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## PRODUCTION PLANNING IN THE EXTRACTIVE INDUSTRY OF THE BRAZIL NUT : A CASE STUDY IN PORTO VELHO, RONDÔNIA STATE, BRAZIL

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### Abstract:

*Production planning is essential to avoid losses during the process, in addition to enhance the results with continuous improvement in quality management. It is required in the activity of the extractive industry of the Brazil nut, a native fruit of the Amazon, whose activity is pending of the plan of operationalization. This work aims the study of the reality of this industry, comparing the practice with conceptual precepts collected. The Contingency Theory underlies the present study, because it states that to be selected the actions in organizations it is necessary to test hypotheses previously. This research is of qualitative nature, and was prepared by the method of Case Study; the common procedures were adopted to the method by practicing these three distinct stages, namely, visits to the places of the chestnut marketing, observation of the chestnut cultivation in EMBRAPA / RO and interview with a regional producer to indirect data collection. The protocol of ethics of informed consent was followed. As result it was possible to observe the difference between the theoretical precepts and practice in the routine of the extraction process of the Brazil nut. It was recorded the disobedience of the minimum recommendations required in the activity by those involved, resulting in a task of a health risk for the extractive agent and also for the final consumer, motivating the notes addressed in this study. This work will serve as an instrument to support the academic knowledge, and those interested in matters of the Amazon.*

### KEY WORDS:

Administration , Amazon , Brazilnuts , Extraction , Production Planning.

### INTRODUCTION

With the market changes, the technological innovations and the competition growing more and more, the organizations seek opportunities, and profit, developing new products of high quality and using effective strategies. The management of production suggests that one of the factors necessary for the quality of development and the success of the product is from the process of Production Planning.

The Production Planning allows for a preparation to the search for data that the companies have favorable production control, always being alert to market changes that happen constantly. The search for planned actions can help improve the steps and the quality of production, avoiding the occurrence of losses and a possible decline in company. Furthermore, from the production planning it is possible to get better

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pricing favoring profitability, innovating and establishing itself in the market successfully. This planning is not only important in industries as well as in the primary sector.

The extraction is the source of income for many families in Brazil, however many times this process takes place without proper planning, which can harm the producers. In this study we discuss the extraction process of the Brazil nut, a native species of the Amazon rainforest, with high production in the region. The issue presented is the lack of planning by the extractive producers who use traditional practices, which could undergo changes in order to adapt the methods recommended in the manuals of good practice extractive to ensure safety and quality in the production stages.

### 1.1 Presentation

This study consists of a case study conducted in the city of Porto Velho, State of Rondônia, in order to analyze and to present the procedures used in the extraction process of the Brazil nut, confronting the theory with the practices developed by social actors. According to Mocelin (2010), the social actors occupy different social positions, which express difference and inequality prevalent in the Amazon. The social actors present in this study are presented as low-income people who use this extractive resource to complement your budget and generate profits for the community. To the produce of this task was admitted as general objective to analyze production planning extraction of the Brazil nut; And, as specific objectives, analyze the processes of extraction of the Brazil nut (1), evaluating the procedures carried out on the product in situ (2) and analyzing the planning of the volume of the production (3).

## 2. THEORETICAL AND CONCEPTUAL REVIEW

The theoretical referential admits the concepts related to production planning, the extraction processes of the Brazil nut, the procedures performed on the product after collection as well as the quantity of almonds produced. To support the research we used the Contingency Theory. It is defended the idea that the certain or uncertain can only be known through the experiences and learning. In it, the authors argue that there is nothing absolute and that the environment and management techniques are interconnected as they are essential for achieving effectiveness. Thus, one sees that for each different situation there are diversified paths. It offers support, but the experience confirms the path to be followed. Varied concepts complement the theoretical grounding, such as those treated in the sub-topics that follow.

### 2.1 Planning of the extraction process of the Brazil nut

The Production Planning corresponds to the junction between the preparation and organization of information that allow the programming and production control. Production management can be defined as any activity developed by a company aiming the attempt to transform inputs into products and / or services, as discussed in Martins (2002). The study related to production management came up with Taylor from the methods of division of labor. For him, the company was literally the manufacturing sector, where the success or failure depended on the studies and methods of production (rationalization). This method aimed above all, the principle of efficiency. The main objective was to increase production while minimizing costs by avoiding waste of time, movements and raw material (CHIAVENATO, 2004).

