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SUMMARY

EDITORIAL

It is very meaningful, for Università Del Caffè Brazil, to release for the first time, the complete version in English of the issue # 8 of Cadernos da Universidade do Café, in the year our 18th anniversary. This edition has a special meaning since it brings four different research developed by UdC Brazil in recent years.

Università del Caffè Brazil was born in March 2000 as a result of a partnership between PENSA (Agribusiness Knowledge Center - FEA/USP and FIA) and illycaffè. The mission, since the beginning, is the generation and dissemination of knowledge to the coffee system. Our goal is to add value to the coffee grower.

In line with its mission, Università del Caffè Brazil has a relevant role as a generator of knowledge. Surveys are developed year by year, always aligned with illycaffè's strategic plan. To support the dissemination of knowledge, we have created this publication “Cadernos da universidade do café”.

Illy is a leader in its segment that stands out for innovation. This innovative feature has been present in the company practically since its foundation and remains for generations in the family. Illy's strategy has been to differentiate its coffee, always towards the high quality. A strategy of success in relation to the competitors, the results were obtained for the company itself, its suppliers and for other agents involved in the agro-industrial system of high-quality coffee. This innovative spirit of the company is reflected in the researches carried out by Università del Caffè Brazil/PENSA.

In 2013 the research "The possibilities in the differentiation in the coffee production and the consumers’ behavior" was coordinated by Prof. Eduardo Eugenio Spers, Ph.D. and carried out by Pensa’s team. Several innovative aspects were pursued in it: a survey with two segments distant from each other: coffee growers and consumers. Qualitative and quantitative techniques were also used. The study's own objective was innovative when testing aspects of innovation on four dimensions: quality, certification, sustainability, and origin. Academic rigor was one of the highlights of this research through the use of methodologies such as laddering.

In 2014 two surveys were done simultaneously. One of them “Drivers of Change in the Coffee Production: Past, Present, and Future Challenges" was coordinated by Professor Luciana Florêncio de Almeida, Ph.D. The objectives of this research were the identification and description of the main drivers of change in the coffee crop in the present. In this way, it was possible to build a scenario of trends and challenges for coffee-growing in the next 10 to 20 years, according to the perception of the agents of the coffee chain. It was verified the new ways of organization that are being created, to give support to the drivers of change identified through survey methodology with ten agents of the chain: growers, exporters, leaders, governmental managers and technical staff, looking for the drivers of change in the last sixty years along with them.

Eight critical factors were identified, which were submitted to the analysis of 39 producers in the three main production regions of Minas Gerais. The objective was to collect the perceptions of the future of coffee cultivation and to verify the preparations for the future demands of this activity in Brazil.

The other simultaneous research “Risk Assessment for Pesticide Contamination of Coffee” was coordinated by Professor Antônio Carlos Lima Nogueira, Ph.D.

This study presents an overview of the regulation and the risks technology of contamination of coffee with agrochemicals. The regulatory aspects involved not only the laws and norms that deal

with the matter in Brazil but also the agencies that regulate standards in Brazil and abroad. It also covers the technological aspects involving the pests and the active principles available in Brazil and those that are to come. In the search for information, extensive documentary research was carried out, followed by interviews with specialists. The main purpose was to bring to the reader a better understanding of a subject that is often not easily found directly and objectively for coffee growing.

In 2015 Università del Caffè Brazil/Pensa's team: Professors Decio Zylbersztajn, Samuel Ribeiro Giordano, and Christiane Leles Rezende De Vita visited the coffee farms in the search for Strategic Supply Contracts for High-Quality Coffee. The focus of this research was the guarantee of the acquisition of specialty coffees, exploring the potential innovations in the relationship between illycaffè and its suppliers to maintain this supply. This research also examines the potential of establishing formal contracts and other forms of long-term relationships. This study also has the description of the Agribusiness Coffee System updated according to Pensa's own methodology. The research deals with the theme of contracts, their characteristics, and particularities. It was included an item related to innovation in this research, recurrent in all other surveys, because it is a topic that illycaffè considers as central.

Thus, we sought to gather in this publication a set of works generated by the Università del Caffè Brazil, in which a private and innovative company, such as illycaffè, since its creation, innovates once again by sponsoring, diffusing and offering to the Coffee community a high quality and current knowledge. The hope of this effort is to increase the training and information of the community adding value to the world of coffee. We wish you a good reading, and we hope to see you in the next edition.

Prof. Samuel Ribeiro Giordano, Ph.D.

Prof. Christiane Leles Rezende De Vita, Ph.D.

1 THE POSSIBILITIES IN THE DIFFERENTIATION IN THE COFFEE PRODUCTION AND THE CONSUMERS' BEHAVIOR.

Eduardo Eugenio Spers, Decio Zylbersztajn, Samuel Ribeiro Giordano, Christiane Leles Rezende De Vita, Antônio Carlos Lima Nogueira

1.1 INTRODUCTION

Ilycaffè adopted a strategy to differentiate its product by producing high quality coffee. This strategy was successful and generated results for the company, for its suppliers, and for all other agents involved in the agro industrial quality coffee system as well as the gourmet coffee subsystem. In Brazil, Illy is a pioneer in this subsystem, coordinating its' actions to obtain a standard in raw material with a very accurate precision.

Innovation has always been present in Illy' s entrepreneurial vision and its' goal is to continue being outstanding in quality, increasing its' visibility as the leader in quality coffee. In order to achieve this, it is necessary to innovate in differentiating the quality. In other words, it is necessary to identify and anticipate tendencies/trends that can be valued or even demanded by consumers, such as differentiation in adopting technologies which are environmentally balanced that are on the agenda of todays' movements and also tendencies that are socially fair. This kind of strategy can be seen as an expansion in the production of quality attributes desired and valued by consumers.

It is important to point out that the quality of the coffee, the social-environmental strategies have a cost and require a high level of co-operation between producers and Illy. This study aims at identifying the possible attributes that can be introduced into the product, generating a new trend, that we will call "second degree differentiation".

This research has several innovative aspects, four of which are worth highlighting. The first is the systemic approach, where two far removed parties are interviewed: coffee producers, Who are specialist in coffee production, and consumers. Generally research focuses only on one agent in the chain: the producer or the final consumer. Research has also been done in different periods, with different objectives, which does not allow us to analyze the comparisons that are part of this study. The second aspect is the use of qualitative and quantitative techniques, which were academically jointly validated in one study. Overall, these modern techniques are used almost exclusively in scientific studies and even in these, in general used separately. These methods included: documental analysis, laddering, conjoint analysis, TCIP- Technical Configuration and Image of the Product and several multivariate analysis techniques. The third aspect is testing innovation regarding four dimensions simultaneously: quality, certification, sustainability and origin. None of these have been fully used by organizations in their communication strategies nor have been perceived by consumers through spontaneous questions or by the stimulus given through the construction of hypothetical products and situations. Last, the academic rigor developed in all stages of the research: construction and validation of the tool for collecting, sampling, analyzing and interpreting the results. This rigor offers a high degree of reliability and validity of the results, which makes publication in academic journals possible.

Glossary

Below is a glossary to standardize concept and facility the understanding of the results of this study:

Attribute: consumers do not buy coffee as a whole, but parts of it. The attributes are seen as properties or intrinsic characteristic of the product, measureable and observable, which can be tangible or intangible.

Sub dimensions: a set of attributes grouped, or perceived similarly by the consumer. This is a level half way between attribute and dimension.

Dimension: is a set of attributes that determine a characteristic innovation. These were determined by the documental research in four great areas: quality of the coffee, certification of coffee, sustainability of the coffee and origin of the coffee.

Value: this is a perception in relation to the cost benefit in relation to the attributes of innovation in coffee. In Laddering, it is the personal value associated to each attribute of innovation in coffee.

Innovation: changes in the coffee attributes based on the positive perception and acceptance by coffee producers and consumers.

Innovative strategies: actions that Illy will define to modify the coffee attributes.

1.2 METHODOLOGY

The methodology adopted for this research was quite innovative. It involved three stages, which are described below.

Stage 1 – Documental research. This research was done using material generated at important forums on current topics in Agribusiness. The aims was to verify what the main authors, who publish, say at these conferences regarding the tendencies with relation to the topics dealt by this research. The themes are those related to the concepts of differentiation such as: technology, environment, social responsibility, and origin amongst others.

Stage 2 –Panel Discussions with Specialist in Coffee. Several collective panel discussions were conducted with qualitative structured questions were made with coffee producers in directed interviews to the representatives of elite producers, market opinion-makers, technical assistants, top coffee classifiers, researchers, heads of coffee producing cooperatives, union leaders and coffee producers and agents of other segments of the agro industrial coffee chain.

These panels aimed at verifying the tendencies to prepare the questions that would be

Used in the survey that would be used with consumers. The producer little know what the consumers want as attributes and the consumers little know what the producers have to offer in terms of attributes that can differentiate the product. Considering this contradiction, these panels aimed at extracting from the producers and production agents, ideas that could furnish and offer some direction for the survey. The panel method with specialist has been used in qualitative research in several areas, as a means of prospecting the future on a certain topic, principally when the aim is to identify scenarios, technological and market tendencies. The Delphi method is used for technological prospection because it favors the convergence of opinions (Ewing & Bartholomeo, 2008).

Stage 3 – Quantitative Research with Consumers (*Survey*). The data collected was done by means of a probabilistic and random sample with 425 respondents, where coffee consumers were approached in public places with a high-flow of people by researchers filling out a questionnaire. The great majority of the interviews were taped. The group of interviewers was composed of 18 people that had been previously trained for three hours on how to conduct the interview. The interviews were conduction in the city of Campinas during the months of July 2013.

1.3 STAGE 1 – DOCUMENTAL RESEARCH

This section presents a discussion on the topics considered relevant to achieve the aims of the project, based on an analysis of the literature. The revision identifies the evolution in the studies on innovation and differentiation of agribusiness products, with a focus on the agro industrial coffee system. The analysis of the studies allowed the definition of the categories for analysis used in the data collecting instruments for both qualitative and quantitative research. This section is structured in four items. The first contains a conceptual approach to the differentiation and innovation applied to agribusiness. The following items deepen the themes of differentiation in the food production chains, with a focus on the coffee agribusiness system. The second item presents a discussion on the technological guarantees offered to the consumers, with a focus on the quality and traceability. The third item deals with the question of social-environmental guarantee, by detailing the certification of organic production and social aspects. The fourth and last item treats the guarantee of geographical origin.

1.3.1 Differentiation and Innovation in Agribusiness

Differentiation has been treated in the economy and administration of organizations

As one of the strategies adopted by companies to obtain competitive advantages in the markets in which they operate. In Poter's (1989) traditional conceptual model for the structural analysis of industries, differentiation is one of the generic strategies of companies, side by side with leadership in costs and focus on customers from selected market segments. For him, the differentiation of a company is to search for a unique position in the market, and for the performance in some widely valued dimensions the consumers' value. The company selects one or more attributes that many buyers consider important, and uniquely positions itself to attend to these requirements. This position would be compensated with a premium price (Porter, 1989).

The differentiation forms are distinct in each industry and can be based on the product, the distribution system or the type of communication with the consumers, amongst other options. A company that reaches and sustains a differentiation will be an above average competitor in its area if its premium price is superior to the extra costs of its unique position.

To differentiate oneself, one needs to always find forms that produce premium price superior to the cost of differentiation (Porter, 1989).

The logic of the differentiation strategy requires the company to chose attributes that distinguishes it from its rivals. It should truly be unique in some characteristic, or be considered unique, so it can expect a premium price. Contrary to the strategy of leadership in cost, there may be more than one success strategy for a company if there is a set of attributes consumers' value (Porter, 1989). In light of the broad concept of differentiation, one can question how this strategy is conceived in companies. As differentiation consists in the creation of value in products and services, it can be associated to entrepreneurialism in existing or new businesses. Entrepreneurialism is an activity that has as its main characteristic, innovation that can be defined as the effort to create a deliberate change, focused on the economic or social potential of a company (Drucker, 1998).

Thus, the strategic base for differentiation is innovation, considered here as a discipline or a practice. Even though innovation can arise from revolutionary ideas of a brilliant mind, most of the successful innovations result from a conscious and deliberate search of opportunities in innovation that can be found in some situations. The conditions in an industry that can generate innovation would be: (1) unexpected events, (2) inconsistencies, (3) needs in processes and (4) changes in the industries and in the markets. Besides these, there are the external aspects: (5) demographic changes, (6) changes in

perception and (7) new knowledge (Drucker, 1998).

In agribusiness, these favorable conditions for innovation are also valid, but it is necessary to consider that they can emerge in different stages of the productive chain: inputs, agricultural production, industrial processing and distribution. In general, the innovation with the biggest impact in generating value and differentiation are those that are perceived by the final consumer, because they can affect the agents in the different productive stages. The management of the food chain, considered as a field of knowledge, is still relatively recent and its research focus is still little defined. This field can be characterized by treating the coordination and support of networks in organizations with relations in dynamic business. Presently there are at least four challenging research areas for this field: (1) the understanding of the dynamics of the critical success factors that can upgrade competitiveness and sustainability in times of globalization and change, (2) innovation in the production logistics and communication processes in order to obtain advancements in providing quality and diversity in accessible and reliable food to the consumers, (3) transparency, interaction and organization in the chains to obtain advancements in governance, reliability , efficiency and innovation dynamics and (4) integration of small and middle size companies in the chains with regional and global value, to advance in the utilization of the innovations generated by these companies (Fritz & Schiefer, 2010).

During the last 150 years, several waves of innovation occurred in agricultural machines, the chemistry of agricultural fertilizers, herbicides and pesticides, seeds, information management and new retail food products. An analysis in the innovation processes of 109 food and agribusiness companies in the United States. Roncan-Kaine, Gray & Boehlje (2011) evaluated the composition of teams, the methods for selecting projects, the characteristic of the portfolios and variations of screening processes according to the company and the sector.

The results indicated that the teams are formed in average by 3,6 functional areas, with predominance of the Research and Development (90% of the respondents), the Executive (89%) and the Marketing (77%) categories. The presence of the Marketing area in the innovation teams reveals the use of information and knowledge obtained by the contact with the consumers.

One of the unique aspects in the food section is that the companies that conduct the innovation projects are subject to two simultaneous forces: technological offers and client demand. On one hand, the technological development continues to press companies to frequently adopt new technologies that involve the re-structuring and up dating of their activities and related training. On the other hand, retailers impose strict standards of quality and demands for the food companies, with low return on investments and high risks. Besides, raw material (agricultural products) is becoming increasingly more expensive and the global supply complex. Therefore, the decision food companies have to adopt and the way to conduct innovation have gained importance (Pascucci, Royer, & Bijman, 2012).

Besides the uncertainty associated with innovation in any economic sector, the food companies face more adverse conditions due to their involvement with products of biological origin. These products present more variability in quality due to the perishability of the raw materials, as well as the eventual change in processes and climate during agricultural production. A relevant theme for companies is the decision on how they coordinate the access to innovation, considering vertical integration alternatives (internal R&D), technological purchases or partnerships with other companies or research institutions (hybrid forms) (Pascucci, Royer, & Bijman, 2012).

Analyzing this choice of 389 companies in the food section in Italy, Pascucci, Royer, & Bijman (2012) found evidence that there are positive correlations between the simultaneous adoption of these governance structures by the same company. This reinforces the hypothesis of complementarity in the forms in detriment to the idea of substitution, which is present in the studies based on the Transaction Costs Economics. Even though they do not offer clear evidence about the key factors for the adopted

structures, the results indicate a positive correlation between the company's orientation to the external market and the adoption of internal R&D. The possible explanation would be that this option allows for the development of exclusive solutions to adapt products to the market demands in every country.

A useful tool to help in the company's decisions in the area of innovation is technological forecast. The analysis of emerging technologies and the identification of technologies with greater potential by means of technological foresight have contributed to the critical decisions of companies regardless their size. The technological foresight field, which has not been a subject of much research, involves different techniques such as market inteligence, forecasting, mapping out technological routes and revision of scientific studies. The quality of this foresight depends on the appropriate choice of method and its correct application. For example, there are studies that argue that the opinions of specialists for the analysis of results is crucial for the final quality in the process of "mining" technologies.

Even though some specialists agree that the application of the technique is specific to technology, place and time, there is little research on the suitability amongst the diverse techniques of technological forecast for a specific technology. The use of traditional bibliometric indicators (frequency of publication and citations, as well as the frequency of patents and related quotes), presents a growing adoption by companies. Therefore, many studies emphasize that technological foresight (TF) in companies is still an unstructured and unsystematic process (Firat, Woon, & Madnick, 2008).

The analysis of literature on innovation and differentiation seems to point out that the companies in the food sector, as well as those in other sectors, should direct their efforts to increase the rhythm of innovation, even if it is only incremental. The systematic observation of the opportunities for innovation aiming at differentiation is the basis of the process. Next, we should consider the organizational aspects in the innovation activities, which include building multidisciplinary teams responsible for the projects, the degree of vertical integration or the search for external partners for innovation. Finally, the process should be grounded on systems or routines directed to the technological foresight as a means of reducing the risks involved in creating or adapting products from determined technological routes which are considered promising. The food sector apparently does not stand out for generating disruptive innovations. On the other hand, it can explore technologies in stages upstream the production chain, like the agricultural input segment (animal and plant genetics), as well as technology that cut across the chain, as those related to information and communication.

1.3.2 Technological Assurance

This section treats some of the aspects related to the technology adopted by the agents in the food chain to generate some differentiation in the product for the final consumer. If one wants to influence the consumers' perception, the application of technology should be clearly disclosed as a guarantee to build trust and market reputation. The text involves a survey of studies on agricultural production with quality and traceability, with a focus on the coffee production chain. Both features depend on technological resources and training of the agents involved.

1.3.2.1 Quality Assurance

Apparently there is an emergent tendency that can be called "belief" in the international consumer markets. Even though there is space of low price products in almost all markets, it is possible to add value by differentiating products. This belief has been increasingly recognized as a source of differentiation. To evaluate the tendencies regarding the belief attributes in the food industry in 21 countries, Marks e Cuthbertson (2008) carried out a research/survey (or conducted research) that can contribute to defining the strategies for companies to attend to the market demands in

the future. By applying in depth interviews and the Delphi technique to obtain consensus amongst participants the authors identified the following trends: (1) "health and welfare food" should represent a high mid-term impact, by consumer demand or governmental requirements, (2) environmentally sustainable supply chains are growing in value as well as in scope, motivated by the growing concern of consumers on the topic or by the pressure of stakeholders on the company operation, (3) the production of ethical foods appears as a concerns of consumers, that can opt for fair-trade products if they are convinced that this option can contribute to a determined underprivileged community, (4) food safety does not appear at the top of the concerns of the respondents in the discussion of belief trends, but is considered a critical control factor because of the risk it represents to companies, (5) the degree in which producers can make informed and concrete claims about the attributes of their products seems to be a key condition for the market belief growth and (6) the consumer should believe that the product is attending some need or existent gap, conducting an inefficient growing image construction of a brand by means of communication.

For Aprile e Gallina (2008), several studies indicate the objective difficulties that consumers have to evaluate the quality aspect in products in the agricultural product market and food market. These aspects seem to be less connected to the search characteristics (attributes that are perceived in a superficial analysis) and increasingly related to the characteristics of experience and belief, for which information seems imperfect and distributed asymmetrically amongst producers and consumers. The authors remind us that in the presence of asymmetric information the markets fail: the low-quality shifts high quality out of the market. If quality cannot be signaled, good quality products cannot obtain a premium price, and thus only low-quality product will be offered for sale.

The volume of available information about the characteristics of experience and the belief seem to be crucial to influence the consumer's perception. Under this perspective, information on the labels signaling quality, as well as certification schemes and private brands, have taken a decisive role in the process of evaluating quality and in determining choices. (Aprile & Gallina, 2008).

These topics were discussed in a study with 200 consumers in the cities of Milan and Naples to evaluate how the information furnished by quality certifications in the European Union are percieved, processed and used by them. With relation to the attributes that were evaluated as being "very important" for buying food products, the results were : "date of sale" (76%), "safety" (55,8%), "type of preservation" (42,7%) and "price" (42%). For the 'important" level, the attributes "methods of production" (58,6%), "brand" (57,5%), " availability" (56,8%), "place of production" (53,8%) and "nutritional value" (53,3%) were important (Aprile & Gallina, 2008).

To understand the determining factors in quality coffee production, the characteristics of the agro industrial coffee system in each country that supports the result of this product, needs to be discussed. The productive system in Colombia is a success example in the coordination of the productive chain of quality coffees. Coffee production is highly relevant for the economy of the country because it is the main agricultural activity that generated jobs for small farmers, providing 500 thousand direct jobs for 566 thousand families of rural producers. The plantation is concentrated in small properties, with an average area of 5 hectares. According to the data of the National Federation of Coffee Producers (FNC= Federation National de Cafeterias), those involved in the production are distributed amongst 64% in family farmers (plantations smaller than 1 hectare), 31% peasants and 5% entrepreneur farmers (Ayala et al, 2008). Colombia only produces Arabica coffee of the varieties *Típica*, *Bourbon*, *Maragogipe*, *Tapi*, *Caturra* e *Variedad Colombia.* The value paid to producers for the coffee is a minimum price defined by an agreement between the federal government and the National Federation of Coffee Producers (FNC= Federación Nacional de Cafeteiros), considering the macroeconomic situation of the country, the price on the New York stock market and the value of the dollar.

In the rural properties, besides planting, managing and harvesting manually, it is also pre-processed which have a big influence on the quality of the drink. The processes involved the use of depulping, washing tanks, solar drying patios (small producers) and silos with drying mechanism systems (medium and large producers). The farmers transport dry coffee in vehicles or pack animals to evaluate the quality and sale to producer cooperatives or to private distributors (Ayala et al, 2008).

