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Economic indicators in the cultivation of passion fruit (*passilora edulis*) in the central region of Rondônia – Western Amazon

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Abstract

Brazil is the world's largest producer of passion fruit, with an average annual production of 700,000 tons. Although the production of the fruit is concentrated in the northeast region of the country, the states of the Amazon region have a significant production, especially in Amazonas, Pará and Rondônia. Even though there are several studies on passion fruit, there are still few works that address the economic aspects of the activity. Thus, the present study aimed to measure and analyze the main economic indicators of passion fruit cultivation in the Central Region of Rondônia, Western Amazon/Brazil. To reach the objectives, this descriptive and exploratory research, used the bibliographical research and the field study, promoting the collection of data through interviews applied to passion fruit producers established in three municipalities contained in the Western Amazon / Brazil - specifically in the central region of the state of Rondônia, and the information collected was treated qualitatively and quantitatively. Thus, it was especially found that the average monthly Return on Investment (ROI) of the activity was 3.98%, the average profitability was 10.86%, while the average profit was BRL 8,853.28 (US$ 2,425.56) per hectare grown from the fruit. Furthermore, through Pearson's correlation analysis, it was found that most economic indicators were highly dependent on the "production" variables.

Keywords: Passion Fruit; Western Amazon/Brazil; Economic Indicators.

1. Introduction

The increase in productivity in agriculture after the Second World War is mainly due to the expansion of the application of scientific and technological techniques in the field, in addition to the interaction of agriculture with other economic segments, thus emerging the concept of agribusiness. (Davis & Goldberg, 1957; Batalha, 2007; Karnopp & Oliveira, 2012; Mendonça, 2015; Souza, 2020). This process has raised food

productivity indices in several regions of the world, including Brazil (Silva, 1993; Alimandro & Pinazza, 1999; Lourenço & Lima, 2009; Brazilian Agricultural Research Corporation [EMBRAPA], 2018; Souza, 2020).

In Brazil, this increase in rural productivity, especially since the mid-twentieth century, has provided several economic contributions, with emphasis on: the balance of trade; worldwide representation in several commodities; in the formation of the Gross Domestic Product (PIB); job generation; and income distribution (Mortatti, Miranda, & Bacchi, 2011; Hamann, Pereira, Junior, Júnior, & Silva, 2010; Silva, 2013; Castro, Carvalho, Ormond, Macedo, & Lima, 2014; EMBRAPA, 2018; Cepea/Esalq-USP & CNA, 2019; Souza, 2020).

In the context of agribusiness developed in Brazil, fruit farming has a prominent place in terms of diversity and representativeness in production, accounting for ¼ (a quarter) of national agricultural production. In addition, in the world scenario, Brazil is the third largest producer of fruit (Coelho, Cenci, & Resende, 2010; Rodrigues, 2015; Souza, 2020), with prominence for the production of oranges, bananas and passion fruit (*passiflora edulis)* (Brazilian Institute of Geography and Statistics – IBGE, 2016; IBGE, 2017; Souza, 2020).

Regarding passion fruit, Brazil is the world's largest producer of the fruit, annually producing 700,000 tons of the fruit on approximately 50,000 planted hectares (Furlaneto, Esperancini, Martins, & Vidal, 2010; Avelino & Rodrigues, 2016; IBGE, 2019; Souza, 2020), according to data from the last decades. Even though passion fruit production in Brazil is concentrated especially in the northeast region, in the Amazon region there is a significant cultivation, especially in the states of Amazonas, Pará and Rondônia (IBGE, 2019), in which the production of the fruit contributes to the internal supply of the entire state, in addition to providing most of the supply in the capitals of the surrounding provinces (Oliveira, 2011; Souza, 2020).

As for economic and social issues, passion fruit cultivation also stands out. The culture encourages family farming and job creation, given its greater need to use labor compared to other agricultural activities (Nogueira, Mello, Rolim, & Sannazzaro, 2004; Araújo, Araújo, & Correia, 2004; Hafle, Ramos, Neto, & Mendonça, 2010; Moreira, Teixeira, & Sousa, 2012; Lima, 2012). In addition, it is estimated that the commercial cultivation of the fruit also contributes environmentally in the Amazon region in relation to the containment of deforestation. This is because the activity does not need large spaces of land, unlike extensive livestock, since most passion fruit plantations occur in areas smaller than 5 hectares (Nogueira et al., 2004; Pimentel et al., 2009; Furlaneto, 2012; Souza, 2020).