The contingency theory is one of the most flexible of all theories of management, because it considers the ideas and principles of the earlier theories and still has the basic requirements of management as tasks, structures, people and technology. According to Chiavenato (2000), the contingency in its essence means something uncertain or eventual, which can succeed or not. The contingency approach stresses that it does not reach goals effectively following a single model or guideline or preestablished method for all circumstances, but through several internal and external variables. This approach makes clear that there is a relationship between the environment and the management techniques used to achieve the goals.

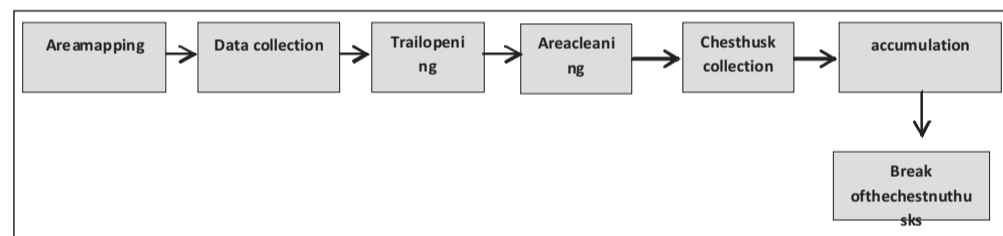
The chestnut tree, scientifically named *Bertholletia excelsa*, is popularly known as the Brazil Nut, Para's chestnut or Amazon's chestnut. It is a native species of the Amazon rainforest, concentrated in Bolivia, Peru and mostly in Brazil, in the states of the North, and in Maranhão and Mato Grosso. The tree is large, reaching up to 50 meters high. Its fruit is called "ouriço", it can reach 1.5 kg, and contains from 16 to 25 seeds (chestnuts), that are rich in vitamins, fats and proteins.

In the State of Rondônia the production of the Brazil nut covers almost all its territory, especially the municipalities of Guajará-Mirim and Nova Mamoré. According to EMBRAPA (2005), its flowering occurs from October to December, and its fruiting occurs from October to March, depending on the region. The Brazil nut goes through a process of harvesting, sorting, washing, drying, storage and marketing performed by the collectors of the region through a system of harvest traditionally transmitted between

**PRODUCTION PLANNING IN THE EXTRACTIVE INDUSTRY OF THE BRAZIL NUT.....**

generations. The extraction of the Brazil nut represents a significant economic importance in the Amazon, for it is used for local consumption and marketing. It is the main source of income for farmers, rubber tappers and indigenous people who live in the forest. The handbook of good practices recommends the planning of the action, that begins from the collection of information regarding the area in which the chestnuts can be found. The first step is the mapping of the site by collecting information, such as the size and location of the chestnuts, the amount of existing trees, location of villages, storage sheds, rivers and roads. This mapping can be done simply, or by technological equipment such as Global Positioning System (GPS) and aerial photo-images. Then it is needed to open trails, connecting a chestnut tree to another. It is also necessary to clean the area in which the chestnuts are located, by removing the vines, old chestnut husks and other kinds of vegetation to facilitate the collect and the transportation of the chestnut husks to the villages. These procedures should be performed in a previous period to the collect. The extraction process of the Brazil nut held in forests generally not undergo a proper production planning, due to the troublesome traditional methods used by the collectors, that jeopardize their safety. The collection must be performed during the harvest period, with the use of Personal Protection Equipment (PPE) such as helmets, gloves and boots. It is convenient that the chestnut husks must be harvested every day to avoid its prolonged contact with the ground due to the possibility of contamination by fungi, which generates losses in production. During the collection, the chestnut husks must be stacked in a appropriate place in the forest. If the chestnut husks are broken and removed in a short time, they may be placed in a clean place. However, if the chestnuts husks remains stacked for a longer period of time it is necessary that they remains scattered over "girais" (a kind of improvised table generally made of wood), with an opening for aeration and for moisture retention, reducing the risk of contamination of the chestnuts. The instruments such as knives, baskets or bags must be clean. The removal of the seeds (chestnuts) occurs from the break of the chestnuts husks. The planning of the extraction process of the Brazil nut occurs as in Figure 1 below. Then comes the Table 1 that refers to the planning of the extraction of the Brazil nut, in which it is detached the steps and the description of the process undertaken. From the stages of the planning of the extraction process of the Brazil nut presented by the Manual of good practices it is possible to analyze the appropriate procedures in the extractive industry of the product in question. The description of the process allows a basement of the producers regarding the use of effective techniques as studied in the subsequent topic.