The positioning of Colombian coffee as a product of high quality on the international market was obtained mainly by the initiatives in adding value by the National Federation of Coffee Producers (FNC) that involve the renovation of the plantations, the increase in income of the producers and the Special Coffee Program developed in 2002. Special coffee is that which has differentiated characteristics form the point of view of the consumer in terms of quality, variety, packaging and type of preparation. Besides this, special coffee has to meet the specific certification standards that guarantee safety and quality. In Colombia, special coffee is classified into three categories: (1) Denomination of origin coffees, associated with the place and way it is produced, (2) Sustainable Coffees, which is produced and commercialized according to the concept of environmental compliance, social responsibility and economic justice and (3) Preparation Coffees, high quality products associated exclusively with certain preparation or specific cuppings for the drink (Ayala et al, 2008).

The preferences and coffee consumer behavior in Brazil were analyzed by Spers, Saes e Souza (2004) in an exploratory study in the cities of São Paulo and Belo Horizonte. The study aimed at analyzing consumer tendencies for the consumption of special coffees. Three hundred people in four supermarkets did coffee tasking and were interviewed with a questionnaire. The most important attributes were price (30%), followed by the type and brand (both 20%), the type of preparation (15%) and the packaging (10%). The authors reported the difficulties those interviewed had in perceiving certain attributes and suggested implementing collective strategies to better the consumers' perception of quality.

Summing up, the consumer's perception on the attributes of the product, principally those related to belief, in general presented a big gap in relation to the objective characteristics obtained by the production processes. Producers have a great difficulty in offering and decodifying all the necessary information for the product to have a desired image, even with the support of the traditional quality certifications, as those present in the European Union. This leads to the need of constant monitoring of the companies on the trends of the attributes consumers value.

1.3.2.2 Traceability Assurance

The recent incidence of widely disseminated news of some diseases in the food production chains, like the avian influenza, the mad cow disease (BSE = bovine spongiform encephalopathy), and the contamination of eggs by salmonella in the USA sold in Canada, has provoked an increase in the concern of consumers on the quality of the foods they consume. The growing demand for food safety has provoked the stakeholder of the sector to introduce new safety procedures in the production, processing and distribution stages, to guarantee that the final consumers get safe products (Haghiri, 2011).

The advancements in the traceability systems, like the adoption and implementation of disseminated bar codes and an integration method and quality control systems like Global GAP on the farms e HACCP at the processing and packaging plants, are possible solutions to mitigate the contamination risks. Analyzing by means of a survey the consumer's perception about these systems in the farm-raised salmon production system in the provinces of Newfoundland and Labrador, in Canada, Haghiri (2011) identified three underlying attitudes in the respondents. The first groups, made up of people who are aware of the topic and that can pay for certified salmon, are moderately favorable towards implementing a traceability system. The second group reflects

consumers that perceive the benefits of traceability, but consider it costly and that it will provoke an increase in the final prices. These consumers might buy the certified product depending on their propensity to invest in a premium price. The final group is the consumer that trusts the food security and is reluctant to accept a change in the producers procedures and policies (Haghiri, 2011).

In Brazil, we have a relevant example in collective and private certification in food safety in the agro industrial coffee system. The coffee roasting companies, through the Brazilian Association of Coffee Industry, initially created a Purity Seal, that involved the auditing of factories and the analysis in coffee samples at selling points. In this case, the seal imprinted on the package, guaranteed that the content was just coffee, without other substances. The success of this seal, contributed to the development of a more recent one by the same association, the Quality Seal, aimed at informing the consumer on the quality attributes contained in the package. The roasting companies can adhere to this seal voluntarily, which guarantees the following characteristics: the kind of coffee (Arabica or Robusta), the roasting point, body, aroma, flavor and grind (Giordano, 2009).

To evaluate the Brazilian consumer's perception on products with a private seal of guarantee of origin (GO), Cunha and Spers (2011) did a research with 120 persons at supermarket chains that own the seal in the cities of Campinas and Piracicaba in the State of São Paulo. The concession of the seal under discussion for the product, involves the service of the supplier of the following demands: (1) safety and sanity, (2) authentic flavor, (3) superior aspect, (4) ecologically correct production and (5) socially adequate production. The analysis of the consumer's perception on the products with the guarantee of origin (GO) seal, revealed the existence of four basic attributes obtained through factor analysis: food safety, intrinsic quality of the product, a differentiated production system and government inspection.

Food safety and sanity is predominant over the others demands, with a 23.60% participation in the observed variance.

1.3.3 Social and Environmental Assurance

Besides quality, another relevant aspect in the food sector that also presents problem in the information asymmetry is sustainability. It is a concept with increasing dissemination in society and the economy, but that still has a very broad and not very well-known meaning. Presently sustainability of a product can be applied to environmental protection foreseen in the production process as well as to the concern on the social condition of the social agents involved.

The guarantee of social and environmental assurance to consumers is related to sustainability, which is one of the most relevant themes for the management of the food product systems. Sustainability studies in the food chains, traditionally deal with the environmental impacts of products and services to help identify the deficiencies and the potential to improve in areas such as carbon emissions, residue reduction, water use and transportation costs. Even though these aspects are important, a broader vision involves the development of new models for analysis and management of the food chain, incorporating consumer needs (Fritz & Schiefer, 2009).

For the development of strategies aiming at reaching robust sustainable situations in food chains, research has to deal with the following inherent complex aspects for these productive systems: (1) the multidimensionality of sustainability requires the professionals involved to have interdisciplinary competences in areas regarding technology, human behavior and ethics, (2) the food system is global in the supply and distribution stages, which requires joint international efforts in research, (3) the adoption of sustainable strategies by food chains is crucial for improving this aspect in the productive systems, regions and countries, (4) the diversity of food products in distinct categories, all originating in agriculture and developed to attend consumer demands, requires a holistic vision on the distinct food chains and categories of the final products (Fritz & Schiefer, 2009).

Coffee is one of the pioneer crops in sustainability, as well as being pioneer in introducing it in Brazil. Generally, this crop has few environmental problems because the cultivated areas were established and title-held a long time ago. One can affirm that coffee is one of the agro industrial systems that least presents social and environmental sustainability problems. It is a perennial crop, which is not very aggressive to the environment, preserves the soil through conservation management and maintenance weed control practices between the rows. It is definitely not a candidate on the list of destructive crops. Added to this, the demands for certain quality soils, mild weather and altitude for coffee to grow well, excludes the possibility of it occupying regions with higher latitudes in Brazil or threatening the Amazon biome (Waack et al, 2007).

Coffee crops occupy more than 320 properties in Brazil. Most are small (up to 10 hectares), and are distributed among 13 Brazilian states. Family farming is widespread in coffee growing, constituting an activity of small producers in Brazil. Coffee is one of the few crops where family agriculture is more competitive than the large-scale operations. Even though these plantations are small, the producers have a larger income than those of other crops. Another aspect that is important to mention is that the coffee producers have other activities on their properties. The coffee crop usually occupies an average of 10 to 20% of the property, thus characterizing it as diverse culture and not a monoculture. This helps reduce the risks, allowing the producer to obtain income from other activities. Coffee plantations generate more than 680 thousand jobs in the field, and around 3 million in the complete production chain. If we calculate the income effect, this number grows to 8 million (data from CECAFÉ- Brazilian Coffee Exporters Council; DECEX – Department of Foreign Trade Operations and MDIC- Ministry of the Industry, Foreign Trade and Services), which is a very large positive economic impact (Waack et al, 2007).

In the following items will discuss the specific aspects of socioenvironmental guarantees in the coffee agrichain, which are the organic production assurance and the social compliance.

1.3.3.1 Organic Production Assurance

One of the related areas to social environmental assurance is the certification of organic production that attests the absence of industrial chemical inputs. With this, there is the expectation of preserving quality in the natural environment, the biological and nutritional qualities of the food, and the life quality of the people in the region where the activity is conducted. From the point of view of the consumer, the certification seal of a product should, in principle, offer information and guarantees of the products' attributes or commercialization process (Giordano, 2009).

To learn more about the influence of the institutional environment on the market of organic products, Cunha, Saes e Spers (2011) comparatively analyzed the laws that regulate organic production in Brazil and the United States. These were the similarities they found:

(1) The presence of the State in regulation, (2) government action in monitoring, (3) State action in the register and accreditation of certifiers and (4) absence for the demand of certifying some types of producers.

The main differences found in the certification of organic products were: (1) quantity of seals available on the market, one in the USA and around 20 different ones in Brazil, (2) the level of efficiency of government inspection. In the USA the inspections are more efficient and detailed than those in Brazil that present a low capacity of surveillance and law enforcement, (3) profile of the certifier. In the USA there are more certifies with a public profile (government participation in the management) while in Brazil the certifiers are in their majority private, (4) the conversion period for the organic production. Brazilian law admits a shorter conversion period in the conventional production than US legislation, (5) a list of permitted products that can be used for organic farming, which is more restricted in Brazil than in the USA, (6) incentives for certification, which are bigger in the USA

because of the certification costs can be reimbursed. This does not exist in Brazil (Cunha, Saes & Spers, 2011).

To evaluate the potential in the disseminating certification of organic products among producers, it is necessary to analyze the perception of these agents on the process, considering local conditions. Bravo, Spiller e Villalobo (2012), analyzed the key factors for satisfaction level of the producers with the certification of organic products in Chile. The basic hypothesis is that satisfaction with certification is positively influenced by the perceived reliability of the system, which represents evaluation of the producer that the inspection system can detect a lack of conformity in the defined standard.

According to the results, the producers are satisfied with the certification system. The perceived benefits appear as the most important determinant for satisfaction than the perceived costs. The principle benefit perceived as determining satisfaction, is the increase in the farm's income, while the bureaucratic cost perceived represents the major barrier for acceptance in organic certification. Surprisingly, the reliability perceived does not have an important role in the producer's satisfaction. The authors consider this result rare in the organic industry, which could be explained by the apparent positive reputation of the certifying body and the absence of big scandalous cases in the organic section in Chile, which could direct the attention of the producers to other factors. The results also reveal that the perceived performance of the State is poor. On the other hand, consumer demands and internal control exerted by producers or producer associations, suggest that the sector can self- regulate their monitoring activities (Bravo, Spiller & Villalobo, 2012).

1.3.2.2 Production Assurance with Social Certification

The guarantee of the company over the adjustment of their processes in relation to the social aspect with the stakeholders has been included in several socio and environmental certification systems for the agribusiness. The principal issues treated are the working conditions of the employees, the prohibition of child labor and the benefits offered to the families of the employees and the local communities affecter by the operations of the company.

An example of a specific social certification that has grown internationally is Fair trade. This is a certificate that is given to the product to inform the consumer that the producing company adopts certain standard patterns of relationship that offer advantages to small farmers that supply raw material. One important aspect in this certificate is the guarantee of a minimum price paid to the supplier. To finance the system, the final consumer pays a premium price. Besides this, part of the companies' income should be invested in development projects for the communities involved in the production (Gomes & Neves, 2011).

According to the international Fair Trade Organization (FLO) the system represent an alternative to the traditional commerce that is based on the cooperation between producers and consumers. The system tries to offer more fair conditions to the producer and thus improve his living conditions. Therefore, the main aim of the certificate is to contribute to the decrease in poverty amongst small rural producers on a global scale. A relevant theme is the existence of barriers for compliance of producers to this system, which was treated by Gomes and Neves (2011). For the contribution demands for local development, the respondents indicated as barrier, the low management capacity of the small producer, the lack of financial resources and the absence of skilled personnel. The activities reported to overcome these difficulties were to go after partnerships with universities, training facilitators, the development of a detailed work plan and the discussion of each action related to each specific demand. In general, the difficulties are a result of low schooling and low income among producers and associations, because they have to understand and conform to a complex certification process.

1.3.4 Geographical Origin Assurance

The concept of geographical indication refers to the word mark issued to products or services that have a reputation, determined by a characteristic or quality attributed to its geographical origin. The geographical indications appeared when producers, businessmen and consumers started identifying that some products from certain places presented particular qualities, attributable to their geographical origin. From then on, the geographical name that indicated their origin was used. Distinguishing products and services by means of geographical indication fosters the promotion of the region, adds value and communicates to the market the attributes of quality, distinctiveness, tradition and cultural heritage.

There are two types of geographical indication. The first is the Indication of Origin that is the geographical name that became known as the center of extraction, production or manufacturing of a specific product or a particular service. The second is the Denomination of Origin, which is the geographical name that designates a product or service, whose qualities or characteristics are exclusively due to the geographical environment, including natural and human factors.

Research on the influence of geographical origin on consumer preferences can contribute to the elaboration of collective strategies for regional brand creation. Krishnakumar can find an example in a study and Chan-Halbrendt (2010), who analyzed consumer preferences in southern India in relation to the Kona coffee imported form the United States from Hawaii. Research established a significant preference for flavor. The strong taste was more accepted than the mild taste. Price appeared a lower level of importance in relationship to flavor, but presented a significant negative impact. On the other hand, the study identified a part of the sample (15%) that is not concerned with price, defining their choice solely by flavor.

Another research evaluated the knowledge consumers from Italy had on quality seals in Europe. Evaluating the Protected Denomination of Origin seal (PDO), a small part of the consumers correctly indicated the attributes of the seal: 23,8% for the area where it was produced, 15,30% for the origin of the supply of the ingredients and 7,29% for the use of traditional methods. Regarding the Protected Geographical Indication (PGI), the answers also indicated little knowledge, with 11,68% for the origin of the supply of at last one ingredient, while 11,88% for the origin of the supply of all ingredients that are certified characteristics of the seal. Other attributes are also little known, like the presence of traditional methods (10,76%) and the localization of at least of one productive stage (8%) (Aprile & Gallina, 2008).

1.4 STAGE 2 - SPECIALISTS PANELS

As described in the methodology, the panels with specialists were done in the cities of Franca, Cabo Verde and São Paulo.

The panels consisted in 3 hour meetings with 8 to 12 specialists: representatives from the producers), elite producers, opinion makers, technical assistants, classifiers in high standing, researchers, cooperative leaders, coffee producers, union leaders, and agents from other segments of the coffee agribusiness system.

At these meeting, the research was presented as part of an academic project, without mentioning the contracting party. The sequence of activities for each panel was:

a. Presentation of the research and method
b. Distribution of the form with one question at a time so all participants could respond individually in 15 minutes
c. Presentation of the individual answers and plenary discussion on the questions coordinated by a mediator for 15 minutes
d. Following, the forms were collected and the process began again with the next question

The script of the questions discussed in these panels was elaborated from a bibliographical review. Three innovation categories were identified: technological, social environmental and guarantee of origin.

The "technological guarantee" category has as subcategories "quality" and "traceability". The "social-environmental guarantee" as subcategories "organic production" and "socially certified production." The "guarantee of origin", despite including geographical indication and denomination of origin, the two items were considered jointly. Based on these categories and subcategories these were the following questions discussed on the panels:

1) What are the possible innovations in quality attributes that can generate differentiation in the coffee market?

2) What are the possible innovations in traceability that can generate differentiation in the coffee market?

3) What is the present situation of organic production as an attribute for the differentiation of coffee on the market? What are the evolution perspectives?

4) What is the present situation of production with social certification as an attribute that can generate differentiation in the coffee market? What are the evolution perspectives?

5) What is the present situation of production for guarantee of geographical origin as an attribute that can generate differentiation in the coffee market? What are the evolution perspectives?

Following we will present the principal answers and points discussed related to each subcategory of innovation from the three panels.

1.4.1 Quality

For this subcategory in innovation the question that was discussed was: What are the possible innovations in quality attributes that can generate differentiation in the coffee market?

The principle answers were:

- Accelerate drying
- Control funguses:
  - Beneficial (differentiated fermentation),
  - Harmful (presence of ochratoxin),
- Control sweetness (Brix),
- Create a BGS Index (Black, Green and Stinker),
- Classify coffee by excellence and not defects,
- Reduce pesticides (Best Agricultural Practices),
- Identify the varieties of the coffee on the packaging,
- Identify the presence of natural coffee.

1.4.2 Traceability

The question defined for the discussion of traceability was:

What are the possible innovations in traceability that can generate differentiation in the coffee market? The answers were:

- Identify microlots with information including labor,
- Identify "Terroir",
- Encourage Information Technology on the farms,
- Measure the carbon emissions,
- Associate ecosystems
- Use QR code packaging,
- Make the phases of the production accessible for the consumer to follow it over the internet,
- Guarantee food safety, exemption from any contaminant (pesticides or microorganisms).

1.4.3 Organic Production

For the subcategory Organic Production, the question was: What is the present situation of organic production as an attribute for the

differentiation of coffee on the market? What are the evolution perspectives?

Differently from the former questions, in this case the theme was the present situation and perspectives. In the three panels the answers indicated that the organic production is and will continue to be a market niche. They also mentioned:

- Small niche,
- Market does not have knowledge,
- Hard to produce,
- Low competitiveness x conventional,
- High elasticity of demand,
- Increase the consumers' trust.

1.4.4 Producing with Social Certification

What is the present situation of production with social certification as an attribute that can generate differentiation in the coffee market? What are the perspectives for its evolution? Differently form the former question, the participants believe in the potential and benefits of social certification. Most of the comments were in relation to:

- Growing demands,
- Low current premium,
- The Brazilian legislation which is more demanding than competing countries,
- Increase in the importance of this certification in the market,
- A certificate that can improve management,
- Suggestions for action:
    - Create an Index for labor,
    - Create a social seal.

1.4.5 Geographical Origin

The fifth questions was: What is the present situation of production for guarantee of geographical origin as an attribute that can generate differentiation in the coffee market? What are the evolutionary perspectives?

The participants showed enthusiasm with the potential of the certification of geographical origin. They mentioned:

- The great potential for growth,
- A not very explored attribute,
- Brazil has many differentiated regions,
- The difficulty in the lack of organization of producers.

  Possible action:

    - Explore historical and cultural elements
    - Create touristic itineraries

1.5 STAGE 3 – QUANTITATIVE RESEARCH WITH CONSUMERS

This research comprises a sample of coffee consumers who reside in the city of Campinas, in the state of São Paulo. This city is located 100 km from the capital of the state. It is the largest city in the countryside in Brazil, and an important consumer and financial center. In 2012 the Gross Domestic Product (GDP) for Campinas was superior to 27 billion reais, which is more than the GDP of countries like Jamaica, Paraguay and Nicaragua.

Besides the economic factors, the history of the city is connected to coffee growing, one of the principle crops that contributed to the growth of the city.

1.5.1 Population and Sample

A sample consists of a sub-set of the population. When defining a probabilistic and random subset, it is possible to infer and make generalizations from the results. For a sample to be representative of an infinite dichotomous population, at 0,05 sampling error and a confidence coefficient of 95%, 400 elements

are necessary. Based on the data of the socio-economic profile of the population of Campinas, it was stratified into the following items: income, gender and age of those interviewed. The option of a stratified probabilistic sample intended to make possible the extrapolation of the results for the city of Campinas. According to the data of the 2010 census of IBGE- Brazilian Institute of Geography and Statistics, Campinas had

1.080.113 million inhabitants, of whom 48% were men and 52%, were women. Table 1 considers age and income distribution in Campinas.

Table 1. Profile of the population of Campinas (Age and Income)

Age	Distribution	Income (in Minimum Salaries)	Distribution
20 to 29 years old	25%	Up to 1	17%
30 to 39 years old	23%	More than 1 to 2	36%
40 to 49 years old	19%	More than 2 to 5	30%
50 to 59 years old	15%	More than 5 to 10	11%
60 years old o more	17%	More than 10	6%

Source: Censo – IBGE (2010).

Based on the above profile, the population of Campinas was stratified considering the total number of inhabitants as 1.080.113. The population the districts of Barão Geraldo, Joaquim Egídio, Nova Aparecida and Souzas were not considered. Table 2 presents this stratification.

Table 2. Stratification of the population of Campinas

Gender	N° of people	Age	N° of people	Income (in Minimum salaries)	N° of people
Male	193	20 a 29 years old	102	Up to 1	69
Female	207	30 a 39 years old	91	More than 1 to 2	142
		40 a 49 years old	77	More than 2 to 5	118
		50 a 59 years old	62	More than 5 to 10	46
		60 years old or more	68	More than 10	25
Total	400		400		400

Source: Elaborated by the authors

1.5.2 Data Collection Tool

Though the panel done with the coffee producers from different regions, it was possible to obtain a basis for the elaboration of a questionnaire for the collection of primary data from the consumer. The questions, in their majority, were closed questions to enable a quantitative analysis (Appendix A). Besides these questions, the Laddering technique and conjoint analysis were used. Each type of questionnaire was divided into six parts:

- Part I: Filter questions and stratification.

- Part II: Questions on the consumption habits.

- Part III: Questions on differentiation.

Obs.: In Part III there were also open ended questions that were part of the *laddering* analysis. The questions varied according to the type of questionnaire.

- Part IV: Profile of those interviewed.

- Part V: Joint Analysis.

Obs.: The joint analysis options varied according to the type of questionnaire.

- Part VI: Conclusion.

The pre-tests demonstrated that the consumer took a long time answering parts

III and V, and several questionnaires were not validated at the beginning because either the respondent had given up or had not answered everything. Therefore, these parts were divided into four dimensions of differentiation:

- Questionnaire Type I: Quality attributes (just Block A for parts III e V)

- Questionnaire Type II: Certification (just Block B for parts III e V)

- Questionnaire Type III: Socio-environmental Assurance (just Block C for parts III e V)

- Questionnaire Type IV: Origin (just Block D for parts III e V)

To reduce the interview time and facilitate the evaluation by the respondent, we used some cards.

1.5.3 Data Collection Process

The data collection was done by means of personal recorded interviews, where coffee consumers were approached in public places with high flow. A gift (chocolate and a sachet with soluble coffee) was given to each of the people interviewed as a token of gratitude for participating.