The survey of the activity, in the last researches, is perceived on the researches, especially the works with the economy and productivity of the fruit. Some works were defined by: Araújo Neto (2004), who carried out an economic analysis of passion fruit in Minas Gerais from several densifications; Arêdes, Pereira, Maciel, & Rufino (2008) who studied the economically viable considering the benefits of irrigation; and Furlaneto (2012) who experienced an economic and energetic analysis of the passion fruit production system in the interior of the state of São Paulo. In addition to these, the works developed by Araújo et al. (2004), Ponciano, Souza e Golynski (2006), Pimentel et al. (2009), Hafle et al. (2010), Moreira et al. (2012), Lima (2012), Javanovic (2014), Almeida, Santos and Holanda (2018) and Borges (2018).

However, even though several works have already been carried out on passion fruit, there are still very few works carried out in the Amazon region, most of which are carried out in the northeast and southeast

regions of Brazil. Among the few works carried out in the Amazonian context, the studies by Ferreira and Araújo Neto (2007), Falesi, Tavares and Pena (2013), Lemos, Maia, Modro and Fogaça (2012), Sá, Neto, Negreiros, Nascimento and Nogueira (2015). In this way, given the scarcity of studies on passion fruit in the region, the relevance of stimulating research on passion fruit in the Amazon is highlighted.

In addition, Moreira et al. (2012) also commented that there are still insufficient works on passion fruit that approach the characterization of costs and profitability of cultivation, being neglected the administrative approach of the activity. In this way, the economic studies that contributed to the management of passion fruit cultivation are salutary, helping in the functions of planning, control and consequently in the decision-making by the producer, even more in the rural environment with all its specificities that go beyond the conventional criteria of production (Hansen & Mowen, 2003; Callado & Callado, 2003; Oliveira & Perez Jr., 2007; Leone, 2009; Martini & Braun, 2013; Martins, 2018; Crepaldi, 2018; Bassotto et al., 2019; Souza, 2020).

Thus, based on the adaptation of the academic thesis developed by Souza (2020), the present study has as its central objective to measure and analyze the main economic indicators of passion fruit cultivation in the Central Region of Rondônia, Western Amazon / Brazil. In order to reach the objectives of this work, it was mainly necessary to know the profile of the producers in the region, the production system commonly adopted, the expenses and the return of the activity.

In this way, it is expected that the present study will be relevant to the academy, as it contributes to economic studies on the fruit; and which is especially relevant from an economic and social perspective for rural producers in the Amazon region, as it makes it possible to better understand important management information about passion fruit cultivation.

2. Methodological Procedures

In this section, the methodological procedures that were used in this research to reach the proposed objectives will be discussed. As stated by Chizzotti (2005) the research should employ appropriate methods according to the degree of complexity provided by the questions established in the investigation. With this, he endeavored to establish the methods most consistent with the proposed problem, aiming to maximize the reality of the results. In this way, the definitions and applications adopted, the method and type of research, unit of analysis and research subjects, collection and treatment of data will be presented in the sequence.

2.1 Settings and Applications

Although the present research requires significant technical and formal levels, as well as any other work of the same nature, we tried to use definitions balanced between constitutive and operational definitions. Thus, it is pertinent to clarify the main termologies used in this work, in order to contribute to its better understanding:

a) Producers: farmers, businessmen or the like who explore the passion fruit culture economically or for subsistence;

b) Production cycle: in the passion fruit crop, the production cycle is characterized, in addition to planting, between the flowering period that precedes the beginning of fruit production until the period of

production reduction, ending the cycle with the pruning (thinning) of the vines and the end fruit harvest, a process similar to that reported by Araújo Neto (2004). In the region, it is common for approximately 5 (five) production cycles to occur during the life of a crop, and this lasts on average between 24 (twenty-four) to 36 (thirty-six) months after planting (Resende, 2017)[1]. At times, the term "crop" was also used to replace "productive cycle";

c) Cycle production expense: it is the result of the sum of all fixed costs (depreciation of equipment, depreciation of biological assets, soil analysis, etc.), variable costs (labor, fertilizers, pesticides, etc.) and expenses (packaging, freight, etc.) until the end of production at the end of the production cycle/crop. It is noteworthy that the costs were calculated in accordance with the concepts of biological asset and agricultural product through the historical cost method, in line with accounting standards. Thus, initially all the expenses perceived in the crop were accumulated until the first flowering, characterizing the implantation costs (formation of the biological asset). The implementation costs were depreciated on a straight-line basis according to the perspective of the number of crops expected by the producer throughout the life of the plant. In addition to the proportional implantation costs, the actual costs perceived after the first flowering were accumulated, thus characterizing the production cost of the cycle/harvest (specific to the crop under analysis). Thus, the amount of the cost of implementation plus the costs of production formed the total expenses (cost of the agricultural product) of the crop in the harvest;