**Figure 1: Diagram of the planning of the extraction process of the Brazil nut**



Source: Adapted from Pinto et al (2010) by the authors.

**Table 1: Specification of the planning of the extraction process of the Brazil nut**

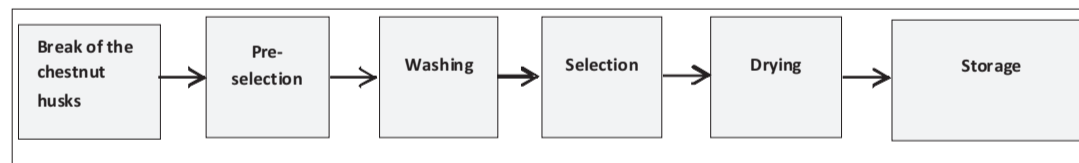
Stages	Description
<b>Areamapping</b>	It is essential to have knowledge about the natural riches of the area from the mapping for the performance of production planning.
<b>Data collecting</b>	Comprises the identifying of the data of the area where the chestnuts are located, as well as sheds, villages, rivers, roads, etc., to perform inventory of the place
<b>Openingoftracks</b>	The opening of trails allows easy access to the chestnut, making the work of the collector more efficient.
<b>Cleaningthearea</b>	The cleaning of the tracks that connect one chestnut tree to another, as well as the huts, facilitates the transport of chestnut husks and / or chestnuts. Besides removing branches and vines, there is also the removal of chestnut husks of the previous harvests around the chestnut tree.
<b>Chestnuthuskscollection</b>	It is better that the collection be made during the harvest, to prevent its contact with the ground. The Amazonian high humidity harbors fungi and other microorganisms that can contaminate the chestnuts.
<b>accumulation</b>	During data collection, it is necessary to look for a place to pile chestnut husks collected. This location should be beyond the reach of the chestnut canopy to avoid accidents with falling chestnut husks.
<b>Breakingofchestnuthusks</b>	The maximum attention is recommended during the opening of the chestnut husk due to the use of sharp objects such as knives, because any distraction can result in a serious accident. It is compulsory to use protective equipment.

Source: Adapted from Pinto et al (2010) by the authors.

**2.2 Planning of the procedures performed in the product after-collection**

The planning of the procedures performed in the product in loco after extraction aims the continuity of quality in the processes used. The withdrawal of the almonds from the husks generally occurs in forests and should be held with the utmost care. There is a pre-selection in which the chestnuts with cracks or signs of mold should be discarded, they should not be mixed with the others. The washing process should be performed in clean water passing by a second selection of the chestnuts in order to remove those that float in the water. Then they should dry naturally in tables or storehouses. After the drying process the chestnuts shall be packed in clean bags and stored in suitable environments, such as sheds to wait for its final destination. The chestnut extractive based on the planning of procedures performed after collection is done as shown in Figure 2 below.

**Figure 2: Diagram of the planning of the process after collection of the Brazil nut**



Source: Adapted from Pinto et al. (2010) by the authors.

Table 2 below refers to the planning of the process after the collection of the Brazil nut.

**Table 2: Specification of the planning of the process after the collection of the Brazil nut**

Stages	Description
<b>Break of the chestnut husks</b>	The break of the chestnut husks should be made immediately after collection, using clean utensils for this purpose. The place of the break must be in a clean environment and protected against access of the wildlife.
<b>Preselection</b>	During the opening of chestnut husks, occurs the pre-selection of chestnuts, discarding the seeds damaged or showing some divergence that compromises its quality.
<b>Washing</b>	The chestnuts should be washed with cleaned and running water to remove impurities.
<b>Selection</b>	During the washing, the chestnuts that float are separated and discarded from the others, because they are unfit for consumption.
<b>Drying</b>	Drying is performed in solar dryers or scattered in the barracks so that allows a partial drying.
<b>Storage</b>	The storage of the product is done in sheds. The area of the warehouses must be compatible with production to avoid large stacks of chestnuts hindering the air circulation.