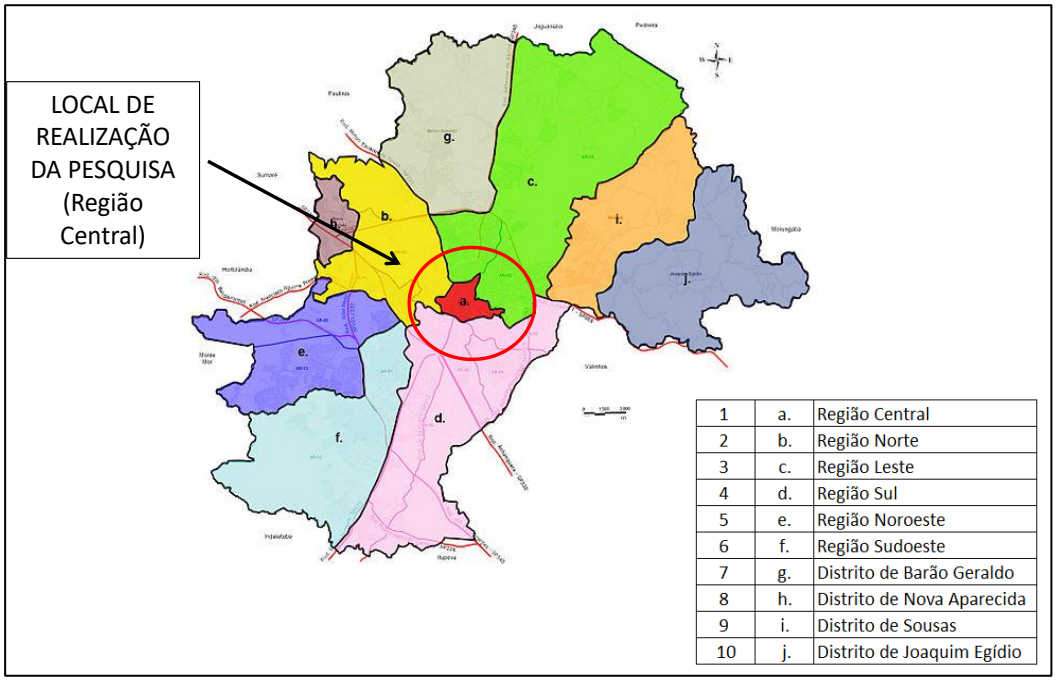
The group of interviewers was composed of 18 persons, students from several courses at ESALQ (The Agricultural College of the University of São Paulo). All received a three-hour training prior to conducting the interviews.

The interviews were done in Campinas, in the month of July 2013, over a period of five days. (Figure 1).

On the first day of the field research de pairs that were conducting the interviews had a complete questionnaire that contained types I, II, III and IV. This approach though was not

successful, because the time required for using the questionnaire was too long (more than an hour), which caused the respondents to give up. That same afternoon, they decided to divide the questionnaire into four parts, creating questionnaires I, II, III and IV. This way, each respondent answered one type of questionnaire, which significantly reduced the required time to complete it.

As the questionnaires were handed in, they



1	a.	Região Central
2	b.	Região Norte
3	c.	Região Leste
4	d.	Região Sul
5	e.	Região Noroeste
6	f.	Região Sudoeste
7	g.	Distrito de Barão Geraldo
8	h.	Distrito de Nova Aparecida
9	i.	Distrito de Sousas
10	j.	Distrito de Joaquim Egídio

Figure 1. Map of Campinas and the Region where research was conducted.

were validated by the responsible team and handed back to the interviewers, so that they could tabulate the data. Of all the questionnaires just 25 were not validated.

All the interviewers received a standard form to tabulate the questionnaires, which were given to the coordinator already tabulated.

According to the reports of the interviewers, part V of the questionnaire dealt with a joint analysis which was more difficult to use because of the different kinds of people: some were illiterate, others had little schooling, some were older in age or even had visual impairment. I these cases the interviewer had a fundamental role in helping the respondent to be as faithful as possible to their preferences without exerting influence or persuasion.

1.5.4 Description of the Respondent

As the history of Campinas is tied to coffee plantations, some of the consumers that were interviewed had already worked with coffee.

At the end of the field research, the questionnaires were tabled, and analyzed, aiming to check if the profiles for stratification had been fulfilled successfully. Based on the analysis of stratification, it was possible to conclude that the research was successful. Four hundred and twenty-five questionnaires were valid according to the profile described in tables 3.4.5.and 6.

Table 3. Distribution of the questionnaires according to the type.

Type	Frequency	Percentage
I	105	24,7
II	104	24,5
III	110	25,9
IV	106	24,9
Total	425	100

Source: Elaborated by the authors

Table 4. Distribution of the questionnaires according to gender.

Gender	Frequency	Percentage
Females	217	51,1
Males	207	48,7
Not informed	1	0,2
Total	425	100

Source: Elaborated by the authors

Table 5. Distribution of the questionnaires according to age.

Age	Frequency	Percentage
20 to 29 years old	109	25,6
30 to 39 years old	95	22,4
40 to 49 years old	84	19,8
50 to 59 a years old	67	15,8
60 years old or more	68	16
Not informed	2	0,5
Total	425	100

Source: Elaborated by the authors

Table 6. Distribution of the questionnaires according to approximate income.

Income (Minimum Salaries)	Frequency	Percentage
Up to 1	69	16,2
More than 1 to 2	153	36
More than 2 to 5	125	29,4
More than 5 to 10	50	11,8
More than 10	27	6,4
Not informed	1	0,2
Total	425	100

Source: Elaborated by the authors

1.5.5 Consumption Coffee Habits

The entire population, in other words, 425 respondents, answered this part of the research. Aiming at increasing reliability and validity of the results, and based on a variance analysis, some questionnaires were discarded because they had very similar answers. This is why the total number of respondents varied between 413 and 425. Table 7 illustrates the quantity of coffee consumed. The great majority (78,4%) can be considered heavy users, because they consume more than a cup of coffee per day.

Table 7. Average number of coffee cups consumed 1 2 3 ou 4 (N=416)

Income (number of Minimum Salaries)	Frequency	Percentage
Up to a cup per week	11	2,6
More than a cup per week	14	3,4
Up to a cup per day	64	15,4
More than a cup per day	326	78,4
No answer	1	0,2

Source: Elaborated by the authors

As for the type of coffee consumed (Table 8) , drip coffee predominates in 88% of the answers, representing 64.2% compared to other types, followed by expresso with 29,3% of answers representing 21.4% compared to other types.

Table 8. What type of coffee is consumed (it can be more than one option) (N=416)

Type	Frequency of those that said yes	Percentage of the total that said yes	Percentage among the types
Drip	366	88,0	64,2
Ground Expresso	122	29,3	21,4
Instant	41	9,9	7,2
Capsules	18	4,3	3,2
Ground	16	3,8	2,8
Sachet	4	1,0	0,7
Other: Likes all	1	0,2	0,2
Other: Cappuccino	1	0,2	0,2
No answer	1	0,2	0,2

Source: Elaborated by the authors

To learn about the quantity consumed, Table 9 shows the result of these questions, which was asked in connection to the former one. Of the types of coffee consumed (it could be more than one), drip coffee was the most consumed (82%), followed by ground expresso (12%).

Table 9. Of the types of coffee above, which do you most consume? (N=413)

Typo	Frequency	Percentage
Drip	341	82,0
Ground Expresso	50	12,0
Instant	4	1,0
Capsule	3	0,7
Ground	5	1,2
Sachet	10	2,4

Source: Elaborated by the authors

Regarding where coffee is consumed (Table 10), 60,6% answered home, and 56,4% when compared to other places. At work followed with 36,1%, and 33.6% compared with other places. Retail, if added up, represents 10,9% of the answers.

Table 10. Where do you consume with the most frequency? (N=425)

Typo	Frequency of those that said yes	Percentage of the total that said yes	Percentage among the types
Home	252	60,6	56,4
Work	150	36,1	33,6
Coffee shops	19	4,6	4,3
Bakeries	19	4,6	4,3
Restaurants / Snack bars	7	1,7	1,6

Source: Elaborated by the authors

The favorite time of the day to consume coffee is in the morning 64,2% and 58% if compared to other periods of the day. The next option “any time” with 21.2% and 19,4% if compared with other options in the day.

Table 11. What time of the day do you most consumer coffee?

Period	Frequency of those that said yes	Percentage of the total that said yes	Percentage among periods of the day
Morning	267	64,2	58,8
Any time	88	21,2	19,4
Afternoon	73	17,5	16,1
Noite	26	6,3	5,7

Source: Elaborated by the authors

The two main factors that explain coffee consumption are: (1) "flavor and aroma" with 32% answers in first place (32,1% if compared to the other options), (2) followed by "feel good" with 20,7% answers in first place (20,6% if compared to other options first).

Table 12. In order of preference, indicate 3 factors that most explain the act of consuming coffee (it can be more than one option) (N=418)

Occasion	Frequency of those that said yes			Percentage of the total that said yes				Percentage among Types	
Order of preference	**1º.**	**2º.**	**3º.**	**Order of preference**	**1º.**	**2º.**	**3º.**	**Order of preference**	**1º.**
Flavor and aroma	134	85	95	Flavor and aroma	134	85	95	Flavor and aroma	134
Feel good	86	82	75	Feel good	86	82	75	Feel good	86
Stop to rest	68	104	89	Stop to rest	68	104	89	Stop to rest	68
Other	54	41	35	Other	54	41	35	Other	54
Being amongst friends	52	60	65	Being amongst friends	52	60	65	Being amongst friends	52
For a moment of reflection	24	33	48	For a moment of reflection	24	33	48	For a moment of reflection	24

Source: Elaborated by the authors

The percentage of those interviewed that does not receive information about coffee is significant (42,8% and 33.6% compared to the other sources of information). Television as a source with 41,1% is probably due to advertisements (Table 13)

Table 13. How do you received or have received information about coffee?

Means of Communication	Frequency of those who said yes	Percentage of those who said yes	Percentage amongst sources
I don't receive information	178	42,8	33,6
Television	171	41,1	32,3
Other	47	11,3	8,9
Sites or Blogs	38	9,1	7,2
Magazines or Newspapers	28	6,7	5,3
Friends	25	6,0	4,7
Coffee shops	23	5,5	4,3
Company sites	12	2,9	2,3
Specialists	8	1,9	1,5

Source: Elaborated by the authors

Table 14 shows that the producer (7,66), the specialists (7,60) the research institutes (7,42) is the most reliable sources of information. The certifying bodes are at a six point lower end. The lowest level given to the government can be explained by the protests that occurred during the research period (3,77).

Table 14. Level of trust in the information sources on coffee (10 point level of trust)

Level if Trust (0 a 10)	Average	Variation
Producer	7,66	5,401
Specialists	7,60	5,701
Research Instituted	7,42	5,092
Certifying bodies	6,90	6,898
Coffee shops	6,53	7,127
Cooperatives or Associations	6,45	6,166
Companies or Industries	6,44	6,078
Government	3,77	7,420

Source: Elaborated by the authors

How coffee is prepared was the item most known by the respondents (7,15). Quality

(6,94), brands (6,44) and price (6,34) came next. The more complex and closes to production like processing (5,31), sustainability (5.23), origin (5.16), production (5,11) and certificates (4,60) are the least known (Table 15)

Table 15. What is your level of knowledge or information on the following aspects related to coffee (10 point scale)?

Level of knowledge or information on (0 a 10)	Average	Variation
Preparing coffee	7,15	7,361
Quality of the coffee	6,94	6,731
Coffee Brands	6,44	6,556
Coffee Prices	6,34	7,786
Types of coffee	5,97	7,802
Processing coffee	5,31	9,117
Sustainability of coffee	5,23	9,371
Origin of coffee	5,16	9,943
Coffee production	5,11	9,786
Certificates for coffee	4,60	8,530

Source: Elaborated by the authors

The Illy brand was the least know brand (Table 16). Only 35 of the 425 respondents know the brand (8,4% of the total or 1,2 when compared to all the other brands). The local brands explain the high number of answers for the "other" option (56,7%).

Table 16. Which of the following brands do you know?

Brand	Frequency of those who said yes	Percentage of the total that said yes	Percentage amongst other brands
Pilão	404	97,1	14,0
Nescafé	398	95,7	13,8
Melitta	367	88,2	12,7
Caboclo	366	88,0	12,7
Pelé	364	87,5	12,6
Café do Ponto	314	75,5	10,9
Other	236	56,7	8,2
Nespresso	222	53,4	7,7
Seleto	180	43,3	6,2
Illy	35	8,4	1,2

Source: Elaborated by the authors

1.5.6 Coffee Buying Habits

To understand the coffee buying habits we had to ask another classifying question: If the respondent had already bought or buys coffee (Table 17). The majority (89,2%) , had already bought or buys coffee. Therefore, they were apt to answer the two following questions.

Table 17. Buys or has bought coffee (N=416).

Has bought coffee	Frequency	Percentage
Yes	371	89,2
No	45	10,8

Source: Elaborated by the authors

It is possible to visualize in Table 18 that quality was the most important decision Factor, 24,8% or 28,2% when compared to other items as first option. The second and third most important items are brand, 22,6% or 25,8% when compared to other items, and price18, 3% or 20,8% when compared to other items as first option

Table 18. In order of preference, indicate the 3 factors that most determine you buying decision for coffee

	Frequency of decision			Percentage of the total			Percentage amongst preferences		
Order of preference	**1º.**	**2º.**	**3º.**	**1º.**	**2º.**	**3º.**	**1º.**	**2º.**	**3º.**
I decide based on quality	103	64	60	24,8	15,4	14,4	28,2	17,8	17,4
I decide based on brand	94	104	67	22,6	25,0	16,1	25,8	29,0	19,5
I decide based on price	76	98	73	18,3	23,6	17,5	20,8	27,3	21,2
I decide based on the presence of a seal or quality certificate	51	45	59	12,3	10,8	14,2	14,0	12,5	17,2
I decide based on the place and when I buy	17	14	32	4,1	3,4	7,7	4,7	3,9	9,3
I don't care, I don't base my decision on anything	18	18	26	4,3	4,3	6,3	4,9	5,0	7,6
I decide on the appearance of the package or the design	6	16	27	1,4	3,8	6,5	1,6	4,5	7,8

Source: Elaborated by the authors

Regarding the package (Table 19), the best evaluated items were the type of package (43,0% or 25,2% when compared to other items), information (34,4% or 20,2% when compared to other items) and price (33,2% or 19,5% when compared to other items).

Table 19. When you are buying coffee, what most calls your attention in the coffee package (it can be more than one option)?

Characteristic of The package	Frequency with which you pay attention to	Percentage of all items you observe	Percentage amongst the types
Type (vacuum or cushioned)	179	43,0	25,2
Information	143	34,4	20,2
Price	138	33,2	19,5
Size	90	21,6	12,7
Design or form	69	16,6	9,7
Color	60	14,4	8,5
Other	30	7,2	4,2

Source: Elaborated by the authors

Table 20. Results regarding the dimension "attributes of quality" (n=105)

Attribute	Importance (1-10)	Variance	Interest (1-10)	How much more would you pay (%)
Security	8,45	0,97	8,55	8,67
Aroma	8,43	0,78	7,80	7,90
Flavor	7,86	0,63	7,42	7,35
Roast	7,77	0,59	7,21	6,46
Body	7,24	0,52	7,31	7,10
Grinding	7,23	0,57	7,02	6,22
Variety	6,95	0,61	6,65	6,53
Drink	5,99	0,75	5,70	4,91
Nutrition	5,63	1,36	5,37	5,18

Source: Elaborated by the authors

1.5.7 Differentiation Aspects

The general results are based on the frequency of the 425 respondents. Crossed and bivariate analysis will be made to measure the causal relations. Multivariate analysis will be used to identify common perception factors (factor analysis), consumer groups or segments (Analysis of conglomerates), desire to pay, elasticity amongst others.

The tables 20, 21, 22 and 23 that follow, summarize the initial results, which refer to the specific part on differentiation and innovation.

The safety issue is the item of greatest importance (8,45) (Table 20). Attributes related to flavor like aroma (8,43) e taste (7,86) was also considered important. Nutrition was the least valued.

Table 21. Results with reference to the dimension "certification attributes" (n=104)

Attribute	Importance (1-10)	Variance	Interest (1-10)	How much more would you pay (%)
Sustainable Coffee	8,63	0,87	7,25	6,47
ABIC – Brazilian Coffee Industrial Association	8,40	0,69	8,38	6,69
Specialists	8,20	0,61	7,79	7,31
Organic Brazil	8,07	0,53	7,60	7,61
Fair trade	7,37	0,42	6,56	5,94
UTZ - Certified label	7,32	0,46	6,61	6,04
Carbon Free	7,29	0,50	6,54	6,00
Level of Quality	6,81	0,53	6,14	5,86
Rainforest	6,46	0,77	5,74	5,25
BSCA Brazilian Association of Special Coffees	5,67	1,53	5,43	5,06

Source: Elaborated by the authors

The seal "sustainable coffees" (8,63) surpassed the traditional ABIC seal in importance (8,40) (Table 21). The desire to pay more is lower for the dimension of certified coffee. The certification done by specialists was a suggestion incorporated due to the panel with producers and specialists. It was considered important for the consumer as well (8,20).

Table 22. Results with reference to the " social-environmental attributes" (n=110)

Attribute	Importance (1-10)	Variance	Interest (1-10)	How much more would you pay (%)
No pesticides	9,10	0,12	8,98	9,29
Water	8,98	0,62	8,22	8,00
Mandatory Legal Reservation	8,86	0,60	8,64	8,29
Work	8,63	0,68	8,71	8,93
More jobs	8,23	0,89	7,87	8,27
Product	7,03	1,73	7,51	7,35

Source: Elaborated by the authors

The attribute "without pesticides" was considered the most important (9,29), surpassing the safety and organic certification (Table 22). The desire to pay was also high, being the highest amongst the four dimensions. According to reports from the interviewers, the main difficulties in applying the questionnaires related to the use of terms such as "biodiversity", "sustainability", principally among those who belonged to the lower income classes, who did not understand the meaning of these terms.

Table 23. Results with reference to the "attribute of origin" (n=110)

Attribute	Importance (1-10)	Variance	Interest (1-10)	How much more would you pay (%)
Monitoring	8,12	0,473	7,46	6,78
Country	7,28	0,347	6,74	6,98
QR Code	7,28	0,375	6,71	5,53
Climate and Soil	7,27	0,402	7,25	6,23
Local History	7,10	0,423	6,66	6,63
Local industry	6,96	0,48	7,02	6,36
Small property	6,64	0,601	6,38	6,65
Mountain	5,53	1,114	5,49	6,29

Source: Elaborated by the authors

Following coffee from production to the end consumer was the item of most importance (8,12). The QR Code and country were considered important attributes (7,28), but there is an expectation that with existence of a bar code the consumer pay less (5,53.) The origin in the mountains was identified by the panel, but not validated by the final consumer (Table23).

1.5.8 Importance, Interest and Propensity to Pay for Differentiating Aspects

After individually analyzing each differentiation dimension, Tables 24, 25 and 26 show in an aggregated and decreasing order, the results of the answers of the respondents. It is important to remember that different consumer groups answered the questions for each dimension of differentiation.

Table 24 shows the importance that was given to each of the questions on differentiation. The attribute "without pesticides" stands out with 9 points. Water, Mandatory Legal Reservation, work, sustainable coffees, more jobs, and Organic Brazil, security, certification (ABIC and specialists), and aroma are in the 8-point range. The least important, in the 5 point range, are Drink, BSCA (Brazilian Specialist Coffee Association) certification, Nutrition and Mountain.

Table 24. Results with reference to all attributes esultados referentes à todos os atributos

Attribute	Importance (1-10)	Interest (1-10)	How much more would you pay (%)
Without pesticides	9,10	8,98	9,29
Water	8,98	8,22	8,00
Mandatory Legal Reservation	8,86	8,64	8,29
Work	8,63	8,71	8,93
Sustainable Coffees	8,63	7,25	6,47
Safety	8,45	8,55	8,67
Aroma	8,43	7,80	7,90
ABIC Brazilian Coffee Industrial Association	8,40	8,38	6,69
More jobs	8,23	7,87	8,27
Specialists	8,20	7,79	7,31
Monitoring	8,12	7,46	6,78
Organic Brazil	8,07	7,60	7,61
Flavor	7,86	7,42	7,35
Roast	7,77	7,21	6,46
Fair trade	7,37	6,56	5,94
UTZ	7,32	6,61	6,04
Carbon Free	7,29	6,54	6,00
Country	7,28	6,74	6,98
QR CODE	7,28	6,71	5,53
Climate and Soil	7,27	7,25	6,23
Body	7,24	7,31	7,10
Grind	7,23	7,02	6,22
Local History	7,10	6,66	6,63
Product	7,03	7,51	7,35
Place of industry	6,96	7,02	6,36
Variety	6,95	6,65	6,53
Quality Level	6,81	6,14	5,86
Rainforest	6,46	5,74	5,25

Small Property	6,64	6,38	6,65
Drink	5,99	5,70	4,91
BSCA Brazilian Specialist Coffee Association	5,67	5,43	5,06
Nutrition	5,63	5,37	5,18
Mountain	5,53	5,49	6,29

Source: Elaborated by the authors

The items that are highly evaluated under "Interest", which indicates a stronger attitude in relation to "importance", are practically the same as the latter. The attributes No pesticides, Work, Mandatory Legal Reservations, Safety, ABIC certification and Water (Table 25) are in the 8-point range. Items of less interest in the 5-point range are: Rainforest certification, Drink, Origin in Mountain, BSCA certification and Nutrition.