d) Net income from the activity: refers to the difference between the total sales of the activity minus the total cost of production;

e) Economic analysis of the activity: to verify the economic analysis of the activity, the following economic indicators were used:

a) Profitability = (Net Income/Sales) x 100 ...(1)

b) Return on Investment (ROI)[2] = Net Income/Investments ...(2)

c) *Payback* = 100/ROI ...(3)

f) Correction of values: for a better comparability, in some situations that were considered opportune in the presentation of the results, nominal values obtained in previous researches were updated to current values. For this, the tool "Calculadora do Cidadão" made available by the Central Bank of Brazil (BACEN)[3], with adoption of the Consumer Price Index (IPCA) for correction; and

g) Conversion into US dollars (US$): also for better comparability, in some cases in the presentation of results, amounts calculated in the official Brazilian currency – Real (BRL) – were converted into US dollars (US$). As the monetary values were calculated in the research during 2018, the average rate of the American currency quotation was adopted in that year, which was BRL 3.65, according to quotations and bulletins of the BACEN[4].

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[1] Speech given by Agronomist Huigor Fernando Lobo Resende at the State Seminar on Passion Fruit Culture, Presidente Médici, 08 Apr. 2017.

[2] It can also be called the Rate of Return on Investments and instead of using the name investments, "assets" are used. (Marion, 2012).

[3] Available in: https://www3.bcb.gov.br/CALCIDADAO/publico/corrigirPorIndice.do?method=corrigirPorIndice

[4] Available in: https://www4.bcb.gov.br/pec/taxas/port/ptaxnpesq.asp?frame=1

2.2 Research Method and Type

The present research used the statistical method to quantitatively describe the reality of the studied unit, as well as establish certain correlations, probabilities and conclusions from the statistical calculations. For Gil (2010), the statistical method has relative precision and is therefore accepted by most researchers.

As for the type of research, relative to the objectives, this thesis is an exploratory and descriptive research. Initially the study had an exploratory research using qualitative analysis. In the subsequent step, a descriptive research was carried out, taking advantage of information obtained from the previous exploratory research, in the search for the establishment of characteristics, variables, relationships and relevant facts perceived in the context of passion fruit cultivation in the central region of the state of Rondônia - Western Amazon / Brazil – that could contribute to the achievement of the objectives of the work. In this way, as perceived, it is highlighted that the research used, in terms of its approach, both qualitative and quantitative analysis. In the opportunity of carrying out the exploratory research, qualitative analysis was used, while in the later phase, the use of qualitative and quantitative analysis in descriptive research was prioritized.

As for the procedures, the research was characterized as bibliographic research and field research using a survey. The bibliographic research, carried out from the analysis of already published works, was necessary to understand the researched subjects. Field research was used in the investigation phase with rural producers, including research in the survey modality and with the use at times - during visits to producers, as suggested by Yin (2010) - of the technique of non-participant observation. for a better understanding of the passion fruit production system in the region.

2.3 Unit of Analysis and Research Subjects

In this research, the unit of analysis was the costs, expenses and income involved in the cultivation of passion fruit in the central region of the state of Rondônia – Western Amazon/Brazil. Thus, all elements that may influence the economic return of the activity were considered, and analyzes of the revenues and expenses involved were carried out.

As for the chosen region, it is noteworthy that the research was developed with producers established in the central region of Rondônia - Western Amazon - specifically in the municipalities of Castanheiras (latitude 11º25'03" S and a longitude 61º56'19" W) and Novo Horizonte do Oeste (latitude 11°42'36" S and longitude 61°59'49" W), belonging to the Rondonia microregion of Cacoal; and in the municipality of Presidente Médici (latitude 11º10'33" S and longitude -61º54'03" W), belonging to the micro-region of Ji-Paraná in Rondônia.

Subsequently, as for the research subjects, these were the passion fruit producers from the central region of the State of Rondônia - Western Amazon / Brazil - from a non-probabilistic sample, who started the passion fruit planting from the second half of 2017 until January 2018. To identify the producers, after identifying the first producer, the snowball method was used, or "snowball" to reach the other producers. In this way, it was the producers themselves, at the end of each visit, that indicated new producers who had the desired characteristics in the investigation. This occurred until the saturation point started, that is, producers began to indicate producers that had already been researched previously. With this, the number of 37 (thirty-

seven) producers was obtained in the three municipalities.