Source: Adapted from Pinto et al. (2010) by the authors.

The planning of the process after collection of the Brazil nut, as specified in the table above, it is also fundamental to the effectiveness of the process as well as the quality of the product. Productivity can be compromised if the procedures are not complied or performed correctly, which influences directly in the profitability achieved in the marketing of the final product. Considering the factor of sustainability of agroecology, the studies performed allow the use of carbonization technologies applied in the chestnut husks originated from the collection and from the discard of the fruits of the chestnut tree, favoring the agroextractivist in the use of these wastes for soil improvement for the practice of agriculture. Another point to highlight is the use of the chestnuts husks also in the production of craft objects, which provides an alternative source of income by the handicrafts production.

### 2.3 Planning of the volume of the production of the Brazil nut

It is called capacity the maximum amounts that can be produced in a production unit or as the time available for work, expressed in hours / machine or man / hours in the productive center. The productive capacity of any product must be clearly defined and measured. To determine the productive capacity it must take into account all factors that may restrict it.

The environment is everything that involves externally an organization or system. It is the context in which an organization operates. As the environment is vast, it is possible to analyze several segments, among which it is pointed the environment of activity, which is the closest and the immediate of each organization. It is the segment of the general environment in which an determined organization draws its inputs and deposits its outputs.

The realization of the planning of the production volume of the Brazil nut is complex due to the variation of production of a chestnut tree to another. For being a seasonal product, it is necessary to forecast the seasonality. This forecast is meant for products that have cyclic behavior, where production systems are linked to climatic conditions, crops, school term and other factors that affect in the demand and in the supply ability, as described by Erdmann (2000).

Generally mature trees are considered the largest producers of chestnuts, so, the planning of the production volume is based on the monitoring of the quantities produced in each crop and, when possible, the identification of trees that produce more, for an adjustment of the capacity of calculations. The handling of the product after its extraction, also generates influence on the quantity produced, which should be avoided contamination and possible losses.

### 3. METHODOLOGY

Method is a set of processes by which it becomes possible to know about a certain reality and reproduce a certain object. It was applied the method of case study, which seeks to study phenomena

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involving individuals, groups, institutions, and others. Moreover, generalizations were made from case or representative cases of those involved and / or facts thoroughly investigated, respecting its totality and the comparative method, to verify similarities and explain differences, fitting itself as a qualitative approach, as indicates Siena (2011).

The procedures used in this work were bibliographic research, technical visit to the Market Hall and Market "Quilômetro um" to collect primary data and information in order to provide a basis for research on the activity to be performed; interviews with the researchers from EMBRAPA in order to sustain credible statements regarding to the exploration of the Brazil nut, and finally an interview with the producer aiming at collecting data on the extraction processes in order to provide the factual elements of the study in elaboration.

#### 4. CASE STUDY ON THE PLANNING OF THE EXTRACTIVE PRODUCTION OF THE BRAZIL NUT IN PORTO VELHO

The present study discusses the planning of the extractive production of the Brazil nut in the region of the Western Amazon, rich in natural resources, with a considerable production of the product in focus. The activity covers specifically the city of Porto Velho which is the capital of the state of Rondônia, and was created by explorers around the year 1907, during the construction of the Madeira-Mamore railway. It is situated on the right bank of the Madeira River, the largest affluent of the right bank of the Amazon River. It is positioned at latitude 08° 45' 43" South and Longitude 63° 54' 14" West, and has a height of 85m and an area of 43,209.5 km<sup>2</sup>, the map below shows the geographic position of the location in South America

Currently the city's population grew rapidly due to the construction of the Hydroelectric Plants of Santo Antônio and Jirau in the Madeira River, but the municipality does not provide the necessary infrastructure for the population increase. Residents suffer from the lack of adequate infrastructure, occurring problems of pavement, lack of proper lighting, inadequacy of the attendance service in the essential services as health, safety and education.