Table 25. Results that refer to all attributes

Attributes	Interest (1-10)	Importance (1-10)	How much more would you pay + (%)
No pesticides	8,98	9,10	9,29
Work	8,71	8,63	8,93
Mandatory Legal Reservation	8,64	8,86	8,29
Safety	8,55	8,45	8,67
ABIC	8,38	8,4	6,69
Water	8,22	8,98	8,00
More jobs	7,87	8,23	8,27
Aroma	7,80	8,43	7,90
Specialists	7,79	8,20	7,31
Organic Brazil	7,60	8,07	7,61
Follow up	7,46	8,12	6,78
Flavor	7,42	7,86	7,35
Body	7,31	7,24	7,10
Sustainable coffee	7,25	8,63	6,47
Climate and Soil	7,25	7,27	6,23
Product	7,51	7,03	7,35
Roast	7,21	7,77	6,46
Grind	7,02	7,23	6,22
Local industry	7,02	6,96	6,36
Country	6,74	7,28	6,98
QR CODE	6,71	7,28	5,53
Local History	6,66	7,10	6,63
UTZ	6,61	7,32	6,04
Fair trade	6,56	7,37	5,94
Variety	6,65	6,95	6,53
Carbon Free	6,54	7,29	6,00
Small Property	6,38	6,64	6,65
Quality Level	6,14	6,81	5,86
Rainforest	5,74	6,46	5,25
Drink	5,70	5,99	4,91
Mountain	5,49	5,53	6,29
BSCA Brazilian Specialist Coffee Association	5,43	5,67	5,06
Nutrition	5,37	5,63	5,18

Source: Elaborated by the authors

Finally, in Table 26, the attributes are ordered by "how much more a consumer would pay" in percentage over the value of the product. "No pesticides" is the isolated item of highest desire in the 9-point range. In the 8-point range we find Work, Safety, More jobs, Mandatory Legal Reservation, Water. The ABIC seal that stood out in "important" and "interest" dropped to 6 points. The items the consumer would pay least for are: Fair trade, Quality of level, QR code, Rainforest, Nutrition and BSCA. And in the 4 point range, Drink.

Table 26. Results that refer to all attributes

Attribute	How much more would you pay (%)	Importance (1-10)	Interest (1-10)
No pesticides	9,29	9,10	8,98
Work	8,93	8,63	8,71
Safety	8,67	8,45	8,55
More jobs	8,27	8,23	7,87
Mandatory Legal Reservation	8,29	8,86	8,64
Water	8,00	8,98	8,22
Aroma	7,90	8,43	7,8
Organic Brazil	7,61	8,07	7,6
Product	7,35	7,03	7,51
Flavor	7,35	7,86	7,42
Specialists	7,31	8,20	7,79
Body	7,10	7,24	7,31
Country	6,98	7,28	6,74
Monitoring	6,78	8,12	7,46
ABIC	6,69	8,4	8,38
Small Property	6,65	6,64	6,38
Variety	6,53	6,95	6,65
Local History	6,63	7,10	6,66
Sustainable coffee	6,47	8,63	7,25
Roast	6,46	7,77	7,21
Local industry	6,36	6,96	7,02
Mountain	6,29	5,53	5,49
Climate and Soil	6,23	7,27	7,25
Grind	6,22	7,23	7,02
UTZ	6,04	7,32	6,61
Carbon Free	6,00	7,29	6,54
Fair trade	5,94	7,37	6,56
Quality level	5,86	6,81	6,14
QR CODE	5,53	7,28	6,71
Rainforest	5,25	6,46	5,74
Nutrition	5,18	5,63	5,37
BSCA Brazilian Specialist Coffee Association	5,06	5,67	5,43
Drink	4,91	5,99	5,7

Source: Elaborated by the authors

1.5.9 Identifying Sub dimensions in the Innovation Dimensions

The aim of this analysis is to group different attributes based on consumer perception. By means of a factor analysis, attributes are grouped in function of their similarity from the consumer's perspective. This means an intermediate grouping between innovation dimension and attribute, called sub dimension of innovation. The chosen question for analysis was the importance of attributes. The name given to the sub dimension is ours.

In the case of quality the variance explained by the questions was 62,1% (above 60% is considered satisfactory. Three sub dimensions were found: sensation (23.2%), attributes to the process (20,6%) and attributes to the product (18<2%). The factor load represents an evaluation of how the consumer classifies the sub dimension (Table 27). The KMO was 0,724 and, therefore considered satisfactory (above 0,5). The KMO is a test to verify the statistic reliability of the result. (**Kaiser-Meyer-Olkin** (**KMO**) Test is a measure of how suited your data is for **Factor Analysis**. Test for Sampling Adequacy).

Table 27. Sub dimensioin for the dimension of quality coffee

Factors or Sub dimension of the Quality Dimension	Factor Load		
	1	2	3
Sensations (1)			
6. The body of the coffee is a sensation in the mouth caused by persistence in the flavor that enriches the drink. What is the importance of this type of differentiation for you?	,753		
7. The aroma of coffee refers to the perception of the drink while it is warm. This factor can be weak, mild or intense, the latter two indicating better quality. What is the importance of this type of differentiation for you?	,748		
10. Safe coffee, free of any contaminant. What is the importance of this type of differentiation for you?	,670		
4. The flavor of coffee is the result of the association in the taste sensations, aroma and the chemical sensations, varying from inexistent to mild and very intense. What is the importance of this type of differentiation for you?	,642	,460	
Attributes to the Process (2)			
2. The roast of the coffee bean is a heating process of the raw bean, resulting in a change in the color of the bean and liberation of aromas that confer flavor to the drink. What is the importance of this type of differentiation for you?		,802	
3. Grinding is a process resulting from the crushing of roasted beans to prepare the drink. The finer the grind, the slower the speed for the water passage, and the more body the coffee will have. What is the importance of this type of differentiation for you?		,790	
Attributes of the Product (3)			
9. The addition to substances that enrich the nutritional content of coffee. What is the importance of this type of differentiation for you?			,785
8. Coffee can be divided into two types of drink that vary from strictly soft, soft and hard. Mild coffee has better quality. It presents a pleasant aroma, a bland and sweet flavor. What is the importance of this type of differentiation for you?			,617
5. The principal variety in coffee is Arabica, of superior quality and Robusta (Conillon), of inferior quality. What is the importance of this type of differentiation for you?		,430	,519

Source: Elaborated by the authors

The analysis of the certification dimension resulted in a variance of 41.4% with no separation in sub dimenstions. This means that the consumer perceives all types of certification as one. The KMO certification was 0,825.

In relation to the social-environmental variance the result was 57,6%. Two sub dimensions were found: Social improvements and Product (1, 30,8%) and Environmental improvements (2, 26,9%). The results can be seen in Table 28. The KMO was 0,714.

Table 28. Sub dimensions for the socio-environmental dimension of coffee

	Factor Load	
	1	2
Social Improvements and in the Quality of the Product (1)		
2. Use of processes to reduce the lack of uniformity in the ripening of the berries in the coffee harvest and in the reduction of green berries in the harvest. How important is this differentiation for you?	,778	
6. Not using pesticides and fertilizers. How important is this differentiation for you?	,702	
3. Respecting working conditions and complying with the working norms. How important is this differentiation for you?	,608	,451
7. A production system that employs the largest number of people. How important is this differentiation for you?	,600	
Environmental Improvements (2)		
4. Respecting the Mandatory Legal Reservation, which is an area within the property where sustainable forest management is possible. How important is this differentiation for you?		,824
5. Adoption of technology that permits a rational use of water on the coffee plantations How important is this differentiation for you?		,793

Source: Elaborated by the authors

Finally, the origin dimension was not divided into sub dimensions. The variance explained was only 47,7% and the KMO was 0,860.

1.5.10 The Spontaneity Analysis on the Differentiation Aspects

To capture the spontaneous perceptions regarding dimension of innovation, we used two techniques: Imaging and Product Design and the Means-end-chains or Laddering. These techniques are relevant to capture innovative aspects that were not defined by the documental research and by the panels with the coffee producers. Besides, it is possible to determine the importance of attributes and correlate them to values.

Technical Imaging and Product Design

In the Technical Imaging and Product Design, those interviewed had to produce 3 words (attributes) that described each of the four dimensions of quality. Following they had to place the three in order of importance. By doing this, it was possible to determine which of the attributes composed the Central Image in each of the quality dimensions.

In the quality dimension almost half of the respondents considered "flavor" as most important (48 out of 105 interviewed). Following was "aroma" (11and "good coffee" (6). Some mentioned "strong coffee" (5), "quality" (5), "reflection moment" (4), "purity" (3), "origin" (3), "brand" (2), "reliability" (2), "habit" (2), "morning" (2) and "process" (2).

In relation to the certification dimension half of the respondents considered "quality" the most important attribute (52 out of 104 interviewed). Followed by "flavor (8) e and "approval" (8). Other items mentioned were "validity" (5), "price" (4), "reliability" (4), "guarantee" (4), "aroma" (3), "brand" (2), "origin" (2) and "honesty" (2).

In the Technical Imaging and Product Design for the socio-environmental dimension the answers were more heterogeneous (110 answers). “Quality” (18), “environment” (17), “production” (16), “sustentainability” (14) and “preservation” (12) were mentioned above 10 times. Following “health” (8), “pollution” (5), “social” (2) and “cost-benefit” (2).

Finally in the origin dimension the answers were also more heterogeneous (total of 106 answers). The principle attributes are “place of production” (18), “farm” (16) “plantation” (16). In second place “quality” (12) and “dimension” (11). Following with “aroma” (8), “brand” (4), “package” (3), “cigarette” (2), “slavery” (2) and “environment” (2).

Table 29 summarizes the main attributes mentioned for each of the quality dimensions. For the quality and certification dimensions there is a consensus about the main attributes “”flavor” and “quality”. For the sustainability and origin attributes there is no consensus. It is interesting to note that quality can be considered a dimension as well as an attribute of quality. Attributes such as arona and flavor appear in the quality, certificatin and origin dimensions. Sustainability presents a set of very distinct attributes in relation to the others.

Table 29. Technical Imaging Analysis and Product Design for the Innovation Dimensions.

Quality (n=105)	Certification (n=104)	Socio Environmental (n=110)	Origin (n=106)
“flavor” (48)	“quality” (52)	“quality” (18)	“place of production” (18)
“aroma” (11)	“flavor” (8)	“environment” (17)	“farm” (16)
“good coffee” (6)	“approval” (8)	“production” (16)	“plantation” (16)
“strong coffee” (5)	“validity” (5)	“sustainability” (14)	“quality” (12)
“quality” (5)	“price” (4)	“preservation” (12)	“flavor” (11)
“a moment to reflect” (4)	“reliability” (4)	“health” (8)	“aroma” (8)
“purity” (3)	“guarantee” (4)	“pollution” (5)	“brand” (4)
“origin” (3)	“aroma” (3)	“social” (2)	“packaging” (3)
“brand” (2)	“brand” (2)	“cost-benefit” (2)	“cigarette” (2)
“reliability” (2)	“origin” (2)		“slavery” (2)
“habit” (2)	“honesty” (2)		“environment” (2)
“morning” (2)			
“process” (2).			

Source: Elaborated by the authors

When compared to the difference in gender for the 4 dimensions (Table 30), it is more significant when the dimensions are compared.

Table 30. Technical Imaging Analysis and Product Design for the Innovation Dimensions.

Attributes (F)	Frequencies	Attributes (M)	Frequencies
Quality Dimensions			
Flavor	24	Flavor	19
Aroma	5	Aroma	6
Good Coffee	3	Origin	2
Strong Coffee	3	Purity	2
Brand	2	Moment if reflection	1
Certification Dimensions			
Quality	23	Quality	21
Flavor	4	Flavor	4
Approval	3	Aroma	2
Price	2	Brand	2
Quality control	2	Origin	2
Socio Environmental Dimensions			
Quality	12	Environment	5
Environment	6	Health	5
Preservation	4	Sustainability	5
Production	3	Quality	4
Plantation	2	Preservation	3
Origin Dimensions			
Plantation	7	Quality	6
Quality	5	Flavor	4
Farm	4	Brand	3
Flavor	4	Aroma	2
Aroma	2	Brazil	2

Source: Elaborated by the authors

Laddering or Means-end Chairs

In the Laddering technique, the consumer's decision is influenced not by the attribute directly, but by values or needs that derive from it. The latter are what justify the choice of an attribute over another. In this approach, the relationship is between the attribute, the consequence and the value. In this case the premise is that the attributes of a product are the principal stimulus that influences the consumer in decision taking to buy and are evaluated in function of values, beliefs or past individual experiences. To determine laddering as means-end chain and the respective values associated we took as basis the most important attribute in the **Technical Imaging and Product Design** for each respondent individually.

Next we asked successive questions on the importance of attribute. What is the first thing that comes to your mind when you say attribute "X "is important to you?

Why is this aspect important to you?

Based on the answers, we constitute a table containing the attributes and they consequences. Based on what was answered in the last question about the importance, we classify it (the value) by the pre-defined list in literature. Based on what was answered in the last question about the importance, we classify it (the value) by the pre-defined list in literature:

- Power: social power, authority, wealth;
- Fulfillment: success, capacity, ambition, pleasure, entertainment;
- Hedonism: pleasure, fun, individual and momentary values;
- Stimulation: life without routine, exciting, challenging;
- Self direction: creativity, curiosity, freedom;
- Universalism: open mindedness, social justice, equality, environmental protection;
- Benevolence: aiming at the well-being of people, solicitude, honesty, mercy;

- Tradition: commitment and acceptance of cultural issues where one is inserted, humbleness, devotion and gratitude;
- Conformity: courtesy, obedience, honor, moderating actions that can harm others;
- Safety: social order, cleanliness, care, social and individual harmony.

Table 31, summarizes the values found in the main functional and psychological consequences in the dimensions of quality: (1) certification, (2) sustainability, (3) origin, (4) for the main attributes: flavor, (5) quality (6) and local production (8)

The number in parenthesis and the ID on Table 31 represent the identification of the attribute, the consequence and the value found.

Table 31. Function and psychological consequences and the classification of value found for the dimensions of quality, certification, sustainability and origin.

Functional Consequences	ID	Psychological Consequences	ID	Values	LOV (Schwatz) Classified Values
Attracting	11	Bitterness	121	Sweet Drinks	Hedonism
Palatable	63	Tasting	19	Desire to drink	Hedonism
Bitterness	64	Sensory Experience	122	Nice	Hedonism
Brand Loyalty	65	Good Times	81	Welfare	Hedonism
Aversion of Bitterness	66	Balance	83	High standard	Power
Value of Flavor	67	Sensation	123	Quality of Coffee	Conformity
Liking	13	Aversion of Bitterness	124	Certainty	Safety
Purchase Decision	68	Confidence	18	Pleasure	Hedonism
Awake	69	Feeling Good	20	Satisfaction	Hedonism
Pleasure	70	Necessity of Taste	30	Feeling Good	Hedonism
Desire to drink	28	Quality	28	Quality	Conformity
Satisfaction	71	Reliability	125	Stress Reducing	Stimulation
Appreciation	29	Routine	126	Pause	Hedonism
Consumption	12	Brand Loyalty	102	Quality of life	Fulfillment
Strong Coffee	72	Alert	127	Nostalgia	Hedonism
Enjoyment	73	Relaxation	128	Humankind	Benevolence
Aroma	20	Satisfaction	29	Routine	Self Direction
Evaluation	30	Feeling Good	20	Satisfaction	Hedonism
Pause	74	Liking	64	Sensory Experience	Hedonism
Quality	18	Pleasure	129	Sophistication	Hedonism
Routine	75	Desire	130	Sophistication	Hedonism
Feeling Good	70	Necessity of Taste	131	Human essence	Universalism
Attention	10	Palatable	132	Happiness	Hedonism
Purchase Decision	76	Moment for myself	133	Cultural	Tradition

Guarantee	77	Good Things	84	Rebuying	Self Direction
Crucial	78	Evaluation	134	Contamination	Conformity
Good	79	Tradition	135	Bankrupt	Safety
Product Characteristics	80	Welfare	136	Buying the best	Self Direction
Harmful	81	Addiction	38	Health	Conformity
Sensory Aspects	82	High standard	15	Liking	Hedonism
Health	33	Crucial	137	Value	Power
Evaluation	83	Fear	94	Value of Money	Power
Welfare	84	Rebuying	114	Trust	Safety
Consciousness	34	Good	138	Usability	Fulfillment
Brand Loyalty	18	Pleasure	12	Brand Loyalty	Tradition
Necessity of Quality	68	Confidence	139	Addiction	Hedonism
Joint Result	85	Doing Well	62	Origin	Tradition
Brand Image	86	Security	73	Relaxation	Stimulation
Guarantee	87	Credibility	38	Health	Conformity
All embracing	88	Prerequisite for consumption	53	Taste	Hedonism
High Standard	89	Believe	69	Feeling Good	Hedonism
Better World	29	Routine	15	Liking	Hedonism
Respecting Nature	38	Health	83	High standard	Power
Respecting the Environment	20	Satisfaction	140	Avoid Diseases	Conformity
Brand	90	In our interest	37	Sensory Aspects	Hedonism
Purity	32	Guarantee	102	Quality of life	Fulfillment
Large Producer	91	Diseases	141	Healthy lifestyle	Fulfillment
Taste	92	Strong Coffee	142	Priceless	Power
Nationalism	34	Good	80	Tradition	Tradition
Source of Wealth	22	Consumption	9	Attracting	Fulfillment
Parana	86	Doing Well	15	Liking	Hedonism
São Paulo	93	Intoxication	32	Guarantee	Conformity
Region	38	Health	143	No health risk	Safety
Best Coffee	20	Satisfaction	103	Family	Fulfillment
Minas Gerais	15	Liking	83	High standard	Power
Quality	94	Value of Money	144	Essential	Power
Brazil	37	Sensory Aspects	145	Ingestion	Hedonism
Origin	95	Avoidance	146	Daily Disposition	Stimulation
	96	Confirmation	12	Brand Loyalty	Conformity
	97	Expectation	147	Alternatives	Self Direction
	98	Selection	102	Quality of life	Realization
	37	Sensory Aspects	148	Altruism	Benevolence
	99	Good Consumption	100	Toxic	Conformity
	95	Value of Money	149	Unblended	Conformity
	85	Rebuying	150	Flavor is Region Specific	Tradition
	100	Toxic	151	Enhance the country	Power

101	Pesticides	20	Satisfaction	Hedonism
102	Quality of life	103	Family	Fulfillment
103	Family	152	Motherland	Tradition
104	Non buying	153	Better Understanding	Fulfillment
81	Welfare	154	Disposition	Stimulation
105	Future Generations	155	Cultural History	Tradition
106	Awareness	156	Fame of Region	Tradition
106	Awareness	157	Avoid Contamination	Conformity
64	Sensory Experience	19	Desire to drink	Hedonism
107	Unmixed	83	High standard	Power
108	Knowing the origin	158	Beautiful	Hedonism
109	Competitiveness	159	High production	Power
64	Sensory Experience	160	Comforting	Hedonism
80	Tradition	28	Quality	Conformity
110	Enhance the country			
111	Knowing the origin			
112	Metabolism			
113	Ancestors			
114	Trust			
115	Soil			
116	Variation of Flavor			
53	Taste			
117	Coffee Plantation			
118	Yields More			
119	Good Country			
120	Large Exporter			

Source: Elaborated by the authors

Based on this classification it is possible to draw a mental map for each of the dimensions.

Classifying the values made it possible to identify the four consumer segments (Table 32):

Open to change: a group of consumers that are more prone to experiment aspects in coffee invocation, sensitized or driven by the pursuit of pleasure or boldness.

Search for improvements: a group of consumers who are sensitized to learning, knowledge, and information content that coffee can offer.

Conservative: a group of consumers less prone to experimenting innovation aspects that are very audacious and that go against or interfere in the basic image or traditional coffee.

Based on values: a group of consumers that values aspects coffee can generate in terms of social and environment benefits like respecting labor laws, and diminishing environmental impact.

Table 32. The relationship between classifying the Schwartz value and the values of those interviewed.

