximum of what each indicator makes available. Among the economic instruments for the feasibility of projects used, the following stand out: the Cash Flow, Net Present Value (NPV), the Internal Rate of Return (IRR), the Benefit/Cost Ratio (Rc/b) and the Risk Premium (RP).

Below, we present some studies that addressed economic instruments for the feasibility of projects in order to contribute to the understanding of the scope of these instruments in the decision-making process. The mention of each of these instruments occurred in this investigation in the material and methods item, where the economic feasibility analysis criteria used are established.

The studies by Pires and Bastos [21] investigated through the analysis of the profitability of the exploration of the corn and soybean crop, with a time horizon of one year, if the use of Pronaf resources is viable. The investigation by Sperotto et al. [26] addressed the economic-financial feasibility of implementing a cotton plantation on a rural property with 5,540 hectares located in the municipality of Costa Rica, in the State of Mato Grosso do Sul.

The work by Pavan et al. [19] aimed to analyze the economic-financial viability of eucalyptus production in Rio Grande do Sul, where the NPV and IRR generated for the energy and cellulose channels by distance from producer to consumer of 50km to 400km were determined.

The studies by Secaf et al. [25] addressed the analysis of economic-financial feasibility from the possibility of using agricultural diversification (Agroforestry Systems) as a viable alternative for the cultivation of cupuaçu in the micro-region of Itaituba, in the Middle Tapajós. The investigation by Lima et al. [11], studies the economic feasibility of implementing an apiary in the region of Taquara, on the 150 hectares Oliveira site, located in the rural nucleus of Planaltina in the Federal District.

The research by Lima and Mendes [12] aimed to indicate the possibility of verticalization of cocoa production in the Transamazônica, state of Pará, analyzing the economic-financial feasibility, with a five-year horizon. Studies by Arêdes and Pereira [5] developed an economic analysis of Arabica coffee production through simulations for low and high productivity systems. According to the economic indicators, both production systems proved to be economically viable, although the activity has a high level of risk, especially the system with low productivity.

III. MATERIAL AND METHODS

3.1 Description of the area

The municipality of Pinheiros, in the state of Espírito Santo, located at latitude 18° 24' 44" S, longitude 40° 12' 55" W, with an altitude of 120 m, has a land area of 970.85 km² and is 286 km away from the state capital, Vitória [1]. According to Lani et al. [10], in the State of Espírito Santo, conilon coffee is cultivated in places with altitudes below 500 m, with a hot climate. Relief ranges from smooth wavy to rugged. Rainfall is irregular throughout the year, usually with water deficit, the soils are of low natural fertility and with little water storage capacity. Coffee and fruit production, along with dairy and beef cattle, in addition to the cultivation of cassava, beans and corn are the main economic activities developed in the municipality of Pinheiros, and the trend is for an even greater expansion, taking advantage of the enormous potential offered. The municipality of Pinheiros is the 8th in the national ranking of coffee production [14].

3.2 Description of the species

Originating in the low, hot and humid regions of the Congo River basin (Africa), Coffea canephora is adapted to conditions of high temperature. Areas suitable for planting coffee must have rainfall between 1,000 and 2,000 mm/year; regions with a water deficit greater than 200mm/year should receive artificial irrigation. Maximum altitude of 500m for plantations [24]. These climatic conditions are similar to those in the state of Espírito Santo, Brazil, which is why the Coffea canephora species develops very well in this state.

Conilon coffee (Coffea canephora Pierre ex Froehner) belongs to the Rubiaceae family, a plant that can reach 5m in height. The leaves are larger (lighter green color and more prominent veins) than those of Arabica coffee. In dry periods they hang down, grouping on top of each other making it difficult to lose water. Pivoting root system.

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Flowering occurs in a concentrated way (one main flowering, plus two small ones), it occurs until the last rosette at the end of the branch. From the beginning of flowering to maturation elapses 315 days [24]. Its fruits vary in size, shape and color from plant to plant and can be large, medium or small, in rounded or long (curvy) shape, color ranging from dark red to light pink when ripe. The beans have light green endosperm, covered with a brown film, are rich in caffeine and have a high content of soluble solids [24].