Figure 3: Geographic Position of Porto Velho in South America



Source: Internet

The data and information acquired to perform this case study were obtained, first, in contact with the marketers of the Brazil Nut in the Market Hall and in the Market "quilômetro 1", that guided us to the suitable sites for the achievement of the research. The second visit was performed in the Brazilian Agricultural Research Corporation - EMBRAPA, aiming the observation of the system of plantation of



chestnut trees of the site and the collect of information related to the object of study. In a third stage, an interview was conducted with a chestnut extractor of the region, to make possible to know the reality of extractors in day-to-day and perform a comparison between the theoretical methods, and the two different ways of extracting the product

**4.1 Analysis of the extraction processes of the Brazil nut;**

The Brazilian Agricultural Research Corporation / RO (EMBRAPA / RO), under the Ministry of Agriculture, Livestock and Supply of Rondônia, is located in the city of Porto Velho, BR 364, KM 5.5 in Rural zone of the Capital. The body performs researchs in different geographical areas and in fields of scientific knowledge. Surveys with chestnut trees are conducted and their products are cultivate in loco, for purposes of study. We interviewed two researchers of the site, where they explained the procedures and methods necessary for planning of the production of the chestnut trees performed through mapping, planting, gathering, and selection.

The interview with the extractor occurred at the "Porto do "CaiN'água", located on Farquar avenue, in the capital of Rondônia. In the interview were exposed some points, as the area of extraction, collection, the amount of chestnuts extracted, the storage method of the almonds and transport to the capital. The respondent is resident and leader of the Pombal community, located approximately 6 hours by boat from the capital Porto Velho, he is a extractive producer since the he was 15 years old and lives in the place since 1955. The place where the producer lives comprises an area of 2,500 hectares.

EMBRAPA has a system of chestnut seedlings planting similar to those of native species through the preparation of the area and follows the exigencies related to the planting of the same. The area needs cultivation, weeding, mowing of the area and around the plants, fertilizing and pest and diseases control. In the area of extraction of the producer, this mapping was never realized. The chestnuts trees are 20 minutes away, through the woods and the trees are arranged without organization, among other species, so the mapping process becomes quite complex.

It was possible to make an inference about the analysis by observing the difference between the methods of the extraction process of the Brazil nut in the situations studied. In the first case there is an organization, planning and mapping that goes from the planting of the chestnut seeds to the extraction of chestnut husks, the area is prepared according to the ideal. On the other hand, in the extractive community there is no planning of the production control because the chestnut trees are located in dense forest; arranged haphazardly. It is also possible to observe that the first place does not make marketing and transportation of almonds, while the second does, but also unplanned. In table 3 it is possible to observe what are the processes involved in the production of chestnuts that each site performs or not.

**Table 3: Comparison between of Production Processes**

Processes	Planning	Pestcontro l	useof PPE	contamination prevention	Transport	Commercialization
Source data						
EMBRAPA	X	X	X	X	-	-
Extractive Producer	-	-	-	-	X	X

Source: Research Data.

It is possible to see that when the two places have equal necessities (planning, pest control, use of PPE and pollution prevention) the producer does not execute them. When the necessities are different (transportation and marketing), EMBRAPA does not materialize them, because its goal is not the trading, unlike the producer, that needs to perform them for the marketing of the final product.

**4.2 Evaluation of the procedures performed on the product in loco**

The harvest of chestnut husks is performed at EMBRAPA according to its standards ( avoiding contamination ) and are used protective equipment . The Pombalcommunity performs the collection process after the fall of most chesnut husks , which occurs between the months of November and February , but often the extractors collect the chesnut husks when they are still falling . Due to lack of habit and by the family tradition , the collectors of the community do not use Personal Protective Equipment - PPE , despite

having knowledge about the importance of these. It was reported that an extractor was hit by a falling chestnut husk, resulting in physical harm to the victim . Another difficulty reported referred to the high number of insects that hamper the routine of the extractor in the woods, in addition to pests like caterpillars and grasshoppers , occurrence that also reflect in the quality of production . Asked the extractor about the possible contamination by fungi, he denied these occurrences.