Consumer segments	Type of Value	Definitions of Values	Values obtained by the research	
Open to change	Self direction	Creativity, independence, curiosity, choses their own goals.	29	Routine
			84	Rebuying
			136	Buying the best
			147	Alternatives
	Stimulation	Daring, a varied life, an exciting life.	125	Stress Reducing
			73	Relaxation
			146	Daily Disposition
			154	Disposition
	Hedonism	Pleasure, enjoy life	121	Sweet Drinks
			19	Desire to drink
			122	Nice
			81	Welfare
			18	Pleasure
			20	Satisfaction
			30	Feeling Good
			126	Pause
			127	Nostalgia
			20	Satisfaction
			64	Sensory Experience
			129	Sophistication
			130	Sophistication
			132	Happiness
			15	Liking
			139	Addiction
			53	Taste
			69	Feeling Good
			15	Liking
			37	Sensory Aspects
			15	Liking
			145	Ingestion
			20	Satisfaction
			19	Desire to drink
			158	Beautiful
			160	Comforting
Searching improvement	Fulfillment	Well-succeeded, capable, ambitions, influential.	102	Quality of life
			138	Useability
			102	Quality of life
			141	Healthy lifestyle
			9	Attracting
			103	Family

			102	Quality of life
			103	Family
			153	Better Understanding
	Power	Social power, authority, wealth	83	High standard
			137	Value
			94	Value of Money
			83	High standard
			142	Priceless
			83	High standard
			144	Essential
			151	Enhance the country
			83	High standard
			159	High production
Conservative	Safety	Family safety, national security, social order, reciprocity of values	124	Certainty
			135	Bankrupt
			114	Trust
			143	No health risk
	Conformity	Self discipline, obedience, education, respect for parents and the elderly.	123	Quality of Coffee
			28	Quality
			134	Contamination
			38	Health
			38	Health
			140	Avoid Diseases
			32	Guarantee
			12	Brand Loyalty
			100	Toxic
			149	Unblended
			157	Avoid Contamination
			28	Quality
	Tradition	Humbleness, respect for tradition, devotion, spiritual life, moderate	133	Cultural
			12	Brand Loyalty
			62	Origin
			80	Tradition
			150	Flavour is Region Specific
			152	Motherland
			155	Cultural History
			156	Fame of Region
Based on Values	Benevolence	Useful, honest, self-forgiving, loyal, responsible	128	Humankind
			148	Altruism
	Universalism	Comprehension, wisdom, social justice, equality, peace in the world, a world of beauty, environmental protector	131	Human essence

Source: Elaborated by the authors

1.5.11 Joint Analysis about the Aspects of Differentiation

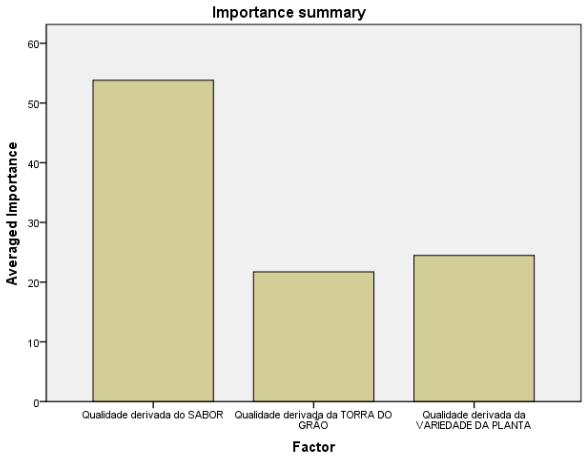
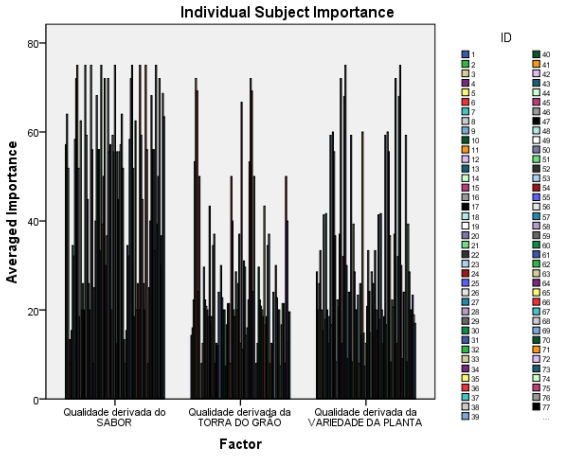
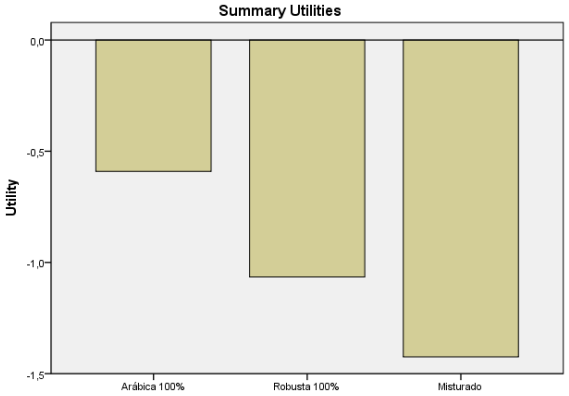
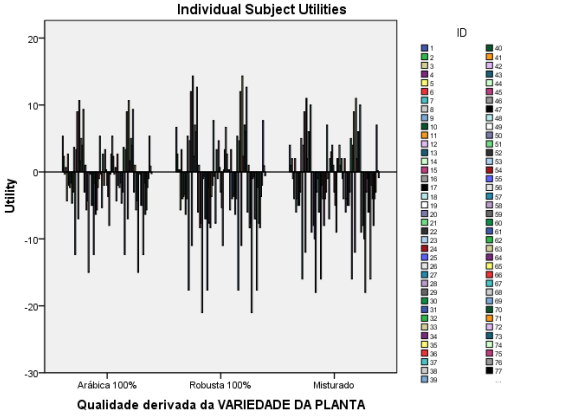
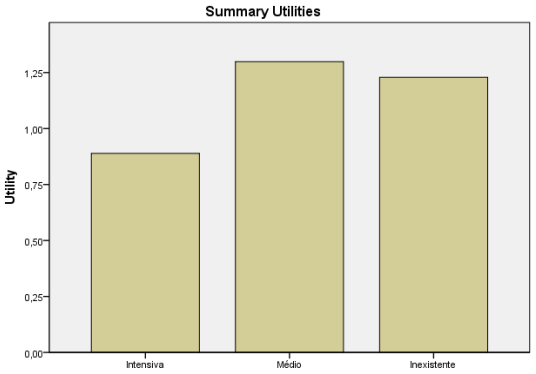
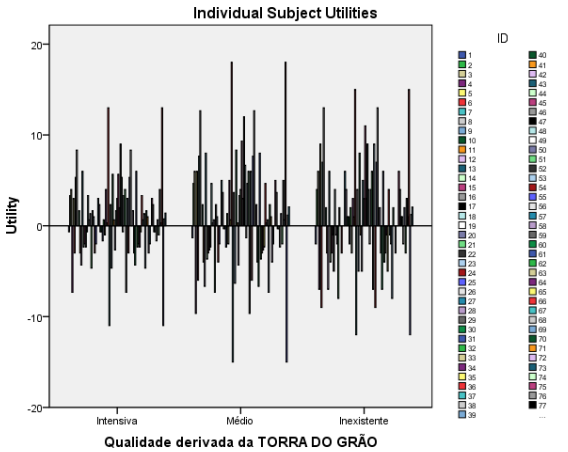
Like the rest of the specific results for the dimension of differentiation, below we describe the results regarding (1) quality, (2) certification, (3) sustainability and (4) origin.

In relation to the quality, the most important item of the selected attributes was flavor (53,81%), followed by variety (24,46%), and roast (21,72%) with very similar levels (Table 33). The column utility defines the preference for each level of atribute.

Table 33. Joint analysis in relation to the attributes of in the differentiation of quality

Attributes and Levels		Utility
Inexistent	5,434	5,434
Mild	**7,878**	**7,878**
Intense	7,333	7,333
Intensive	0,889	0,889
Medium	**1,298**	**1,298**
Inexistent	1,229	1,229
Arabica 100%	**-0,590**	**-0,590**
Robusta 100%	-1,065	-1,065
Mixed	-1,425	-1,425

In relation to the attribute of flavor, the mild was the favorite, followed by intense and last, inexistent In relation to variety, Arabica (less negative) was preferred and followed by Robusta and last by Mixed. In relation to roast, medium roast was preferred, followed by inexistent and finally by intensive. Figure 1 illustrates the importance and preference by each individual.

Aggregated Preference	Individual Preference
	
 B = -,6481 C = ,0577 Ideal Pt = 5,6132	
 B = 1,1285 C = -,2397 Ideal Pt = 2,3545	

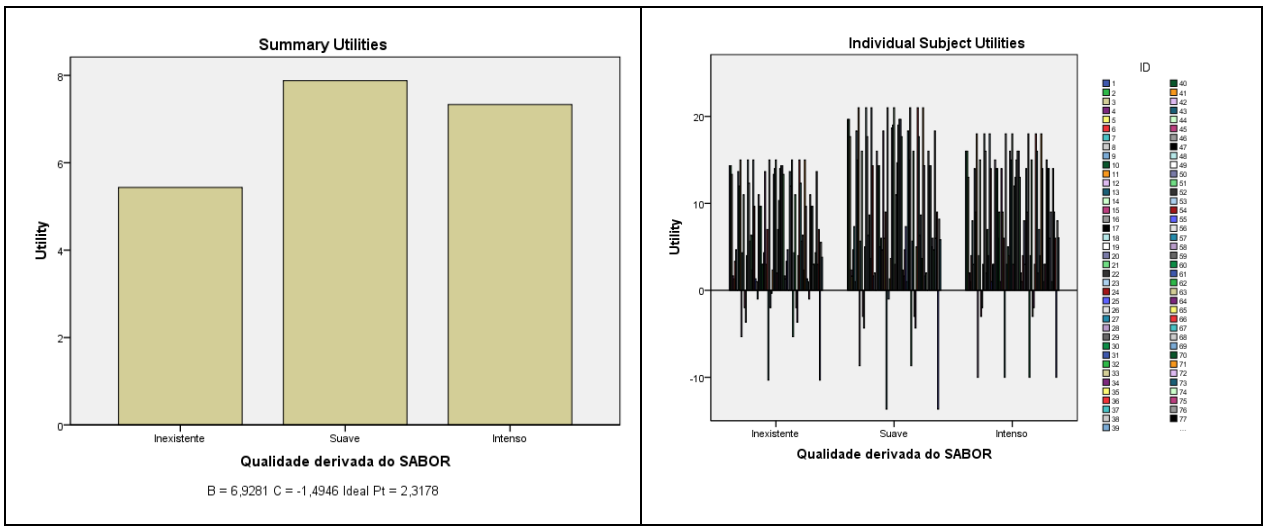


Figure 1. Joint Analysis in relation to the attributes in the differentiation of quality.

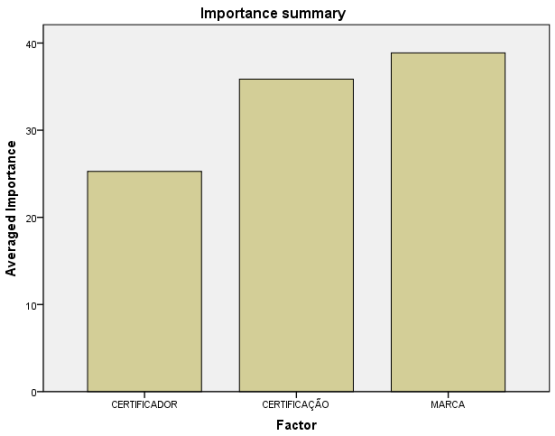
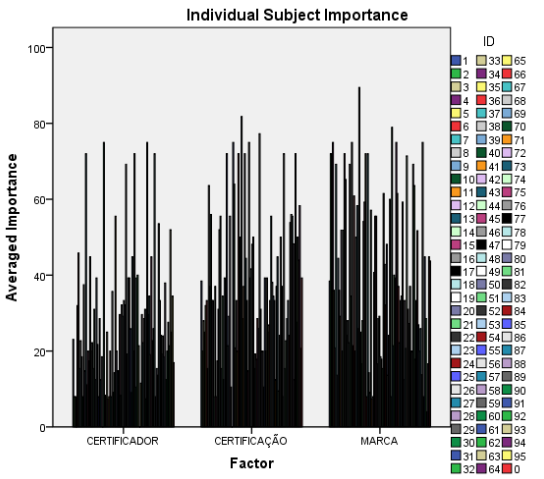
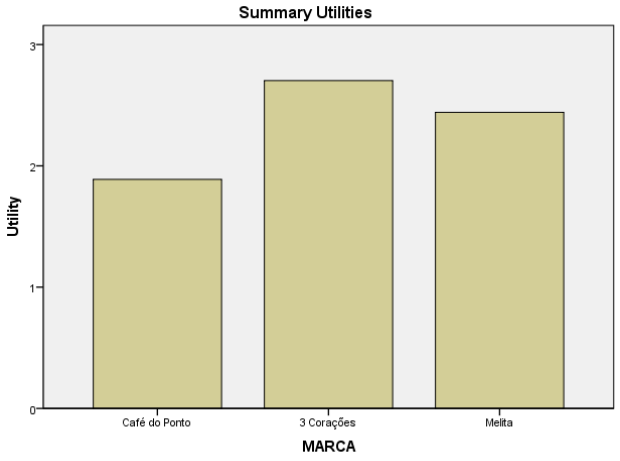
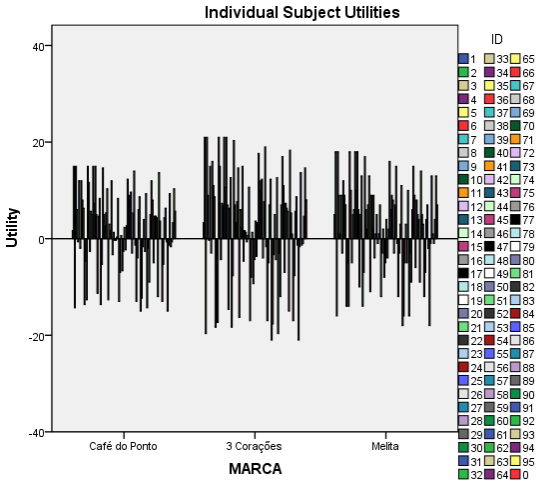
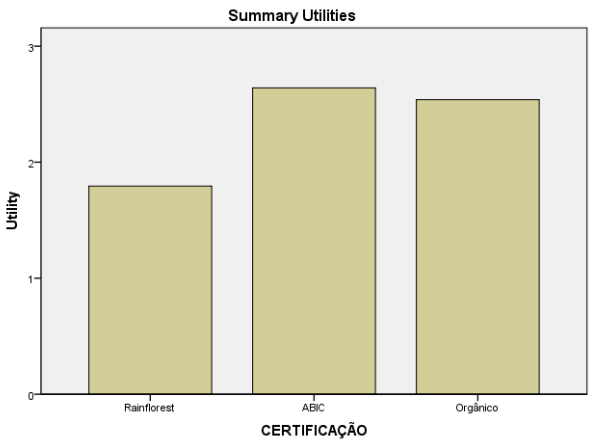
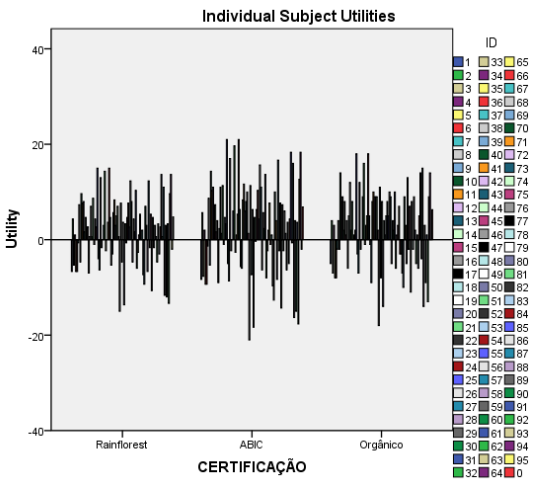
For the certification dimension (Table 34), the most important attribute was brand (38,87%), followed by certification (35,85%) and last of all the certifier (25,27%)

Table 34. Joint analysis in relation to the attributes of in the differentiation of certification

Attributes and Levels		Utility
Government	2,062	Government
Association	**2,971**	**Association**
Company	2,725	Company
Rainforest	1,794	Rainforest
ABIC	**2,641**	**ABIC**
Organic	2,539	Organic
Café do Ponto	1,889	Café do Ponto
3 Corações	**2,703**	**3 Corações**
Melita	2,441	Melita

Source: Elaborated by the authors

In relation to the attribute of brand, the favorite of the three was 3 Corações, followed by the brand Melita and last of all the brand Café do Ponto. In relation to certification, ABIC, as was expected, was preferred followed by organic and last of all by Rainforest. O The favorite certifier was the Association. Figure 2 illustrates the importance and preference of each individual.

Aggregated Preference	Individual Preference
	
 B = 2,4265 C = -,5376 Ideal Pt = 2,2568	
 B = 2,2680 C = -,4739 Ideal Pt = 2,3931	

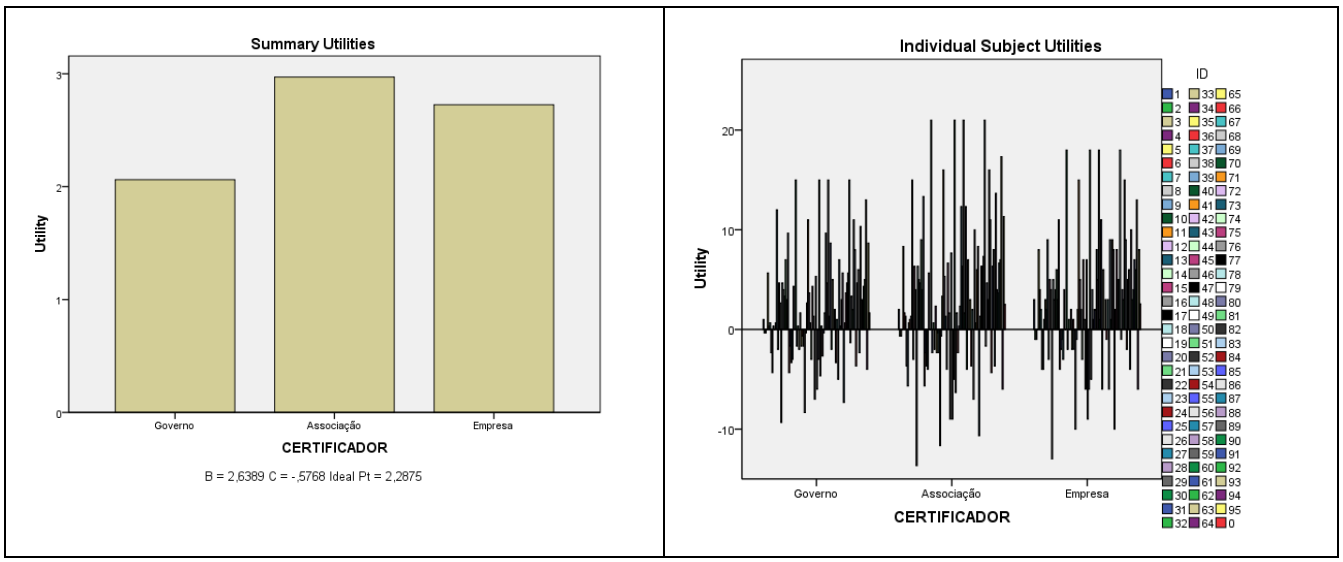


Figure 2. Joint analysis in relation to the attributes of in the differentiation in certification.

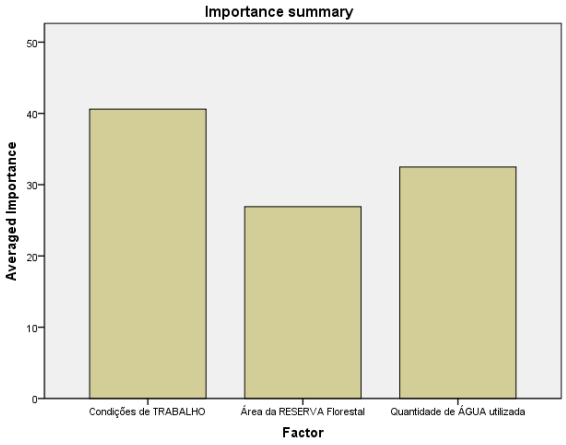
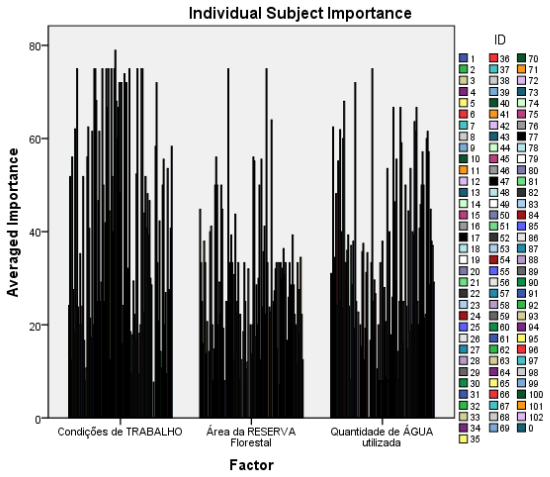
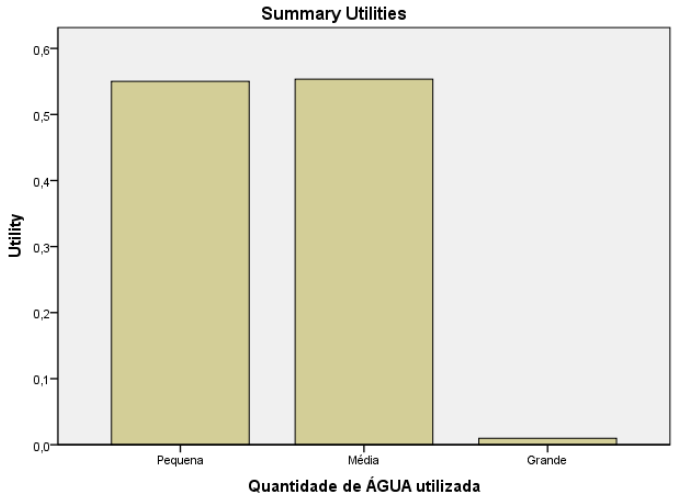
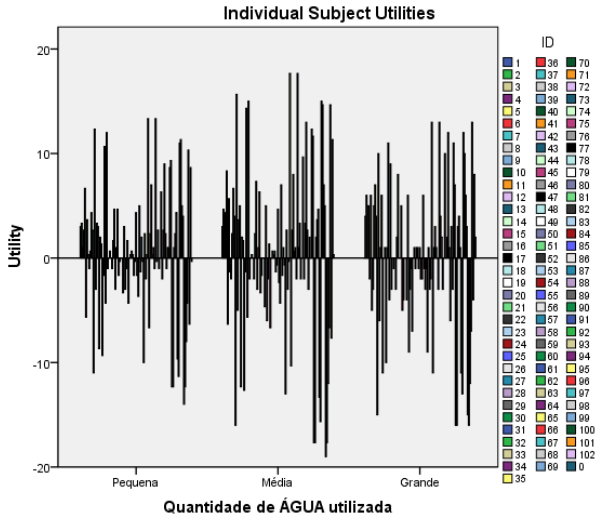
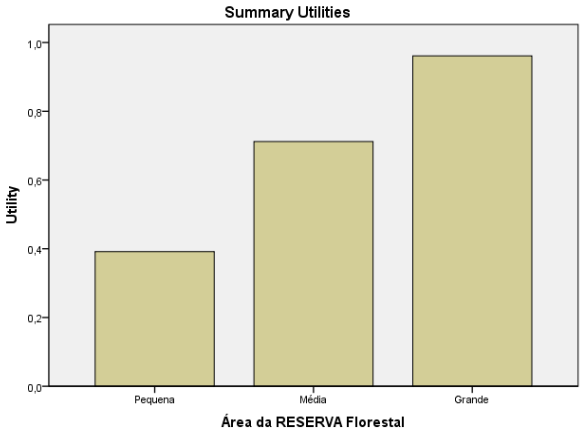
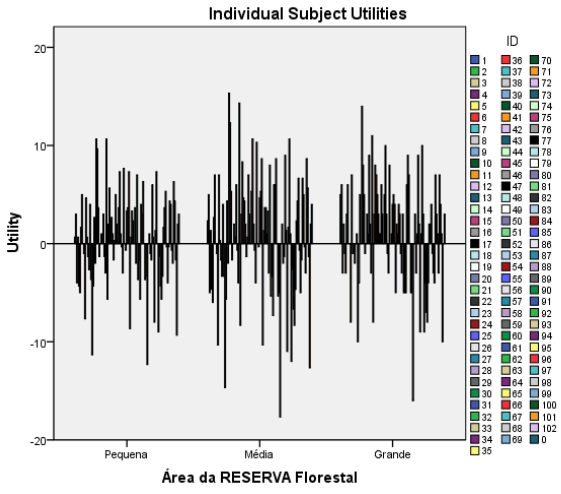
In the differentiation of the attributes for sustainability (Table 35), work was the most important condition (40,60%), followed by use of water (32,48%) and mandatory legal reservation (26,91%).