3.3 Criteria for economic feasibility analysis

According to Souza and Clemente [27], in order to assess the economic viability of a new business, it is necessary to estimate the capital costs such as investments, debts and financing and also forecast the corresponding revenues, that is, the future generation of cash. According to Matos [13], decisions about the economic feasibility of investment result from the estimation and analysis of feasibility indicators. Among these indicators, we can highlight the Cash Flow, Net Present Value (NPV), the Internal Rate of Return (IRR), the Benefit/Cost Ratio (Rc/b), and the Risk Premium (RP).

a) Cash flow

The cash flow comprises the movement of inflows and outflows of resources in a given period of time [16]. The correct construction of the cash flow is of paramount importance, since the project's profitability and risk indicators are derived from it, that is, from the inflows and outflows of cash that occurred during the project's duration [5]. By taking into account time, a variable that the budget does not include, the cash flow allows producers, according to Lima [12], that the entrepreneur anticipate cash movements in the business, so that problems are detected in advance so that preventive actions are carried out. Pereira et al. [20], defines that it is through the preparation of the cash flow that project feasibility analysis tools, as well as risk analysis, are defined.

b) Net Present Value (NPV)

The Net Present Value - NPV is understood as the equivalent amount, on date zero, of a cash flow, discounting the interest rate determined by the market [7]. The NPV is one of the most important indicators to show the financial viability of a project, which corresponds to the difference between the amount invested and the amount of expected benefits [28]. The Net Present Value - NPV is understood as the equivalent amount, on date zero, of a cash flow, discounting the interest rate determined by the market [7]. The NPV is one of the most important indicators to show the financial viability of a project, which corresponds to the difference between the amount invested and the amount of expected benefits [28].

The NPV, according to Santana [23], allows the updated costs to be compared with the updated revenues of a project. In other words, it is the sum of the updated net benefits (revenues minus costs) of the project. The update of the cash flow is done by an interest rate that reflects the long-term opportunity cost of the activity. The calculation of NPV is given by the equation:

$$VPL_t = \sum_{t=0}^{n} \frac{BNL_i}{(1+i)^t}$$

Where:
BNL = Nominal Net Benefit
i = Interest rate
t = Time
n= Number of years of the Project

The NPV, when greater than zero, indicates that production costs are covered, thus obtaining profits. If the NPV is lower than the estimated value for a project, it means that the project should not be carried forward, as it is causing losses.

c) Internal Rate of Return (IRR)

The Internal Rate of Return - IRR is a relative index that measures the return on investment per unit of time, requiring that there be revenues involved, as well as investments [15]. The IRR comprises a relative index that determines the return on investment for each unit of time [15]. When the IRR is greater than the interest rate (i), it is inferred that there is more gain investing in the project than in the interest rate, that is, the decision rule indicates that there will only be investment if the IRR is higher than the interest rate in the financial market. The IRR is obtained in Excel using the formula:

$$TIR = \sum_{j=0}^{n} \frac{FC_j}{(1+i)^j}$$

Where:
IRR= Internal Rate of Return
FCj= Net Cash Flow at moment i
n= Duration of the project

To calculate the IRR and the NPV, it is necessary to use a rate, which in this case we call the minimum attractiveness rate (MTA), which is the return established for investing in a project. It is

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composed of the opportunity cost of capital, which is the interest rate practiced in the market, monetary correction, which is the projected inflation for the period, and the operating cost, which are all costs and taxes of monetary movement, and the margin of profitability. The TMA value used in this case study was 8.5% per year.

d) Cost/benefit ratio (Rc/b)