At EMBRAPA the chestnuts are stored in a room designed for the procedures of scientific study. However in the community, after the extraction, the chestnut husks are broken with a machete and then the almonds are sanitized in basins, with the aid of appropriate sieves. The chestnuts of refuse are removed because the damaged chestnuts do not enter the market but can be used in the production of oil in an detached procedure. After cleaning, the product is bagged. On methods of drying and storage, the producer states that they remain devoid of the ideal places to carry out these procedures. It can be observed in Figure 4 below which are the procedures performed by the product in the extraction process of the Brazil nut.

**Figure 4: Diagram of extractive processes performed by the producer**

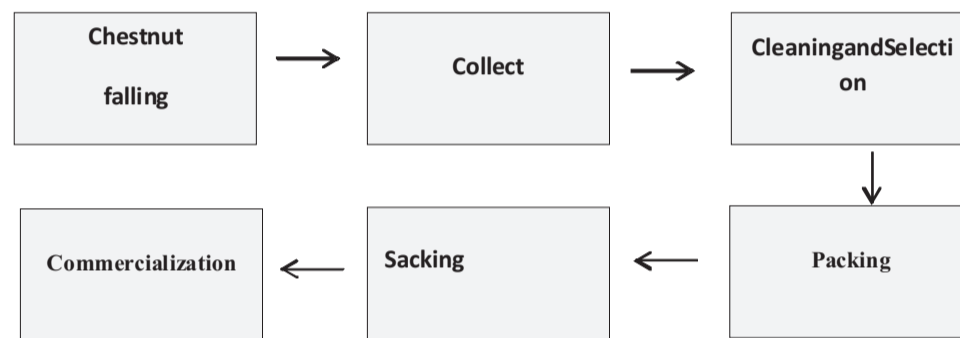


Table 4 below refers to the evaluation of the procedures performed in the "in loco" product of the post-collection process of the Brazil nut performed by extractive producers.

**Table 4: Specification of the evaluation procedures performed on the "in loco" product**

Stage	Description
<b>Fall of the chestnut husk</b>	The fall of the chestnut husks usually happens during the rainy season. Chestnut husks fall from trees up to 40m high.
<b>Collect</b>	After the fall, the chestnut husks are collected as soon as possible to avoid prolonged contact with the ground due to the risk of contamination and gradual loss of production.
<b>Selection</b>	Then the chestnut husks are selected, discarding the fruits that might be contaminated or has any other damage that compromises its quality.
<b>Cleaning</b>	The chestnut passes through the cleaning process, where it is washed and in the washing operation is used cleaned and running water.
<b>Packing and sacking</b>	The chestnut to be stored, it must be packed in 60kg bags and should avoid the stacking, because the necessity for aeration.
<b>Commercialization</b>	After performing the previous procedures, the chestnut is ready for commercialization, which happens on boats. The vessels should be cleaned and free of debris before loading and sanitized after each load.

Source: research data

It is noted neatly the steps followed by the extractors regarding to the studied community. Comparing with the diagram in Figure 4, it is possible to see that the extractor of the place does not perform the process of drying and storage of chestnut marketed. This fact proves the carelessness that results in infection of the almonds with fungi and bacteria that reflect in the health not only of the extractors and their families, but also in the health of the unsuspecting consumers who buy the product.

**4.3 Analysis on the planning of the production volume**

Regarding the amount of chestnuts, EMBRAPA informed that this is a significant count only for the studies. It was reported that in the community were already obtained collects of up to 800 cans of 18 liters each, with an average of 500 cans per harvest. However, at times, the production was zero and the extractors and residents used the chestnuts only for their own consumption. Recalling that the amount of chestnut husks depends on the flowering of each chestnut tree and, in the seasonality of this study, in other words, in August 2013, the chestnut trees of the community are not flowered as in prior periods; so, the extractors expect losses in the collect of this year. When asked about the off-season, the producer informs that even without suitable place for storage, he still commercializes an amount of chestnuts just enough to sustain the family. The table 5 represents a comparison between the quantity and the price during the season and offseason of the place focused on this study; all monetary values expressed in this activity are shown in US\$ (U.S. Dollar)