Work as well as legal reservation was the levels that were marked excellent and large respectively. AS for water use, the level large was least preferred with a significant intensity signaling a rejection of the consumer to the waste of this resource. Figure 3 illustrates the importance for each individual.

Table 35. Joint analysis in relation to the attributes in the differentiation for sustainability.

Attributes and Levels		Utility
WORK (40,60%)	Basic	0,282
	Good	1,084
	Excellent	**2,408**
Mandatory Legal Reservation (26,91%)	Small	0,392
	Medium	0,712
	Large	**0,961**
WATER (32,48%)	Small	0,550
	Medium	**0,553**
	Large	0,010

Source: Elaborated by the authors

Aggregated Preference	Individual Preference
	
 B = ,8236 C = -,2735 Ideal Pt = 1,5059	
 B = ,4272 C = -,0356 Ideal Pt = 6,0000	

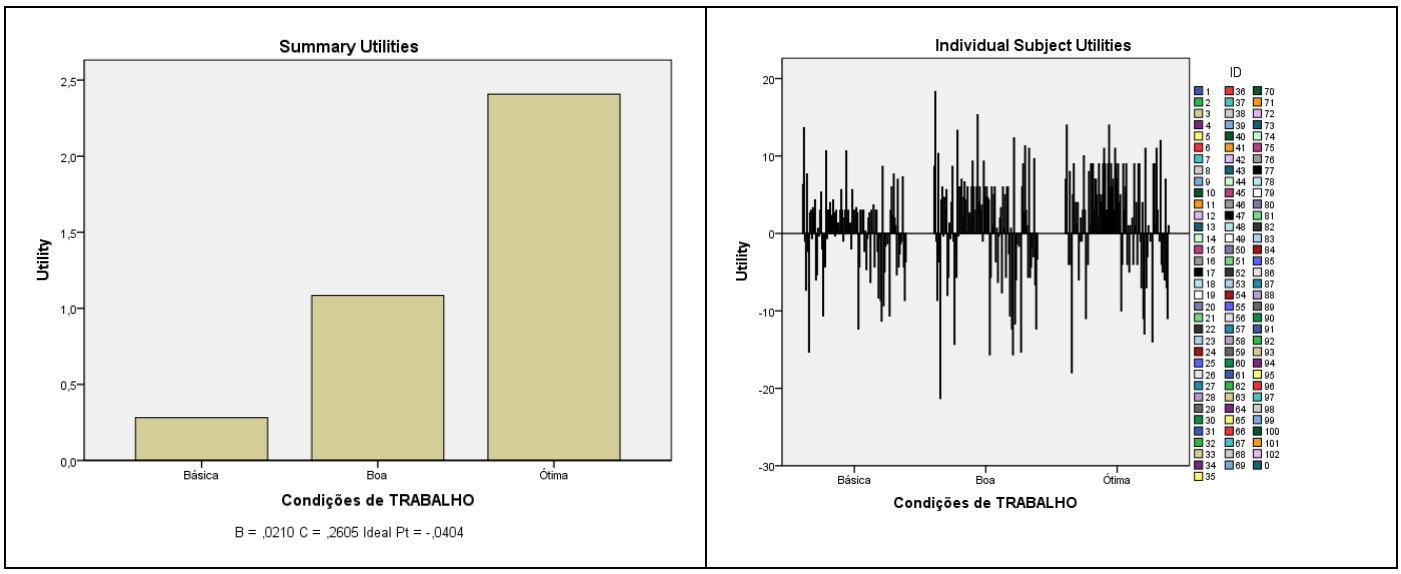


Figure 3. Joint analysis in relation to the attributes in the differentiation of sustainability.

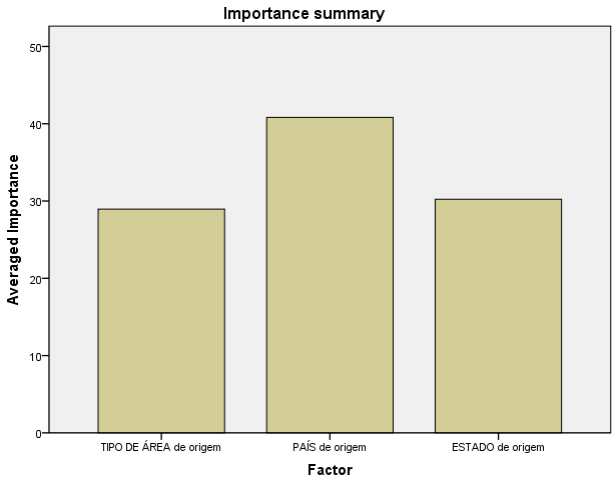
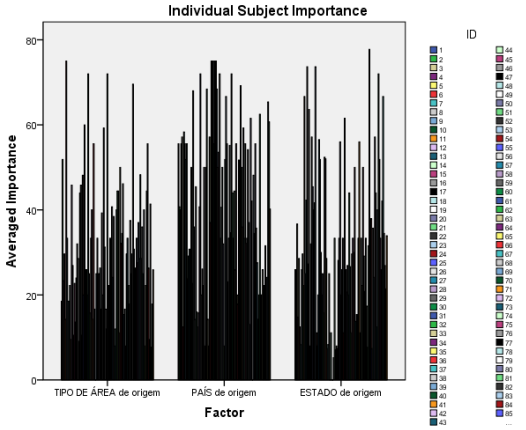
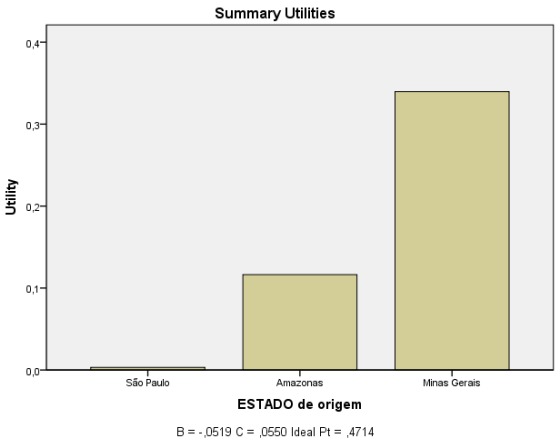
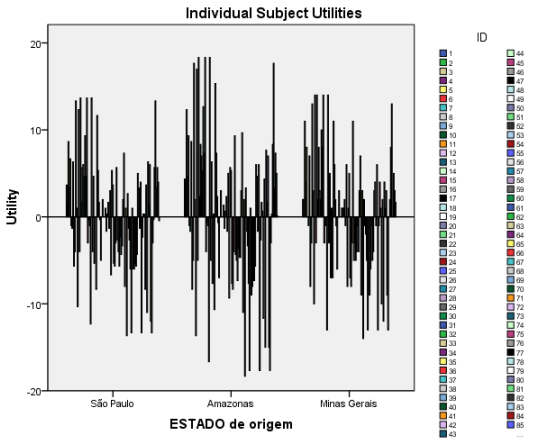
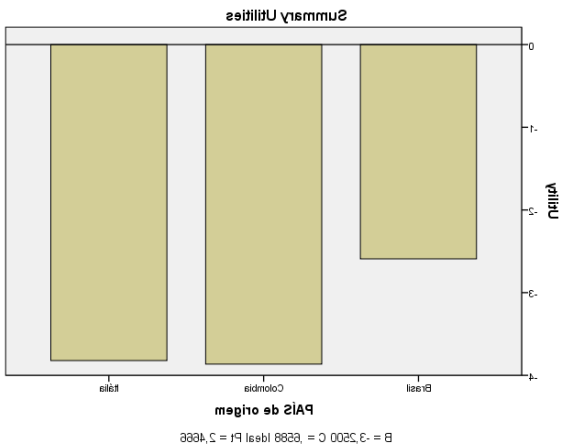
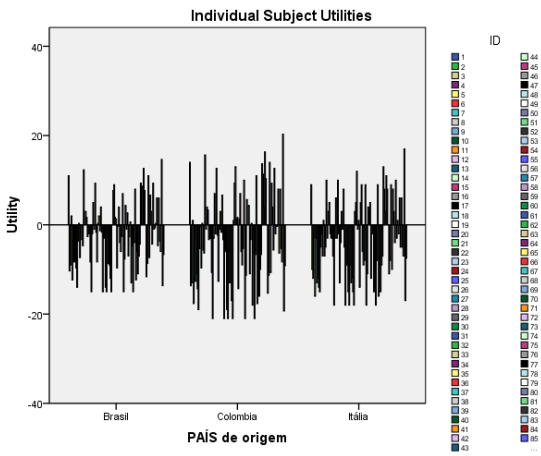
Last, regarding origin (Table 36), the logic used ran from the broader to the most specific being that the most important was the size of the country (40,82%) followed by the state (30< 23%) and the type of cultivated area (28,94%).

For the consumer, The Savannah of Minas Geris was the prevalent area for traditional coffee growing. Figure 4 illustrated the importance and preference for each individual.

Table 36. Joint analysis in relation to the attributes in the differentiation of origin

Attributes and Levels		Utility
AREA (28,94%)	Atlantic Forest	AREA (28,94%)
	Mountain	
	Savannah	
COUNTRY (40,82%)	**Brazil**	**COUNTRY (40,82%)**
	Colombia	
	Italy	
STATE (30,23%)	São Paulo	STATE (30,23%)
	Amazonas	
	Minas Gerais	

Source: Elaborated by the authors

Aggregated Preference	Individual Preference
	
	
	

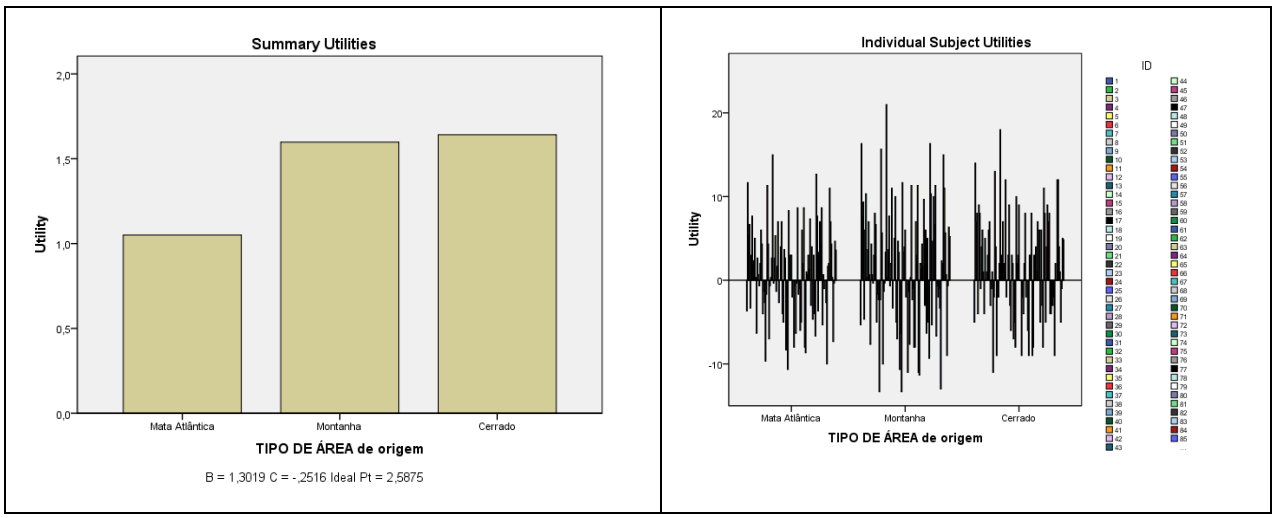


Figure 4. Joint analysis in relation to the attributes in the differentiation of origin

1.6 FINAL DISCUSSION

This item presents the results based on two perceptions: first the upstream of the chain, based on the perception of the coffee producer (Table 37).

Table 37. Principais resultados baseados na percepção do produtor rural.

Innovation Attributes	Results
Quality and traceability	Guarantee food safety
Quality	Identify the variety of coffee on the package
Quality	Control sweetness (Brix)
Traceability/ social certification	Identify microlots
Traceability/ social certification	Create an index of manual labor / Create a social seal
Traceability	Use QR codes on the package
Traceability	Make it possible for the consumer to follow the production phases via internet
Traceability	Measure carbon emissions
Traceability /Geographical Identification	Identify "Terroir", Historical and cultural elements
Geographical Identification	Create touristic itineraries routes

Source: Elaborated by the authors

Last, Table 38 summarizes the main attributes based on the final consumers' perception:

Table 38 - Principal results based on the consumers' perception

Innovation Attributes	Results	Consumer Vision
Target Audience	Population and sample of *survey*	A great part of the population and sample (stratified) of this research ranges from 2 minimum salaries (52%) are between 20 and 39 years old (48%).
Consumption habits	Drip, expresso and ground coffee are the most consumed, and capsules are becoming significant	64,2% of the total prefers drip coffee, followed by 21,4% for expresso and ground coffee. The consumption of capsules is around 3,2% when compared to the other types. Sachets range from 0,7 to 2,4% when asked which kind of is most consumed.
Consumption habits	Home and work still represent a great part of local consumption	At home (56,4%) and at work (33,6%) are still where coffee is most consumed representing 90% of the total. Retail represents only 10%.
Consumption habits	Morning is when coffee is most consumed.	Coffee is most consumed in the morning (58,8%) followed by "any time" (19,4%).
Consumption habits	Flavor and aroma are the factors that are most relevant that explain coffee consumption.	Flavor and aroma is the item that is most relevant (32,1%) followed by feeling good (20,6%) and pause to rest (16,3%). These results were confirmed by the specific questions in the dimensions for quality.
Information	Most consumers do not received information about coffee.	Comparing the answers 33,6% said they did not received information about coffee, whereas 32,3% claimed to have via TV.
Information	The majority trust information furnished by those directly connected to coffee production.	Technical knowledge is decisive for the consumer to trust the information on coffee. The average in reliability in the source of information was 7,66 for the producer, 7,60 for the specialists and 7,42 for the Research Institutes.
Information	Information about the product is better known than the information on the production process.	Level of knowledge on the characteristics of coffee (closer to the consumer, simpler, such as how to prepare it, quality, brands, price and types of coffee) was more than the production (more distant from the consumer and maybe more complex as processing, sustainability, origin, production and certifiers).
Brand	Illy brand is the least known.	Only 8,4% said they knew the brand Illy. When compared to 9 other brands the proportion falls to 1,2%. The branch that was most known had 97,1% *share of mind*.
Buying habits	The relation between those who consume (filter) and those who buy is high.	One of he filter questions in the questionnaire was the need of the respondent to be a coffee consumer (100%). Of these 89,2% were also buyers.
Buying habits	The most relevant aspects when buying coffee are: the quality, the brand and the price.	The three aspects added up, represented almost 75% of the buying decision. Packaging (appearance and design) represented only 1,6%.
Buying habits	The most relevant aspects on the package are type, information and	The three aspects added up represent almost 85% of the attribute package.

	price.	
Differentiation Aspects	Food safety and no pesticides are the attributes most valued by the consumers	The consumer is willing to pay more for attributes related to food safety (8,67%) and without pesticides (9,29%). These are the ones most valued amongst all attributes.
Differentiation Aspects	In the socio- environmental dimension work, water, mandatory legal reservations and jobs are the most importatnt.	The consumer is interested and recognizes the attributes connected to socio-environmental issues. After issues like food safety, this is the set with the highest percentages of value that the consumer is willing to pay for.
Differentiation Aspects	Certification by specialists is considered important to the consumer	The results indicate that the consumers think that certification is important, but that they are not willing to pay for this. On the other hand, when a specialist talks about the qualities of the product the consumer trusts him.
Differentiation Aspects	Aspects considered the most interesting	Comparing the average amongst all attributes, the biggest interest was in “no pesticides”, work, and mandatory legal reservation Amongst the attributes with lowest interests were those related to certification and origin,
Differentiation Aspects	How much more a consumer would pay for the coffee	The attributes related to the environment and social aspects (no pesticides, work, safety, more jobs, mandatory legal reservations, water) are those the consumer would pay more fore. The kind of drink was the item they had less interest in paying more for.
Differentiation Aspects	Following and traceability: origin.	The consumer values the fact of knowing the origin of the product. He is willing to pay 6,89% for this attribute.
Sub dimension in Differentiation	Certification and origin are understood by the consumer as one single dimension.	The result of the exploratory factor analysis resulted in only one factor with a low variance explained.
Sub dimension in Differentiation	The consumer as a set of sub dimensions understands quality and sustainability.	The result of the exploratory factor analysis resulted in three sub dimensons for quality (sensorial, process and product) and two for sustainability (social and product, and environmental).
Image	The socio- environmental image and origin image were heterogeneous.	The principle attributes that define image and Technical Imaging and Product Design (TIPD) Indicated heterogeneity between those that define these two dimensions of quality.
Image	Quality and certification images were homogeneous.	The principle results of image and Technical Imaging and Product Design (TIPD) indicated homogeneity among those that define these two dimensions of quality,
Image	Image perception between genders.	The results of image and Technical Imaging and Product Design (TIPD) by gender, indicated homogeneity among

		The attributes that define the dimensions of quality And certification and heterogeneity for the socio-environmental and origin attributes.
Values	Means-end chains are complex	The results of the analysis of means-end chains permitted A great number of connections between attributes, functional consequences, psychological consequences, and Values (LOV – *List of Values*)
Values	Segmentation starting with the principle values found.	Four distinct segments were identified: **Open to change:** a group of consumers that are more prone to experiment aspects in coffee invocation, sensitized or driven by the pursuit of pleasure or boldness. **Search for improvements:** a group of consumers who are sensitized to learning, knowledge, and information content that coffee can offer. **Conservative:** a group of consumers less prone to experimenting innovation aspects that are very audacious and that go against or interfere in the basic image or traditional coffee. **Based on values:** a group of consumers that values aspects coffee can generate in terms of social and environment benefits like respecting labor laws, and diminishing environmental impact.
Joint Analysis	Trade-off between Flavor, Roast and Variety – quality dimension.	Flavor is the item, which is most (53,81%), followed by variety (24,46%) and roasting (21,72%). The favorite was mild flavor, medium roast and the variety Arabica.
Joint Analysis	Trade-offs between Certifier, Certification and Brand– certification dimension.	Brand was the item of most preference (38,87%), followed by certification (35,85%) and the certifier (25,27%). The favorite was: brand 3 Corações, ABIC Certification ABIC and Association Certifiers.
Joint Analysis	Trade-offs between Work, Mandatory legal reservations, and Water- socio-environmental dimension.	Work is the favorite item with (40,60%), followed by water (32,48%) and mandatory legal reservation (26,91%).
Joint Analysis	Trade-offs between Production Area, State and Country– origin dimension.	The country of origin is the item most preferred (40,82%), followed by state (30,23%) and production area (28,94%). The favorite levels of area were Savannah, Brazil and the state of Minas Gerais.

Source: Elaborated by the authors

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2 DRIVERS OF CHANGE IN THE COFFEE PRODUCTION: PAST, PRESENT AND FUTURE CHALLENGES

Luciana Florencio de Almeida, Decio Zylbersztajn, Samuel Ribeiro Giordano, Christiane Leles Rezende De Vita

2.1 EXECUTIVE SUMMARY

This study proposed to identify and describe the major drivers of change for the present stage of the Brazilian coffee production, and elaborate a scenario of the tendencies and challenges of the coffee production for the next 10, 20 years according to the perception of the participating agents of the coffee agribusiness chain. Therefore, the new organizational forms that are being molded to attend the drivers of change were investigated.

Ten interviews were conducted with specialist, including producers, exporters, leader of coffee associations, managers and technicians of government agencies, with the aim of identifying the principal drivers of change in the last 60 years and the present panorama of the Brazilian coffee business. The analysis and compilation of information collected, led to the identification of 8 critical factors of success that bring together the main challenges in the management of the coffee business, whose main focus is to guide the productive unit, the coffee farm.

The critical factors of success were submitted to the analysis and discussion of 39 producers of the main Brazilian coffee producing regions: the Minas Gerais Savannah, the Minas Gerais Atlantic Rain Forest, and Southern Minas Gerais. Three panels were set up in these regions to collect the producers' perceptions of the future of the coffee production and how they are preparing for the future demands in the coffee business in Brazil.

Some factors were identified as crucial for all the regions that point to a more coordinated management amongst the agents in the coffee business chain. Themes like commercialization, mechanization, sustainability and family succession were some of the principal challenges for the development and competitiveness of the coffee business in and out of the country.

The panels captured the existing diversity amongst the regions, yet at the same time the similarities characteristic of the present stage of the coffee activity in terms of external factors like legislation, non-tariff barriers of consumer countries, rising cost of local labor, and hence the need to mechanize the processes to increase the productivity and improve the quality of the bean.

Table 1 provides a summarized view of the panels in relation to each critical factor that was investigated. The Minas Gerais Savannah presents a more modern coffee business with middle-size and large production units constantly working towards productivity and the quality of the bean. Besides, the coffee producers are noticeably more organized in trying to reach common aims like maximizing the seal of denomination of origin, by participating in international fairs to divulge the coffee of their region, as well as work with the roasting industry to adopt and market the blend of the Minas Savannah coffee on the packaging. The Minas Gerais Atlantic Rain Forest region is represented by the family and sharecropper, has a strong appeal for sustainable certification, fair trade and carbon credit, The producers have been approached by international buyers in search of good quality certified coffee. However, the producers in their majority still resort to the traditional sales

channels because they do not know the benefits that other alternatives could generate or because they believe that the coffee produced does not meet the demands of these buyers. The region also is characterized by little mechanization due to its topography, and the rising cost of processing due to high maintenance cost and /or acquisition of more modern machines.