The benefit/cost ratio determines the ratio involving the sum of revenue streams and cost streams [23]. According to Santana [23], it is given by the ratio between the sum of the revenue stream and the sum of the cost stream, updated at an adequate cost rate i. Rb/c is found through the formula:

$$\mathbf{R_{c/b}} = \frac{\sum_{t=0}^{n} \mathbf{Revenue_t} \times (1+i)^{-t}}{\sum_{t=0}^{n} \mathbf{Cost_t} \times (1+i)^{-t}}$$

e) Risk Premium (PR)

And the Risk Premium - PR, in turn, represents the additional profitability that an investor expects to obtain by accepting a certain degree of risk [17]. The Risk Premium is an excess financial return, corresponding to the difference between the rate of return on a given asset and the return on assets without associated risk. The value of the Risk Premium (PR) will be offered as a percentage, being defined after the application of the TMA and calculation of the IRR [9, 28]. Note the following equation:

PR=TIR-TMA

Where:
PR= Risk Premium
IRR = Internal Rate of Return
TMA = Minimum Attractiveness Rate

3.4 Data source

The data for this work were obtained from the Brazilian Agriculture Yearbook - Agricultural [2] and correspond to the 2010/2011 harvest. Conilon coffee production takes place in different stages in time: soil preparation, planting, cultural treatments and harvesting. The long period for these steps to be carried out means that expenses with inputs and services are incorporated into the crop at different times throughout the production process. The evaluation period was 12 years, at an interest rate of 8.5% per year and its processing was carried out with the help of Excel software.

IV. RESULTS AND DISCUSSIONS

To analyse the cash flow, the cost and revenue information was detailed. The cost of production is considered. The recipe comes after the coffee crop is harvested. Therefore, the coffee crop has a formation period and a production period.

Gross revenue usually starts with the production phase of the coffee crop. In the first year this recipe does not exist, as it is the year of formation of the culture, where only costs are incurred. In the production phase, in the second year there was a gross revenue of R$ 6.880,00 and from the third year onwards the revenue was R$ 13.760,00. This last value remains the same until the twelfth year.

In the case of study, the Net Nominal Benefit was negative in the first and second year. In relation to the first year, there were no revenues, as this training phase is only made up of costs. In the second year there was gross revenue, but this year in particular this revenue did not exceed costs, resulting in a negative net revenue. This data was already expected, as in the first year's investment expenditures are large and as coffee only starts to produce after almost a year, this is more or less the time needed for the activity to start making a profit. In other words, the revenue was not enough to cover all costs in the second year. In the following years, revenue was greater than costs, as the culture started to have net revenue only 3 years after its implementation.

According to Ponciano et al. [22], when the net revenue is positive, there is a situation in which all production costs are being covered, leaving a residue that can be used in the expansion of the enterprise. The BNL calculation makes it possible to compose the cash flow (Table 1), composed of the annual costs and revenues of the crop. Cash flow was calculated using a minimum attractiveness rate of 8.5% per year.

Using TMA, the present value (present or discounted) of all components of the net cash flow is then calculated, whose values are then added together to find the net present value (NPV). For this profile, the NPV is calculated at R$2.166,21, meaning that the results obtained remunerate the value of the investment made, at 8.5% per year, and also allow for an increase in the value of the company of that importance, showing economic viability.

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Table 1: Cash flow of conilon coffee in Pinheiros - ES, Brazil.