2.4 Data Collection and Processing

Data collection started in January 2018 from a semi-structured interview, with subsequent monitoring of the plantations fortnightly until the end of the first harvest. Thus, the analyzed period comprised the months from January 2018 to December 2018, with the first producers with the first harvest closed in May 2018 and the last ones in December 2018.

After capturing the data, they were treated for consecutive analysis and thus strive to achieve the objectives proposed by the work. From this, data processing was carried out using mathematical and statistical calculations, especially regarding the establishment of frequencies, dispersion measures and correlation analysis. To perform the mathematical and statistical calculations, the software Statistical Package for Social Sciences (SPSS) it's the Microsoft Excel®.

Regarding the application of correlation, as usually used in social sciences, it is emphasized that Pearson's correlation coefficient was used to analyze the relationship between the variables studied. To analyze the correction, which can vary between -1 and 1, the classification performed by Cohen (1988) was adopted, which considers the correlation (or scores) between 0.10 and 0.29 to be small; means between 0.30 and 0.49; and large between 0.50 and 1 (also called strong dependence by some statisticians). For confidence analysis, the significance with p value was applied to the levels of 0.05 (significant level at 5%) and 0.01 (significant level at 1%) (Figueiredo Filho & Silva Júnior, 2009).

Therefore, for correlation analysis, the dependent economic variables considered were ROI, Payback, Profitability, Net Result with labor and Result per hectare. The association variables were unrestrictedly considered, especially those raised through the profile (ownership and producer) and the characteristics of production and commercialization of the fruit.

3. Results and Discussions

The data obtained in the research, as well as their respective exposition and discussion will be presented in this chapter. Thus, the behavior of the economic result of the passion fruit cultivation in the central region of Rondônia will be presented, analyzed and discussed, especially regarding the indicators of Profitability, Return on Investment (ROI) and Payback, according to methodological indication. However, before the economic approach of the research, the main productive characteristics of passion fruit in the central region of Rondônia - Western Amazon are presented.

3.1 Main Characteristics in Passion Fruit Cultivation in the central region of Rondônia – Western Amazon

For a better understanding of the productive reality of passion fruit in the Western Amazon, specifically in the central region of Rondônia, a survey of information that is considered relevant to the research was carried out. Thus, table 1 presents a summary of the main findings related to the productive characteristics of the fruit in the region.

Table 1 - Main Productive Characteristics in Passion Fruit Cultivation in the central region of Rondônia

INVESTIGATED ELEMENT	MAIN RESULTS
Municipality of planting	35.2% Presidente Medici; 24.3% Novo Horizonte do Oeste; and 40.5% Castanheiras.
Number of passion fruit plants planted	40.5% of producers plant between 201 and 300 passion fruit plants per harvest.
Time working with passion fruit plantation, in Years	62.2% of producers have been cultivating the fruit for less than 5 years.
Planting time	Most producers plant the fruit in December and January, representing 27% and 35.1% of producers, respectively.
Production cycle, in months	The average duration until the end of the first harvest in the region was 9.76 months.
Area occupied, in hectares	The size of the most commonly used area does not exceed 0.25 ha, or 2,500 m², representing 45.90% of cases. The average area occupied was 3,151.92 m², or 0.32 ha.
Density (m²/foot)	The lowest concentration per hectare was 556 feet per hectare, while the highest was 1,111 feet per hectare.
Did soil analysis	70.3% of the producers never carried out a soil analysis at the place where the fruit is planted.
Has technical assistance	Only 1 producer among the 37 investigated in the region has technical assistance monitoring.
Degree of knowledge	Most of the producers (43.2%) have incomplete elementary education; 32.4% of producers believe they have a good knowledge of basic mathematical operations.
Yield (ton/ha)	The average production per plant in the region in the first harvest was 0.78 boxes, or approximately 12.48 kg per plant. In addition, an average yield of 11.14 tons per hectare was observed in the analyzed period.
Average total spend ($/kg)	The average total expenditure per kilo of passion fruit produced in the region was BRL 1.55 (US$ 0.42), and the average expenditure per hectare produced was BRL 10,647.03 (US$ 2,916.99).

Source: own elaboration according to research data (2019)

In addition to leading to greater knowledge about the productive reality of passion fruit in the central region of Rondônia - Western Amazon - the data contained in table 1 will be essential for making inferences from the analysis of correlations with economic data of the activity, as presented at the end of the next section.

3.2 Economic Indicators of Activity

Before presenting the economic indicators themselves, it is necessary to present the investments made in the culture, even because the investments are necessary data to calculate the ROI of the activity and consequently the Payback. In this way, the investments made in the region for the cultivation of passion fruit are presented in table 2.