Few in this region belong to associations, and there is still a lot of suspicion on the part of the producers of the existing cooperatives.

The southern Minas Gerais region mainly possesses a mixture of the traditional coffee farms with the larger professionalized properties. They all orbit around the Cooparaíso e Cooxupé Cooperatives that determine the quality of the coffee and exert a great influence on the crop management with technical guidance on the use of machinery and pesticides. The cost of production is high for most of the producers considering the expressive use of manual labor, and the dependent income of the standardized price set by the buyers.

Table 1. Producing regions and their characteristics in light of the critical factors.

Critical Factors	The Minas Gerais Savannah	The Minas Gerais Atlantic Rain Forest	Southern Minas Gerais
Technology and Management	Intense use of agricultural implements and modern management techniques	Minimal mechanization due to the topography of the region. High cost in processing for the small property and absence of crop management (pruning, harvesting, labor, costs, etc.)	Mixes mechanization in flat areas and little use of machinery in mountainous areas.
Labor	Uses qualified labor, with investment in training and differentiated payment	Intensive use sharecroppers and family labor.	Mixes mechanization and hired labor, which is still not too qualified.
Quality	Denomination of origin and coordinated efforts to market the coffee of the region.	The region is going through a certification process. The traditional middlemen have not considered the quality of the bean and thus have not taken advantage of this in commercialization.	Sold mainly to the cooperatives. The quality depends on the demands of the buyers of the cooperative.
Cost management and productivity	A growing number of producers who adopt modern instruments for cost and productivity management .	Traditional management by the local producers who are in the majority family nuclei. There is an absence of cooperatives and governmental agencies to give them support.	Adopted mainly by middle size and big properties, but still in simplified form.
Financing	Access to official credit and alternative forms.	Access to PRONAF –National Family Financing Agricultural Program and alternative forms. The challenge is the efficient allocation of resources.	Access to official credit and alternative forms.
Commercialization	Utilization of different sales channels (cooperatives, direct trade, export, etc....) including protection tools such as	Counts on the presence of the traditional middleman, but sees a growing participation in direct trade, sales to exporters and participation in competitions	Sales mainly to local cooperatives, the major part being to the Coxupé Cooperative, and directing the special coffee to exporters or

	future contracts and derivatives.	that aim at quality.	direct trade.
Sustainability	Adjustments that conflict with bureaucracy.	Few properties with sustainable certification and fair trade, but with a tendency to be adopted by the families.	Producers concerned in adjusting to the demands of the buyers . Lack of support from the cooperatives.
Legislation	Increasingly more important for the development of the activity- need for specialized support.	Increasingly more important for the development of the activity- need for specialized support	Increasingly more important for the development of the activity- need for specialized support

Source: Elaborated by the authors

Despite the advancement in the complexity of the coffee farm management, the producers are optimistic with the future, principally with the perception of financial gains that have come from the growth in the consumption of the product in the world and in the domestic markets, besides the growing adoption of quality coffees that provide even more income.

Research with specialists and later the validation by the producers permitted the consolidation of new drivers of change: a) the growing complexity of the activity; b) succession of the rural property; c) growth in mechanization; d) growth in the use of pesticides; e) climate change; f) consumer behavior; g) risk management in the coffee business.

Regarding the organizational forms, the major change is the growing possibility of the polarization of the productive units, in other words, the gradual disappearance of the middle-size properties to large ones that are professionally managed and the small properties, who in their majority are managed by families. The reason the middle-size properties are disappearing is due to the cost structure based on labor vis-a-vis the volatility in prices, that incur in tighter margins, even if cost and productivity management are applied. This scenario was found and discussed principally in the Minas Savannah and Southern Minas regions. The middle-size property was characterized in around 200 hectares with an average investment of R$13 thousand per hectare; therefore, a working capital of R$2,6 million, for a cycle of 15 months, hiring around 60 fixed employees, and another 180 during harvest time. Many of these properties are found in the mountainous areas. Some specialists predict that the sale of these properties will be for reforestation.

Another important factor that determines the configuration of the productive units, is the succession of the small and middle-size properties. In many cases, the successors are studying or working in cities. For them the rural activity presents little appeal in detriment to the many existing possibilities in the urban scenario.

At the end of the research, the new drivers of change for the next 10, 20 years for the Brazilian coffee business are: a) the growing management complexity of the coffee property; b) family succession; c) mechanization; d) growth in the use of pesticides; e) climate change; f) consumer behavior; g) risk management in the entire coffee business. These drivers were extracted from the regularity in the perceptions of those interviewed by the specialist, as well as the results obtained from the regional panels. These are the present demands, as well as the expectations and uncertainties about the future of the coffee business in the country.

2.2 INTRODUCTION

> *"What I think about coffee is: we covered the cycle. It was an extremely important instrument to finance the growth of this country. It was a catalyst for investments, such as the railroad, the ports, energy, which were all connected to coffee. In reality, coffee produced the capital that was necessary for the beginning of industrialization. Coffee made Brazil and Brazil made coffee.".* Delfim Netto, in interview for Revista do Café (Coffee Magazine) in 2001 (Saes, Nakazone, 2002)

Brazilian coffee today is in a new phase. It is slowly leaving behind its recognition for quantity for recognition for quality, reaching more and more demanding markets. Nevertheless, in order to make this transition, new paths were drawn and a set of factors have been critical for the success of the coffee business in all its grandeur and complexity.

This study proposes to identify and to describe the major drivers of change for the present stage of the Brazilian coffee production, and elaborate a scenario of the tendencies and challenges for the production of coffee for the next 10, 20 years according to the perception of the principal agents of the agribusiness chain. The study will investigate the new forms of organization that are being molded to attend the identified drivers of change.

Ten specialists were interviewed, including producers, exporters, leaders of producer associations, technicians and managers of governmental agencies, aiming to identify the principal drivers of change in the last 60 years and the present Brazilian coffee business. An analysis and compilation of the information collected, led to the identification of 8 critical success factors that group the major challenges in the coffee business management, with the main focus on the management of the productive unit, the coffee farms.

The critical factors for the success were submitted to the analysis and discussion of 39 producers in the principal Brazilian coffee production regions: the Minas Gerais Savannah, the Minas Gerais Atlantic Rain Forest, and Southern Minas Gerais. Three panels were set up in these regions to collect the producers' perceptions of the future of the coffee production and how they are preparing for the future demands in the coffee business in Brazil.

Some factors were identified as crucial for all the regions that point to a more coordinated management amongst the agents in the coffee business chain. Themes like commercialization, mechanization, sustainability and family succession were some of the principal challenges for the development and competitiveness in the coffee business in and out of the country.

This report is composed of 5 parts including this introduction. The next section will present the stages of the research process. Section three will present the perceptions of the specialists who were consulted on the principle drivers of change in the Brazilian coffee business, and the panorama of the present challenges. The fourth part will bring the summary of the discussion panels of each region, presenting the perceptions of the critical factors and the future of the coffee business. The fifth part, based on the analysis of the common perceptions of the three producer groups, will bring the main challenges based on the future vision outlined in research.

2.3 RESEARCH STAGES AND CONCEPTUAL MAPS

Below are the three stages of the research:

2.3.1 Stage One

In this phase, 10 specialists were interviewed including producers, exporters, leaders of producer associations, technicians and managers of governmental agencies, aiming to identify the principal drivers of change in the last 60 years and the present Brazilian coffee business panorama. The method used were personal interviews with a semi-structured script. These were collected over the period of March, April and May 2014.

2.3.2 Stage 2

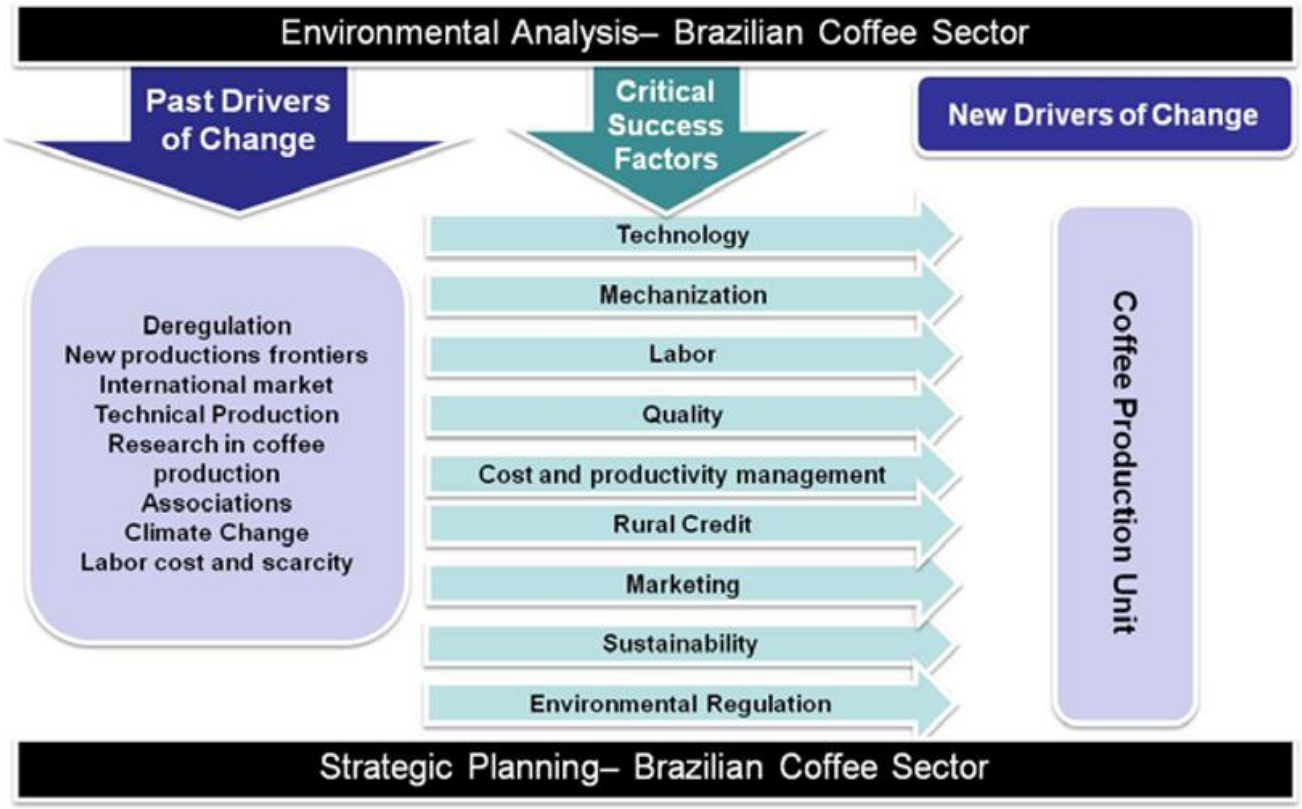
Based on these interviews, the principle results were drawn up and eight drivers of change were identified among the factors pointed out by the interviewees, relative to the description of the major marks of the coffee business in terms of production, regulation, technology, consumption and commercialization. In this phase, it was also possible to elaborate a conceptual map that served as the basis for the field research in Stage three.

The conceptual map presented in Figure 1, brings the principle drivers of change pointed out by the interviewees and the resulting critical factors in today's coffee business. It is important to highlight that the critical factors presented, represent regularity in the answers obtained in the interviews, especially with regards to question 4 (With regards to the drivers of change, what factors do you consider relevant for the present scenario and the future?)

2.3.3 Stage 3

In this stage, the critical factors for the success were submitted to the analysis and discussion of 39 producers in the principal Brazilian coffee production regions: the Minas Geris Savannah, the Minas Geris Atlantic Rain Forest, and Southern Minas Geris. Three panels were set up in these regions to collect the producers' perceptions of the future of the coffee production and how they are preparing for the future demands in the coffee business in Brazil.

Figure 1. Conceptual Map of the research



Source: Elaborated by the authors

2.4 DRIVERS OF CHANGE IN THE COFFEE BUSINESS

Research permitted identifying 6 drivers of change that molded the national coffee business and continue to conduct the way transactions are made and principally, the management of a producing unit, the coffee farm. These drivers are: the International market, the deregulation of the coffee market, the new planting areas and technified production, research in coffee, climate change, and the shortage and cost of labor .

Hereafter is a synthesis of the perception of those interviewed about some of the drivers that were pointed out with more regularity and importance in the interviews.

2.4.1 The Internacional Market

The International Market has always been an important driver of change in the Brazilian coffee business because of the world's supply and demand, and presently it is even more by attending the demands of the final consumer. Between 1890 and 1910, there was a promising scenario with high production in the red soil of the State of São Paulo, the international consumption of coffee, both in Europe and the United States, absorbing the entire Brazilian production. Nevertheless, the rise in prices stimulated the investment in the coffee business, and in the years of 1985 – 1985 the production jumped from 6 million bags to approximately 11 million bags. This was the first coffee crisis. Many others were to come with government interventions adjusting prices by buying coffee, creating regulatory warehouses e even the burning of coffee, which happened between 1931 and 1944, decimating 78 million bags, equivalent to three

times the global consumption (MARTINS, 2012). Furthermore, the producer lived at the mercy of innumerous factors such as frost, plagues, the harvest, the stock market, and the demand of the international markets, amongst others.

In an attempt to minimize the mismatches between production, consumption and the international market prices, in 1962, the International Coffee Agreement (ICA), of the International Coffee Organization (ICO) was signed by 42 exporting countries and 25 consuming countries, that established production quotas as a policy to sustain the world market. At the national level, the regulations were made by the National Coffee Department (DNC) which was substituted by the Brazilian Coffee Institute (IBC) in 1952.

> *"(..) There was an interventionist policy totally focused on coffee which generated taxes, every bag of exported coffee suffered a currency confiscation, a kind of tax over the value exported, a tax on the circulation of goods, (...) it was a terrible tax burden and this created a great sum of money inside the Brazilian Coffee Institute that maneuvered the market in favor of the producer and the internal market (...) and gave a price guarantee to the foreign buyers, in other words, if the market went up too much or fell, it would pay back in dollars. This was called warranty notice." (interviewee)*

The aim of the Brazilian Coffee Institute was to get financial funds to reach their goals such as: the incentive policies to renovate the coffee plantations, buy the exceeding coffee, construct warehouses and adopt policies that aimed at minimizing the damages incurred by climatic occurrences and policies that would avoid the excess of supply in international market. Nevertheless, the interventionist actions led to the loss of the competitiveness of the Brazilian coffee (SAES, NAKAZONE, 2002), such as:

a) the retraction in the participation of the Brazilian coffee in the world market, adopting several times the position of residual supplier that led to the fall from 40% to 25% between the 50's and the 80's.

b) focus on the volume, without stimulus to the market segmentation determined by the official control of prices that made coffee a homogeneous product.

c) characterization of the Brazilian coffee as one of average quality, that could easily be substituted by other sources, as blends formed with robusta coffee largely produced in Vietnam.

d) growth in the participation of countries like Colombia, Costa Rica, Ethiopia who offered better quality coffee.

e) Lack of incentives in the investment in quality because of price homogeneity.

> *"Until 1991, Brazil exported without worrying about quality because most of its coffee was exported as a commodity, as there was no difference between common coffee and quality coffee, and the price was the same. So the coffee producer at that time did not have any stimulus to produce quality coffee. (...) so much so that Brazil was considered a country that supplied coffee to complement the blends of other countries "(interviewee)*

> *" At that time, one planted, harvested and sold...(..) there was no investment..(...) tearing down woods, selling the lumber helped pay for the beginning of the activities. Then all we did was stuff our pockets with money, principally in the state of São Paulo, (...) around the 1800's , coffee entered through the Paraíba Valley, then went to the regions of Mogiana, Araquarense, Northeast of São Paulo, Sorocabana and the state of Paraná.(...) regions where railways were built to bring the coffee from the*

countryside to the port of Santos. (...) looking for fertile lands, no concern with investment."(interviewee)

The scenario was favorable for the consumption of world coffee, duplicating the volume consumed from 80 million bags in the 1970's to 160 million bags in 2012. Besides, even in the traditional markets, the per capita consumption has grown, such as Finland (12,3 kg/year), the USA (4,2 kg/year), Germany (6,9kg/year) and France (5,7 kg/year). New markets like Australia (3,9 kg/year) and Argelia (3.3 kg /year) already surpass the per capita consumption of countries like the United Kingdom (3.3 kg/year) and Japan that has grown at the rate of 3,5 a year in the last 10 years and is already the third largest importer (International Coffee Organization, 2012). The same is expected for China and Korea.

There is a demand for quality coffee out there, much more that what can be offered. (interviewee)

Illy coffee was founded in 1933 and always bought from exporters and always wanted quality , and at the end of the 80's, Illy Coffee did not find the quality to attend to their need...the exporters would send samples to be tried in Trieste...there came a point in which Illy Coffee tested 20-30 samples to select one. (...) it reached a point that Dr Illy did not believe that Brazil had quality coffee...and substituted Brazilian coffee for those of other countries. (...) in 1991, Dr Illy came to Brazil on a mission ....to institute a prize for quality, second, to buy directly from the producer and not through an exporter, and third, pay a higher price than the market for this quality. (...) As of the second year, Illy did not have a problem with quality anymore." (interviewee)

2.4.2 Deregulation

With the liberation of the market, accelerated by the closing of the Brazilian Coffee Institute, and Brazil's retreat from the International Coffee Association, due to the constant failed attempts to regulate the market, the Brazilian coffee business faced a challenging scenario of competitivity and coordination of the agro industrial chain. On the other hand, this opened space for new opportunities.

The Illy Quality Prize instituted in 1991 is a successful example of identifying an opportunity despite the backward scenario of the Brazilian coffee business. It served and continues to be an important trigger for the dissemination of the culture of quality inside and outside the coffee farms, by means of direct sales with a differentiated price based on the appreciation of the coffee bean with few defects. This opportunity extended itself to retail, that altered the consumption pattern from free coffee at the end of a meal to offering a product whose perceived quality value justify being charged for.

Following this example, other roasting companies like Nespresso, and other smaller ones like Ipanema, besides the sale through programs like Expoccacer, the Cooperative of the Minas Savannah, all have offered the Brazilian coffee producer possibilities to segment their crops and consequently their income based on quality criteria and differentiated prices.

Besides, the above companies and traditional roasting companies have directed their production efforts and marketing to the internal market and have become attractive growing 3% a year in the last ten years. With regards to the special coffee market, there is an estimate of a 15 to 20% growth a year in Brazil compared to the world market.

Internally, 4% of the 20 million bags consumed belong to the gourmet coffee market, that count on 120 brands certified by the quality program of the Brazilian Association of the Coffee Industry (ABIC). There is an estimate that the same number of brands is available to the consumer without this seal, by means of small roasting companies or direct sales (ABIC, 2014)

> *"It became known that Brazil had quality coffee...the producer discovered that if he went after quality he would get a better price...so he started becoming interested in producing quality."* (*interviewee*)

The end of coffee deregulation with the suppression of the Brazilian Coffee Institute in 1989, made the market free and new production structures and commercialization were molded to attend the demands of the international consumer market. Production focused on quantity had to modernize, attending to factors which before had been disconsidered like productivity, production technology, cost management and demands regarding the quality of the bean. Therefore, the deregulation was determinant for the appearance of new and important critical factors in the management of the coffee business, added to the complexity of the micro sphere of the producing unit, as well as the inter and intra relations of the coffee agribusiness system. Unprotected by the government regarding a minimum price, international agreements, stock and quotas, the producers had to transform themselves from owners of coffee trees to farm managers, transforming and making the profile of the national coffee business more entrepreneurial and technified, principally in the regions where the soil was not too good for growing coffee, like the Minas Savannah.

2.4.3 New areas for planning and Thechnified Production

> *In the province of São Paulo, between 1816 e 1889, the exact period of the growth of the coffee plantations, 101 new municipalities were born.(..) between 1890 and 1929, and because of the coffee plantations, 127 new municipalities were born, with ten railway stations being transformed into cities along the Northwest railway line, Penápolis, being the first. (MARTINS, 2012, p. 186)*

In 1906, the Brazilian coffee production reached over 22 million bags and São Paulo represented 76% of the world coffee production. In the same year, the Taubaté Agreement was celebrated, which prohibited new coffee plantations in the state of São Paulo. Consequently, the expansion of the coffee plantations was larger in the north of the state of Paraná, reaching the peak in the 20's. The city of Londrina is an example of planned private investment based on the fertile lands of the region. There were large farms side by side with small landowners, an innovation at that time. The small properties measured up to 121 hectares , were principally based on family labor, but that also hired workers. In the 60's most of these small landowners migrated to the cities, maintaining the farm as a source of basic family income. At this time, the state of Paraná represented 40% of the national coffee production.

In October 1961, the Executive Group for the Rationalization of the Coffee Business (GERCA) established two principals objectives: a) by paying the producers, irradicating the coffee trees that were not producing much, freeing the land for other crops, and stimulating via financing, the modernization and renovation of the coffee business in areas that were considered more adequate. From 1961 to 1968 the coffee trees were reduced from 4.307 million to 2.310 million (BACHA, 1988).

At the end of the 60's, the implantation of the Renovation and Reinvigorating of the Coffee Plantation Plan (PRRC) was important for the implementation of a more technified plantation. Through this plan, the Brazilian Coffee Institute wanted to technically guide the planting in areas that were apt for coffee, with the aim of reaching a biannual average of 29 to 30 million bags. Therefore, the Bank of Brazil granted subsidized credit and the Brazilian Coffee Institute did the technical control until 1981. In 1975 there was the great frost, destroying a large part of the coffee plantations. The financial incentives and the technical indication of the ecological zoning promoted by the Executive Group for the Rationalization of the Coffee Business (GERCA) , promoted the advancement to new areas like the Minas Savannah.

At the same time there was the campaign for the increase in the internal consumption of coffee, which through the subsidized sale of an only blend to the roasting factories, and by tabling the prices of roasted and ground coffee, according to the Brazilian Coffee Institute, the national consumption grew from 5.400 thousand bags in 1960 to 8.270 thousand bags in 1969 (SAES, 1995).