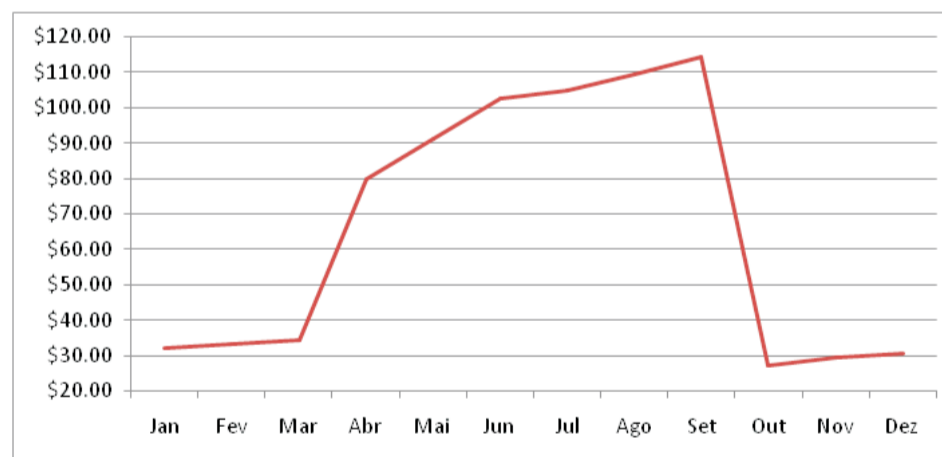
**Table 5: Number and Value of Chestnut in season and off season**

EMBRAPA	Extractiveproducer		
	Amountproduced		
Product for purposes of study only		Harvest	Offseason
	production	Averageof 500 cans(18 L)	Zero
	Sale (can 18L)	US\$ 36,52 a US\$ 57,07 per unit	US\$ 102,73 per unit

Source: research data

Based on Table 5, it is found that the production of EMBRAPA is not used commercially in order that the product is harnessed for research purposes only. Referring to production specified by the extractive producer, it is concluded that the quantity produced in the harvest period is equivalent to 500 cans (18 liters), costing between US\$ 36.52 to US\$ 57.07 U.S.. In the off-season there is no production, however, as reported by the producer, there is the commercialization of the chestnut, despite the absence of a suitable place for storage. The price of the chesnuts in this period is high and amounts to US\$ 102.73, due to the lack of product on the market, which increases the its demand and respectively its value. The chart 1 below shows the variation in prices of Brazil nut according to the period of harvest and offseason.

**Graph 1: Variation of the Prices of the Brazil nut in harvest and Off season, amounts in U.S. \$.**



Source: research data

It is observed that between the months of November to April, period of the seasonality of the product, the price of the chestnut is lower due to the large amount offered in the market. In the off-season, from May to October, the price of the chestnuts increases due to low supply of the product in the market.

#### **5. CONCLUSION AND RECOMMENDATION**

Therefore, it is possible to conclude that Production Planning is fundamental to the success of the product in the market. Perform the prior planning, in the preparation of the product, and after, to see its potential in the market, besides the analysis and implementation of possible adjustments. With the chestnut is not different: it is essential the planning of the extractive process and of the other steps to commercialization. The planning allows an overview of the process and the procedures performed in the production, in order to help in the control and in the necessary adjustments from the evaluation of the process that reflect directly in the quality of both the product and in the lives of the producers. It is suggested an incentive for the propagation of these manuals in extractive reserves through awareness programs so that the producers introduce these methods in their reality. It is necessary to emphasize the safety of these workers because the extraction of this fruit is quite dangerous.

It is recommended the mapping, the opening of trails and the cleaning of the place, utilization of safety equipment during the collect and rigorous care in order to avoid the proliferation of contaminants, as well as the adequacy of the remaining steps of the process in order to achieve security both in the extraction, and the quality of the fruit. The modernization of the production system besides being significant in the quality, makes the Brazil nut a competitive product on the market, allows the development of derivatives in the food industry, both the almond, as the utilization of the oil and flour, opens new opportunities of business, generating income and employment in its production chain.

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