Table 2 - Investments in Reais (BRL) made in the cultivation of passion fruit in the central region of Rondônia

Variables	N	Amplitude	Minimum	Maximum	Average	Mean standard error	Interval (95% confidence)
Investments	37	22,159.25	2,101.39	24,260.64	9,111.42	876.78	[7,392.93; 10,829.91]
Investment per foot	37	61.28	7.35	68.63	34.72	2.72	[29.40; 40.05]
Investment per ha	37	63,380.21	5,248.23	68,628.44	30,828.52	2,622.47	[25,688.48; 35,968.57]

Source: own elaboration according to research data (2019)

As a result, the investments shown in table 2 were considered as all the expenses calculated for the consolidation of the biological asset up to the point of the first passion fruit flowering in the region, according to the methodological design. Thus, the value of BRL 9,111.42 (US$ 2,496.28) related to the average general investments in production in the studied area was identified.

In addition, to equalize the investment values, since there were producers with plantations of 100 (one hundred) feet and others with 700 (seven hundred) feet, the costs per foot and the proportional costs per hectare based on the occupied area were also calculated. Thus, it was found that, on average, for each passion fruit tree planted there is a demand of BRL 34.72 (US$ 9.51), or for each hectare of passion fruit planted there is an average investment of BRL 30,828.52 (US$ 8,446.17).

The confidence intervals obtained were from BRL 29.40 to BRL 40.05 for investments per foot and BRL 25,688.48 to BRL 35,968.57 for investments per hectare. The amplitudes found for investments per foot and per hectare (BRL 61.28 and BRL 63,380.21, respectively) reflect the characteristics of production adopted by each producer, mainly related to the facilities adopted (such as wood of better or worse quality, wood removed from the property or purchased), in the inputs used (quantity, quality and brand) and services used. In any case, it is believed that the average values per planted foot/hectare found in this research can be used by producers in the region as parameters for estimating investments for the implementation of future crops.

As for the economic indicators themselves, the rate of Return on Investment (ROI), Payback,

Profitability and Net Result, are presented in table 3, below.

Table 3 - Economic indicators of passion fruit cultivation in the central region of Rondônia

Variables	N	Amplitude	Minimum	Maximum	Average	Mean standard error	Interval (95% confidence)
ROI % (period)	37	198.50	-14.56	183.94	38.30	7.26	[24.07; 52.53]
ROI % (month)	37	18.45	-1.46	16.99	3.98	0.72	[2.57; 5.39]
Payback (month)	37	666.00	-420.00	246.00	-3.14	17.36	[-37.15; 30.88]
Profitability %	37	637.69	-557.63	80.06	10.86	18.41	[-25.23; 46.95]
RL[1]	37	19,580.09	-2,222.83	17,357.26	3,235.14	725.96	[1,812.26; 4,658.01]
RF[2]	37	23,185.82	-372.31	22,813.51	5,123.99	865.49	[3,427.64; 6,820.35]
RL per foot	37	46.17	-2.48	43.69	17.18	2.19	[12.89; 21.48]
RL per kg	37	10.59	-8.99	1.60	0.21	0.31	[-0.39; 0.81]
RL per ha	37	38,057.13	-8,232.70	29,824.43	8,853.28	1,633.85	[5,650.95; 12,055.62]

[1] RL: Net Income

[2] RF: Family Income, equivalent to RL plus expenses with family labor

Note: Net Results presented in Reais (BRL or BRL)

Source: own elaboration according to research data (2019)

Thus, it is perceived that the ROI within the confidence interval was from 24.07% to 52.53% during the total production cycle, with an amplitude of 198.50%. To standardize the data, the ROI was also converted into months, since the production cycles are different among the studied producers. Thus, the average monthly ROI found in the region, as shown in table 3, was 3.98%, within a confidence interval of 2.57% and 5.39%. Thus, for every BRL 1.00 invested in the crop, there was an average monthly return of BRL 0.0398, or it can be said that there was a monthly return of 3.98% on the investment made to set up the crop by the producers in the central region of Rondônia.

In a study carried out by Ferreira and Araújo Neto (2007), they found in the state of Acre an average rate of return of 2.40% with different forms of pitting and treatment of passion fruit. Moreira et al. (2012) found in the Federal District a return of BRL 0.08 for every BRL 1.00 invested in passion fruit, while Falesi et al. (2013) identified a return of BRL 0.64 for every BRL 1.00 invested in the fruit.