	NOMINAL FLOW				UPDATED FLOW		
YEAR	**Cost (R$)**	**Revenue (R$)**	**Nominal Net Benefit**	**FA 8,5%**	**Cost (R$)**	**Revenue (R$)**	**Annual Net Benefit**
1	R$ 7.282,00	-	-R$ 7.282,00	0,92	R$ 6.711,52	R$ -	-R$ 6.711,52
2	R$ 8.052,00	R$ 6.880,00	-R$ 1.172,00	0,85	R$ 6.839,81	R$ 5.844,25	-R$ 995,56
3	R$12.019,00	R$ 13.760,00	R$ 1.741,00	0,78	R$ 9.409,77	R$ 10.772,82	R$ 1.363,04
4	R$12.019,00	R$ 13.760,00	R$ 1.741,00	0,72	R$ 8.672,60	R$ 9.928,86	R$ 1.256,26
5	R$ 12.019,00	R$ 13.760,00	R$ 1.741,00	0,67	R$ 7.993,18	R$ 9.151,03	R$ 1.157,84
6	R$ 12.019,00	R$ 13.760,00	R$ 1.741,00	0,61	R$ 7.366,99	R$ 8.434,12	R$ 1.067,14
7	R$ 12.019,00	R$ 13.760,00	R$ 1.741,00	0,56	R$ 6.789,85	R$ 7.773,39	R$ 983,54
8	R$12.019,00	R$ 13.760,00	R$ 1.741,00	0,52	R$ 6.257,93	R$ 7.164,41	R$ 906,49
9	R$ 12.019,00	R$ 13.760,00	R$ 1.741,00	0,48	R$ 5.767,67	R$ 6.603,14	R$ 835,47
10	R$ 12.019,00	R$ 13.760,00	R$ 1.741,00	0,44	R$ 5.315,83	R$ 6.085,85	R$ 770,02
11	R$ 12.019,00	R$ 13.760,00	R$ 1.741,00	0,41	R$ 4.899,38	R$ 5.609,08	R$ 709,69
12	R$ 12.019,00	R$ 13.760,00	R$ 1.741,00	0,38	R$ 4.515,56	R$ 5.169,66	R$ 654,10

Fonte: Prepared by the authors.

The internal rate of return (IRR) corresponds to the discount rate that nullifies the current value of the investment. In this profile, the IRR is 13.1% per year, representing a case in which the entrepreneur's investment will be remunerated at this annual rate. It means that the project has a rate of return on the initial investment made above the average rate of market attractiveness. In summary, the project can be considered viable. De Sá et al. [6] found in their study an IRR of 17.67%, at an interest rate of 6% per year.

Economic viability is also calculated through the cost/benefit ratio, where in this profile the result was 1.02. According to Santana [23], a result greater than 1 indicates economic feasibility. In this profile, we can say that for every R$ 1,00 invested in the project, it generates an amount of R$ 1,02 grosses, which implies a net R$ 0,02. De Sa et al. [6] found R$ 1,59, that is, R$ 0,59 net, corresponding to R$0.57 more than what was found in the present study, but at a rate of 6% per year.

The Risk Premium can be understood as the difference between the IRR and the TMA. As this project opted for an AMR of 8.5% and obtained an IRR of 13.1%, then the risk premium is 4.6%, that is, it is more profitable to invest in the project in question, which uses the rate of 8.5% per year.

Note that when using rates higher than those indicated by the IRR (13.1%), the NPV starts to become negative, this occurs because the sum of the discounted revenue streams is lower than the discounted cost stream. The lower the rates used, the greater the financial return on the investment and the greater its viability. For example, at a rate of 8.5% we have a NPV of R$ 2.166,21, and at a rate of 5.5% the NPV goes to R$ 4.045,97.

V. FINAL CONSIDERATIONS

Given the proposal of this study to carry out an economic feasibility analysis of conilon coffee (Coffea canephora Pierre ex Froehner) in the municipality of Pinheiros in Espírito Santo, the study indicated the economic feasibility of this crop, as it has an IRR greater than the cost of capital opportunity, NPV greater than zero, positive cost/benefit ratio and risk premium. The study indicated the economic viability of the conilon coffee crop at a minimum attractiveness rate of

8.5% per year, with an Internal Rate of Return of 13.1% and a risk premium of 4.6%, in order to generate a positive net income in its production phase.

In the case of the different interest rate scenarios proposed, the project's viability is increased according to the use of increasingly lower rates, in this case the increase in the NPV follows the application of lower rates. Thus, the investigation concludes that the investment in conilon coffee culture in the municipality of Pinheiros in Espírito Santo is economically viable and rewarding in order to become a suggestive undertaking for the region's producers.

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