The Payback in the studied area, arising from the ROI, was negative by 3.14 months, forced by the 8 producers (equivalent to 1/5 of the total) that showed losses in the activity. However, if the average monthly ROI % were considered, the Payback would be 25 months and 4 days (100%/3.98%). As for profitability, the average percentage of gain in relation to revenues was 10.86%, that is, for every BRL 1.00 of passion fruit sales, BRL 0.1086 was converted into profits.

Regarding the net result of the activity, it was noted that the producer in the central region of Rondônia

who had the worst result realized a loss of BRL 2,222.83 (US$ 608.99) and the one with the best result had a profit of BRL 17,357.26 (US$ 4755.41). The net result was also presented in table 3, broken down into foot, kilo (kg) and hectares (ha) for better comparability, showing, for example, an average profit of BRL 8,853.28 (US$ 2,425.56) per hectare of fruit. Ferreira and Araújo Neto (2007) identified an average net result of BRL 7,846.20[5] per hectare in the state of Acre; Hafle et al. (2010) realized an average result of BRL 649.43[6] per hectare in Minas Gerais in the experiment on plants with different formations; and Lima (2012) found a positive result of BRL 3,634.87[7] in the state of Parana.

Finally, in table 3, the net income is also presented, excluding expenses related to labor, which in most of the properties surveyed belong to the family itself, an application similar to that adopted by Moreira et al. (2012) and Sá et al. (2015), called by these authors as Family Income (RF)[8]. Thus, it is noted that if labor is not considered, the average net result increases by 58.39% (BRL 5,123.99 against BRL 3,235.13), precisely due to the significant expenditure on labor in the activity. Moreira et al. (2012) in the Federal District found an average annual family income of BRL 21,388.34, while Sá et al. (2015) in the state of Acre found an average annual family income of R BRL 29,907.54 per hectare.

In this way, given the economic results found for the production of passion fruit in the central region of Rondônia, it is also pertinent to compare the result obtained for the fruit in relation to other agricultural activities developed in the region. With this, it was noticed that the return on investments of passion fruit are more attractive than those obtained: in dairy cattle in the municipality of Cacoal, state of Rondônia, there was an average ROI of 1.21% per month and payback of 83 months, as determined by Loose et al. (2016); in the production of free-range chickens in São Felipe do Oeste, state of Rondônia, according to a study by Loose, Silva, Junnior, Sandri, & Souza (2017) who presented an ROI of 1% per month and a payback of 100 months; and in sweet potato cultivation in the municipality of Castanheiras, state of Rondônia, which presented an ROI of 4.72% in the semester and payback of 21 semesters, according to research carried out by Souza, Rodriguês, Loose, Piacentini & Piacentini (2019). However, passion fruit cultivation was less attractive than clonal coffee cultivation, which according to Deina, Loose, Correia, Souza, & Sandri (2017) was 17.91% per month, with a payback of 6 months, in Rolim de Moura, state of Rondônia.

Thus, in addition to the passion fruit being more economically viable than the production of free-range chickens and milk production (although it is less attractive than coffee), another important factor observed is the average Payback calculated in the central region of Rondônia for the fruit cultivation, which was 25 months

[5] Updated amount equivalent to BRL 14,864.83. Correction carried out using the IPCA, with the initial period considered as 12/2006 (average date of the calculation carried out by Ferreira and Araújo Neto (2007)) and the final period 01/2018 (beginning of the calculation in the studied region).

[6] Updated amount equivalent to BRL 1,262.99. Correction carried out using the IPCA, with the initial period considered as 01/2006 (according to the calculation date indicated by Hafle et al. (2010)) and the final period 01/2018 (beginning of the calculation in the studied region).

[7] Updated amount equivalent to BRL 5,265.59. Correction carried out through the IPCA, having as an initial period considered 01/2012 (average date of the calculation carried out by Lima (2012)) and final 01/2018 (beginning of the calculation in the studied region).

[8] The difference between the calculation performed in this research and those performed by Moreira et al. (2012) and Sá et al. (2015) is that they also excluded the opportunity cost in addition to spending on family labor.

and 4 days. This period is close to the total lifetime of the passion fruit plant in the region (Resende, 2017)[9].

Another important point found in the research was the family income, that is, the net result added to the expenditure on labor. When this concept is applied, it is noted that only two properties presented negative RF in the activity, while when the net result was calculated (without excluding labor expenses) eight properties presented a negative result. Thus, as already mentioned, the finding shows, due to the great demand of passion fruit for labor, that the fruit presents itself as a good alternative for the occupation of farmers and for generating income for rural families, having an expressive economic value. and social. Furthermore, as observed in the research, many farmers do not easily admit the need to consider labor as a production cost when calculating the result, as indicated in the economic and accounting models. In this way, it is essential that producers know the result of the activity determined according to the literature and according to the parameters that they believe are relevant for decision making.

Furthermore, due to evident variations identified in some economic indicators, it is worth mentioning the statements by Araújo Neto (2004) and Hafle et al. (2010), who explain that the results of passion fruit cultivation may vary due to the producer's knowledge, soil and climate conditions, and the occurrence of pests and diseases in the crop.

Finally, regarding the economic analysis, the Pearson correlation was verified to identify possible influences of certain events (association variables) on the main economic indicators calculated in the region (dependent variables).

Table 4 - Pearson's correlation for economic variables

Association Variables	Economic Variables				
	Monthly ROI	Monthly Payback	Profitability	RF	RL per ha
Municipality	0.407*	-0.194	0.250	0.472**	0.429**
Time working with passion fruit plantation, in years	0.006	0.218	0.115	-0.185	-0.078
Planting time	-0.113	-0.099	0.086	0.069	-0.026
Production cycle, in months	-0.080	0.157	-0.115	0.182	0.123
Number of feet planted	0.337*	0.189	0.281	0.640**	0.358*
Area occupied, in hectares	0.382*	0.179	0.254	0.614**	0.331*
Density (m²/foot)	0.005	-0.083	-0.154	-0.167	-0.111
Did soil analysis	0.222	0.226	0.210	0.357*	0.336*
Has technical assistance	0.201	0.051	0.155	0.294	0.481**

[9] Speech given by Agronomist Huigor Fernando Lobo Resende at the State Seminar on Passion Fruit Culture, Presidente Médici, 08 Apr. 2017.

Degree of knowledge	0.140	0.292	0.142	-0.002	0.158
Investments	-0.139	-0.022	0.095	0.525**	0.258
Investment per foot	-0.501**	-0.188	-0.190	-0.088	-0.101
Investment per hectare	-0.471**	-0.186	-0.125	-0.041	-0.080
Production in tons	0.639**	0.243	0.426**	0.981**	0.872**
Yield (ton/ha)	0.558**	0.295	0.468**	0.708**	0.886**
Average total cost ($/kg)	-0.490**	-0.367*	-0.994**	-0.406*	-0.519**

** The correlation is significant at the 0.01 level (bilateral). *Correlation is significant at the 0.05 level (bilateral).

Source: own elaboration according to research data (2019)

As shown in table 4, the economic variable “monthly ROI” has a great dependence, as per the classification indicated by Cohen (1988), for the association variables “investment per foot”, “production in tons” and “yield (ton/ha)”, with respective correlations of -0.501, 0.639 and 0.558, all with a significance level of 0.01. Even while the economic variable “monthly ROI” showed an average dependence for the variables “municipality” (correlation of 0.407), “number of planted trees” (correlation of 0.337), “hidden area, in hectares” (correlation of 0.382), “investment per hectare” (correlation of -0.471), and “average total cost ($/kg)” (correlation of -0.490).

As for profitability, it showed a strong correlation only in relation to the "average total cost ($/kg)", with a correlation of -0.994, and a mean correlation for the association variables "yield (ton/ha)" (correlation of 0.468) and “production in tons” (correlation of 0.468). However, for all variables with medium degrees and high correlation, a significance level of 0.01 was found.

The RF had a strong correlation with the "number of planted trees", "occupied area, in hectares", "investments", "production in tons" and "yield (ton/ha)", with respective correlations of 0.64, 0.614, 0.525, 0.981 and 0.708 – all with significance at the 0.01 level. For the dependent variable RF, a medium correlation was also found in relation to “city” (correlation of 0.472), “made soil analysis” (0.357) and “average total cost ($/kg)” (correlation of -0.406).

Finally, there was a strong correlation between the variable “RL per ha” with the variables “production in tons” (correlation of 0.872), “yield (ton/ha)” (correlation of 0.886) and “average total cost ($/kg)” (correlation of -0.519); and average correlation with the variables "municipality", "number of planted trees", "occupied area, in hectares", "made soil analysis" and "has technical assistance", with correlations of 0.429, 0.358, 0.331, 0336 and 0.481, respectively.

In general, it appears that the variables that impose the greatest correlation to the economic variables calculated are “production in tons”, “yield (ton/ha)” and “average total cost ($/kg)”, including many of them with correlations close to 1 and/or -1 (perfect dependence). It is believed that the three association variables found were not highlighted by chance. When you have a good production in tons, you tend to have a good yield. Consequently, as discussed by Bruni and Famá (2008), the more ýou produce, optimizing fixed installations, the lower the total unit costs tend to be and, therefore, the better the economic results (cost,

volume and profit ratio).

Even if to a lesser degree, the association variables "has performed soil analysis" and "has technical assistance" also deserve to be highlighted, which had an average correlation with the RL per ha[10]. Therefore, the result of the correlation analysis highlights the importance of technical assistance to increase fruit productivity and consequently better economic results in the activity.

The correlations found regarding investments per foot and per ha are also worthy of emphasis. It is noted that the reduction of investments tends to increase the ROI of the activity [11]. It is inferred that this occurs mainly in situations in which the producer has less investment in the plant's installations as a result of having his own wood on the property, unlike other producers who have to acquire the wood, for example.

On the other hand, it is noteworthy that no correlations (or small correlations) of the economic results were perceived when compared with other association variables, such as "time in which passion fruit has been planted, in years" (producer's experience), "planting time", "production cycle, in months", "level of knowledge" of the producer and "density (m²/foot)".

With this, in general, it is noted that the production of the fruit is demonstrated as an interesting productive alternative for rural production in the region, mainly for small producers due to the occupation of family labor and for presenting itself as profitable in the vast majority of the properties surveyed.

However, through the results found, there is a need to monitor the production costs of the crop in the region. Although the exception is the properties that had losses in the activity, there is still the possibility of perceiving a negative result, being elementary the economic monitoring of the culture to avoid surprises.

4. Conclusion

The present study sought to measure and analyze the main economic indicators of passion fruit cultivation in the Central Region of Rondônia, Western Amazon/Brazil, according to the methodological design previously established for the research.

In this way, it was possible to verify that the average investments in the region for the development of the activity are in the amount of BRL 9,111.42 (US$ 2,496.28) related to the average general investments in production in the studied area, and for each passion fruit plant planted are invested on average of BRL 34.72 (US$ 9.51), or for each hectare of passion fruit planted there is an average investment of BRL 30,828.52 (US$ 8,446.17). Regarding the monthly ROI, it was observed that for every BRL 1.00 invested in farming in the region, there was an average monthly return of BRL 0.0398, that is, a monthly ROI of 3.98%. On the other hand, profitability reached an average of 10.86%, that is, for every BRL 1.00 of passion fruit sales, BRL 0.1086 was converted into profits, while the average profit was BRL 8,853.28 (USD 2,425.56) per cultivated hectare of the fruit.

In the origin of the statistical analysis of the results, it was noticed that the economic variable "monthly

[10] Especially in terms of ROI and Payback, in addition to the variables associated with "has done soil analysis" and "has technical assistance", those also depend on the values of the investments.

[11] ROI is obtained precisely between the ratio of the result to the investments (ROI = Net Result/Investments). Thus, when there were equal results, the smaller the investment, the greater the ROI.

ROI" has a great dependence, according to the classification indicated by Cohen (1988), for the association variables "investment per foot", "production in tons" and "yield (ton/ha)", with respective correlations of -0.501, 0.639 and 0.558, all with a significance level of 0.01. Regarding profitability, there was a strong correlation only in relation to the "average total cost ($/kg)", with a correlation of -0.994. RF, on the other hand, had a strong correlation with the "number of planted trees", "occupied area, in hectares", "investments", "production in tons" and "yield (ton/ha)", with respective correlations of 0.64, 0.614, 0.525, 0.981 and 0.708 – all with significance at the 0.01 level. Finally, there is a strong correlation between the variable "RL per ha" with the variables "production in tons" (correlation of 0.872), "yield (ton/ha)" (correlation of 0.886) and "average total cost ($/kg)" (correlation of -0.519). At general levels, it was observed that the variables that impose the greatest correlation to the economic variables calculated are "production in tons", "yield (ton/ha)" and "average total cost ($/kg)", including many of them with correlations close to 1 and/or -1 (perfect dependence).

This way, considering previous economic studies on other rural activities developed in the region, it was found that passion fruit activity is economically more viable than that observed in dairy cattle in the municipality of Cacoal, state of Rondônia; in the production of free-range chickens in São Felipe do Oeste, state of Rondônia; and sweet potato cultivation in Castanheiras, Rondônia state.

Thus, anchored by the results found, it is noted that the production of passion fruit in the Central Region of Rondônia, Western Amazon/Brazil is an alternative of attractive rural activity and of great economic and social contribution. With this, it is considered salutary the origin of the stimuli to the activity, as well as the expansion of the development of academic research on the fruit in the region.

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