According to the specialist, the zoning and the incentive program of the Brazilian Coffee Institute for the renovation of the coffee business, allowed the consolidation of the a more entrepreneurial coffee culture, worried with productivity and cost management, principally in the expansion areas like the São Paulo state, Minas state and Bahia state savannahs.

Thus, the coexistence of two distinct coffee producer profiles: a) those that are in regions that were occupied in the past, which are not in the 4th and 5th generation of family producers that use hired labor in harvesting seasons and b) those that entered the coffee business in more recent decades, principally driven by renovation programs implemented by the Brazilian Coffee Institute in the 70's and 80's with a more entrepreneurial profile. There is still a third group, that consider the coffee business as leisure and supplementary income, still widely present in the regions, principally formed by medical doctors, lawyers and other kinds of business people.

> *One cannot think of the profile of rural producers with out connecting this to the migratory characteristics of the coffee business. As the business occupies new territorial niches, this profile has changed. Going to the Minas Savannah and more recently to the Bahia Savannah, this profile, which already existed in the São Paulo Savannah, namely the city of Franca, is more entrepreneurial....with a more modern management, focused on results, price and quality.*

Specialist do not believe in significant advancement in the new areas of planting, due to the balance in supply and demand, and the consolidation of existing entrepreneurial and family coffee business areas interested in the continuity of the business, and who are more prepared for the advancement in the complexity of the property management.

2.4.4 Coffee Research

Today there are important centers that dedicate themselves to the study of coffee, in the agricultural sense, through phytosanitary research in the combat of coffee plagues like the stem borers (Xylotrechus quadripes), specially studied by the Agronomic Institutes like (the IAC- Agronomical Institute of Campinas, and the IAPAR, Agronomical Institute of Paraná), and the Agricultural University of São Paulo (ESALQ), the Federal University of Lavras (UFLA), the University of Viçosa, both of the later in the state of Minas Gerais. There are other important centers that prepare professional specialists in preparing coffee to be served to the consumer, like the Preparation Coffee Center, inaugurated in 1996 by the Union of the Roasting Industry of São Paulo (Sindcafé-SP). The decentralization of research centers contributes to the advancement in research that attends the specific demands of each region.

The National Coffee Fund (Funcafé), which the Council of Deliberate Coffee Policies (CDPC) coordinates has an important role in the continuity of this process by destining resources to the research centers. An important initiative was the creation in 1997 of the Consortium of Coffee Research, whose aim was to integrate important research institutions for the betterment of technology at all stages of the coffee agribusiness chain, which included EMBRAPA –Brazilian Agricultural Research Corporation EMATER – Technical Assistance and Rural Extension Corporation, EPAMIG –Agricultural Research Corporation of Minas Gerais, the Agricultural Research Institutes and the Ministry of Agriculture.

Those interviewed believe that many advancements were made principally after the

extinction of the Brazilian Coffee institute, and with the emergence of a new configuration of the Brazilian coffee market, promoting more concern in all the sectors in the agribusiness chain to make the Brazilian coffee more competitive and maintain its position of leadership in the production and bean export market.

> With the free market the producers started first looking for productivity to make feasible the process, and the world on the other hand started asking for quality.(..) Brazilian coffee supply has always had a considerable volume, but was never well marketed.
>
> A new phase began with the democratization of information. Part of the producers were eager for information and wanted to increase their productivity...there were coffee seminars in the countryside, (...) everyone started realizing that it was important to have these conferences and meetings advance in the coffee business.
>
> *Embrapa, the* Brazilian Agricultural Research Corporation had a fundamental role in divulging these organizations such as the Agronomical Institute of Campinas, Lavras, ICAPER- Agronomical Research Institute of Espirito Santo (.) and started to give strong emphasis in research and divulging of the research results.

It is important to consider the important contribution in recent years of SEBRAE (Support service to the small and micro businesses) through programs like EDUCAMPO (*an educational management program aimed at the producer*), which was positively mentioned by the majority of those interviewed as being an important developer of good management practices in the rural properties and in the main coffee production poles in Brazil.

2.4.5 Climate Change

Even though in general this is a theme of great importance for agriculture, this driver did not appear as critical for those interviewed. There is though a pressing concern about the uncertainties that surround this theme. However, as the forecasts of the impact of climate change on the coffee plantations are long term, even the specialists interviewed pointed to other more critical and urgent issues.

Even so, it is relevant to consider the power in climate changes as a strong driver of change in the Brazilian coffee business. A report published in 2009 by EMBRAPA – the Brazilian Agricultural Research Corporation, in conjunction with UNICAMP (University of Campinas) and other research institutes, point to some possible scenarios for the coffee plantation, considering valid the forecast released in the 2007 IPCC- International Panel of Climate Change - UN report, which estimates a pessimistic scenario with the rise in temperatures between 2ºC and 5,4ºC until 2100. According to the report:

> *"The results obtained coincide with the previous forecasts made by* EMBRAPA – the Brazilian Agricultural Research Corporation, in conjunction with UNICAMP (University of Campinas) with data from *the 2001 IPCC-* International Panel of Climate Change - UN report*, of the impacts of rise in temperatures in the areas with potential agricultural production. The rise in temperature will cause a growth in evapotranspiration and consequently, an increase in hydric deficiency that will provoke an increase in areas with high climatic risk. The areas that today suffer from frost, especially in the southern regions of the country and some southeastern and southwestern parts of Brazil, will be at an advantage with global warming. All the other regions will have a decrease in low risk areas for most part of the crops. (p. 9)*

For the coffee crops specifically, the forecasts point to two principal impacts: hydric deficiency and very high temperatures in the traditional coffee regions. Thus it is expected that the arabica coffee plantations will be the most affected, promoting a possible migration from the present areas in the states of Minas Gerais, Espírito Santos and São Paulo to the states of Paraná, Santa Catarina and Rio Grande do Sul until 2050. There is a projection that there will be a decrease in lands favorable to planting coffee from 6,75% in 2020, increasing to 18,3% in 2050 e 27,6% in 2070 of the

The data presented above draws attention to all those involved in the coffee production chain for the dimension of risks involved for each producing region, which in turn calls for the adoption of measures to minimize the possible climatic impacts.

It is worth pointing out that in the view of those interviewed, the producers are aware of the climatic risks once they daily live the uncertainties of nature. Thus, to talk about climatic change is neither trivial nor catastrophic, but inherent to working the land. Nevertheless, it is important to always consider how the farmers think about the future, who in general do not plan beyond the harvest period.

> *"The farmer inadvertently has a great environmental concern which is innate and very different from those living in cities. "*

2.4.6 Shortage and Cost of Labor

Brazil has a great comparative advantage that is in the harvest process by stripping. This brings an advantage in terms of the cost of production, even though the process can compromise the quality. Meanwhile, the advancement in research to improve the harvesting, the storage and the processing has permitted Brazil to advance in its participation in the market for fine coffees, and maintain its tradition in the harvest by stripping. According to CECAFÉ – Coffee Exporters Council (2013), the fine coffees already represent between 15% to 20% of the total Brazilian exports, reaching better prices than those paid to Colombian coffee producers who are recognized by the high quality beans.

The binomial quality and labor has become a growing challenge for the coffee producers especially because of the need for workers during the harvest period, even if in smaller number than some decades ago. The biggest concerns are the weight of taxes, associated with the payment of more adequate salaries due to the qualification of the workers, which requires more care in working with the coffee.

This factor has directed the properties to a constant search for automatization processes, reducing the need to hire labor, which in mountainous areas become even more challenging. According to those interviewed, the reduction in labor has gradually occurred as a response to two main factors: the absence of qualified labor and the high risk of maintain this labor force. However, the substitution for machinery also presents itself as a challenging process, principally because of the immobilization of capital.

The drivers of change pointed out by the interviewees, transformed the Brazilian coffee business in the last 20 years, principally in the way the transactions were molded to attend the new demands of the consumer markets as well as climatic and production factors. In the rural scope, the organizational forms went from lands without any management and technical concerns to production units connected with the agro industrial coffee chain, receptive to the adoption of a business management with focus on productivity and quality as a way to survive in the business.

In the next chapter, the coffee producers will present other critical factors for the conduction of the coffee activity, especially within the production unit. It is important to point out that these factors are elements that mold the form in which the transactions are realized between the economic agents and the agriindustrial coffee chain, protecting itself form future risks and in search of better recipes, principally by means of adopting technical and professional management of the business.

2.5 CRITICAL FACTOR FROM THE VIEW OF THE COFFEE PRODUCERS

In this stage, nine critical factors were submitted to analysis and validation by a group of producers from three regions: the Minas Gerais Savannah, the Minas Gerais Atlantic Rain Forest, and Southern Minas Gerais. The nine factors were extracted from the first phase of the research and reflect the challenges inside and outside the farms to attend the increasing complexity of the Brazilian coffee management, which are: technology and handling, mechanization, labor, quality, cost and productivity management, financing, commercialization, sustainability and legislation.

During the first round of discussion, the producers analyzed and validated the importance of each of these factors for the management of the farm and proposed new critical factors based on their perceptions and present challenges in their regions.

During the second round of discussion, the producers were invited to debate the future of the coffee business by answering the following questions: How will the coffee business be in the next 20 years? What will be the new drivers of change? What will be new critical factors to respond to these changes?
Below are the results of these discussions for each group of producers from the three regions that were investigated:

2.5.1 The Minas Gerais Savannah

Results from the 1st round of discussion – general view of the coffee business in the Minas Gerais Savannah

For the producers of the Minas Savannah the critical factors indicated in the research are present in their daily lives. Those that are somewhat under control are technology and handling, mechanization, quality, cost management and sustainability The producers believe that much as been done to prioritize a more modern management of the rural property using instruments and methods to guarantee reaching better results.

> *One has to work on the meaning of quality inside the farm...because there is a lot of resistance...one needs to give access to information to the workers for them to understand the reason of things.*
>
> *More and more there is a market demand ...today a person who is not well informed drinks a coffee at the gas station...what horrible coffee, it tastes like hay...(..) If one does not specifically adjust the quality, one is out of the market.*
>
> *One needs to encourage the workers more, so that they buy the idea,(..) the worker*
> *needs to enjoy working...to discover that he does not only work to eat, but to grow professionally...to have more opportunities.*
> *If you want to professionalize your business, you have to give value to those who are in the operation of the business.*
>
> *The minority does cost management... 10 a 15% of the producers.*
>
> *EDUCAMPO (an educational management program aimed at the producer) is good because it changes our way of thinking, helps one have better technical and financial control of the business, which in turns generates more income.*
>
> *At the Expocaccer (Minas Savannah coffee producers' Coorperative) we are 45 producers that share our numbers, which allows us to compare our results. This in turn helps everyone improve.*

Besides the critical factors presented by the research, the group suggested others which are relevant nowadays to the management of the farms: a) climate problems and hydric

management, b) logistic inside the farm, c) logistic to transport the product, d) family succession, e) a strong demand of the external consumer market for traceability, f) macroeconomics that makes commodities more volatile, g) the role of governments on the management of the coffee business economy, and e) professionalization of the farm manager.

The producers mentioned some problems that they particularly face in their region with regards to the federal government:

a) Increase in the legal demands for the sustainability of the farms, and little structure to support the producer with regards to beaurocracy of the process.
b) Lack of representativeness at the federal level for the coffee business, with few many organizations that do not communicate with each other.
c) Obsolete research centers.
d) Considering that 70% of the coffee produced in the region is exported, there are serious problems with road infrastructure, which greatly raise the costs of coffee transportation to the ports.

To overcome these difficulties, the producers have organized themselves in the cooperative and associations to find solutions, like hiring professionals for the associations to help the producers in the rural registration process, a document required today by the Environmental Authorities. Besides, the producers have gone after professionalization of their farms, controlling costs and searching for better commercialization alternatives, to not feel the impact in the lack of infrastructure and macroeconomic volatility in the results of the business.

With regards to the climate problems, the producers mentioned the initiative to amplify irrigation and hydric management inside the rural property by means of reuse of rainwater.

Last, the issue of succession is a significant challenge for the producing families who in general are not prepared for this process. Those interviewed still feel there is a generation conflict and a lack of preparation with regards to the succession, which needs to be thought out by the families before the death of the landowner.

<u>Results from the 2nd round of discussion – Vision of the future</u>

The producers were optimistic with relation to the coffee business and pointed out the following boosting factors:

a) Renovation of the coffee plantations with the introduction of more resistant varieties as was recently done in Colombia, increasing the efficiency and lowering the costs;
b) Growth in the consumption by younger people, principally in the coffee shops in Brazil and around the worked, that allow the use of internet and a pleasant place to meet;
c) Growth in the consumption in Asian countries, where in places like China and India, the consumption takes place via Starbucks and McDonalds chains, differently from what occurred in Japan with the introduction of the habit through consumption of instant coffee;
d) Growing recognition of the Minas Savannah coffee as, denomination of origin.

"The Savannah should maintain the model of high efficiently and large scale with the betterment of quality...including the virtualization of offer, search for more efficiency."

"We have to show the world who we really are. You will not find a boy harvesting coffee, but a super machine with air condicioning and radio, which anyone can work in with a suit and tie, that costs 600 thousand reais (approximately US200 thousand/ 2016)

The producers pointed out the following factor amongst their challenges:

a) Increase in the consumption of robusta in the world, to facilitate the entrance in countries with emerging consumption, favoring buying coffee from Indochina;

b) Renovation of the plantations in competitive countries increasing the productivity of these markets
c) The market will demand more and more exotic coffees, of extreme quality with the presentation of the history of the property and traceability;
d) The need of more coordination between producers and owners of roasting companies with potential virtualization;
e) High volatility in the coffee price due to the growing participating of investment funds.

> *"the owner of the roasting company wants to pick up the phone and call the producer at the farm to find out about the weather, the quality of the coffee...he wants the QRcode to put on the packaging so the consumer can access information about the property, the farm, the traceability via smartphone, thus approximating the consumer to the producer.."*
>
> *"When the prices in the market are high, quality does not make a difference, and this can be the enemy in the search for quality on the farm."*

2.5.2 The Minas Gerais Atlantic Rain Forest Region

Results from the 1st round of discussion – general view of the coffee business in the Minas Gerais Atlantic Rain Forest region

The producers of this region are particularly worried with the commercialization of the product, the prices, absence of the local producers having a planning culture, and mid term and long term climate problems.

With regards to the commercialization, many point to the historical existence of middlemen in the region that induces a speculative behavior on the part of the producers more worried about the price short term than questions about quality. Many point out that the local producer is still not aware of what he produces and because of that is at the mercy of the middleman who determines the price which possibly could be better due to the superior quality of the product in the region.

There are local cooperatives; however, there is much distrust on the part of the producer, who is accustomed to having a relationship and trust with the broker and middleman, who also function as
Financiers without the formalities of the bank, using promissory notes.

> *The producer supports himself with who he knows and trusts, which in many cases helps finance the production without demanding anything in return except for* promissory notes*....it is instantaneous.*
>
> *The producer still discusses the price a lot and does not look to the future.*
>
> *It would be interesting if a larger number of producers had the cooperative spirit and not have a cooperative come and try to solve the problem and not be able to like what happened with the Cooparaiso Cooperative.*

In the last years there has been an approximation between traders buying directly from the producers, which the latter consider positive.

The producers still point to the high cost in maintaining the processing structure and due to this hope to sell the natural dried coffee in the future. Besides, they believe that the criteria for quality could be broader, going beyond the flavor to consider other physical aspects and sanitary production as well as food safety.

The critical factors regarding technology, management and quality are considered important, but have been incorporated in the daily routine of the properties. The producers say that there is a constant search for new technologies that decrease the dependence on

the use of labor, besides the adoption of alternatives to reduce the impact of climate change, as irrigation and planting trees. There is however, resistance in the adoption of new cultivars, due to cultural issues, and the belief in knowledge passed down from generation to generation.

Many stress the lack of preparation of the producer with regards to the planning of the property, be it pruning, financing, harvesting, or labor. Many are unaware of the cost of the plantation and that is why they prefer to negotiate with the brokers. They believe that for this kind of planning to be done more technical assistance is necessary, through EMATER (the Technical Assistance and Rural Extension Company), cooperatives and the Secretary of Agriculture. Besides, they believe that there should be a concern in qualifying local labor to work on the plantations through courses at SENAR (Rural Learning Service).

> *We need more technical assistance. The producer does not know how much he will harvest, how many people he will need to help him, no one here does any planning*
>
> *There is financing available but lack of planning on the part of the producers.*

The group added two more factors as being critical: a) climate problems and b) management of the rural property.

Results from the 2nd round of discussion – Vision of the future

The group of producers was optimistic about the future of the coffee business, giving credit to the success in the growth of special coffee consumption in Brazil and the world.

Even tough they mentioned being worried with the climate change and increasing costs in labor, these factors were not mentioned directly when they talked about the future. All of them said they were motivated to invest in new technologies that could overcome these and other limiting factors for the local coffee business. In both rounds the producers did not demonstrate real concerns that the activity might disappear or be concentrated in few properties, due to the rising costs of production in the mountains compared to other regions.

There is an understanding that it is possible to become equally competitive in the mountains and that the coffee produced in these regions can have more noble destinies, and therefore, have a more valued price than coffees of other regions. There is a perception that the market will value more and more the coffee form the mountain because of its singularity, for its family productions, for the history behind the bean, for the cultural characteristics and the geographical regions that can amplify local rural tourism.

> *The commercialization will be direct to attend specific niches, direct trade and the consumer market will come get the product here.... this already happens and tends to increase.*
>
> *The properties will be smaller and more technified and the family groups stronger with the administration of the second generation.*
>
> *(rural tourism)..is fantastic here, but the access and roads have to improve, the cities need to prepare themselves, the culture of the region.*

Management is the central concern with relation to the future of the coffee business. The producers believe they are not prepared to respond to the increasing complexity of the business, and that is why they believe that the presence of more organizations in the region that can act as tutors and propellers of modernization of the activity in the region is important. Because the children of the producers are leaving for the big cities, the producers believe they are a source of opportunity, as they will return bringing administrative, agricultural, environmental and technical knowledge. Improving the

competitiveness of the properties, and amplifying the possibilities of increasing the producers' income.

> *The children are looking for other alternatives...they want to earn more, this direct relation with the consumer, with the product, the profit will increase and the tendency is that the grandchildren will be interested in becoming agricultural engineers, environmental engineers, and they will modernize the property.*
>
> *The exporting companies will be closer to the producer, helping in the management, because they are part that is interested in the business.... to attend to the quality they demand.*
>
> *There will be more certifications; these will be pre-requisite; more cooperatives.*

2.5.3 The Southern Minas Gerais region

Results from the 1st round of discussion – general view of the coffee business the Southern Minas Gerais region

The producers of this region were particularly worried with labor, the increasing volatility of prices, making it difficult to manage the activity with the increase in the production costs of coffee in the mountains, the need to constantly invest in mechanization and in agricultural pesticides. Besides these factors mentioned by the study, the producers suggested other critical issues: the succession process in the rural properties; the need for leaders engaged in defending the coffee production at national and international organizations; and the diversification of the business as a way out for the constant oscillations in the coffee business.

Regarding the management of property, the producers were concerned with the mechanization options vis-a-vis the quality of the product. There is the belief that there is no preparation for the producer on how to use this mechanization and the consequences of the management of the product.

> *Mechanizing is not only buying the machine.... this is an important detail, but a detail. With it comes the nees to transport the coffee, and what was done in 3 months is done in 45 days, and changes the business culture a little.*
>
> *If you opt for quality there is a larger window for the harvest, differently from leaving the bean on the tree and using the machine.*
>
> *In the past all you had to do was plant and harvest. Today you have a series of variables like the management of labor, mechanization, sustainability, and environmental legislation. It is complex for management. To a certain extent it is treated like something that anyone can do.*

The absence of local leadership to defend the interests of the coffee producers was also a recurrent theme during the discussion. Added to this is the issue of labor that has become more costly when inexistent, because work on the farm is discriminated, even though nowadays one can earn more on the plantations than in the city.

> *The coffee business in a great number of municipalities is the principal economic activity and incredibly society gives the impression that they don't see the coffee activity with good eyes.*
>
> *There is discrimination.... It is historical. Working the land is second category.*

With regards to technological management, the producers mentioned excessive care, which has elevated the cost of production, but in counterpart has increased the productivity.

> *There is a lot of marketing and a lot insistence in buying pesticides from the agrichemical companies.*

Results from the 2nd round of discussion – Vision of the future

This group of producers was little optimistic about the future of coffee business in the region because of three main factors:

- The climate issue which has forced the retreat from planting coffee in the mountains;
- The volatility of prices along with a growing investment in mechanization, and high immobilization of capital, without the certainty of a return on investment.
- The strict regulation of the buying countries with regards to the MRLs (Maximum Residue Limits), the imposition of non-tarifary barriers that end up reducing the price, and at the same time practicing other conditions for competing countries like Ethiopia.

These issues have made producers rethink their succession, believing that it will be necessary to search for alternatives to diversify the business or even move to other regions.

> *There will be a redirection of the coffee business in southern Brazil, with the withdrawal of the coffee from the mountains because of mechanization issues...because of the exhaustion of labor.*
>
> *The region will have to search for alternatives, because with the withdrawal of coffee from the mountains, there will be an impoverishment of the region.*
>
> *My children will graduate in other things ....I told them they would have this (the farm) as an extra, and not to depend on the farm to live off of, because it is very insecure. One always needs to have capital.*
>
> *The entrepreneur that is rational doesn't enter the coffee business today.*

In this scenario the producers believe that in the future there will be two types of producers: the specialized producer and the service providers. The second are the owners of middle-size or large properties that have machines and inputs for the harvesting and processing of coffee that exceed the capacity of their own farms and due to this will sell their services to specialized producers in the coffee business. Besides the coffee producers, specialized companies will appear with this objective, once the machines are increasingly more expensive and it is not worth buying them.

They believe that coffee consumption will become more elitist, which opens an opportunity for the production of quality coffee. At the same time, the questions of food safety will become more relevant in the consumer markets, imposing a growing number on tariff barriers for Brazil. They believe that the sector should be concerned with the idea of the Brazilian coffee producer that is concerned and cares about nature.

2.5.4 General Vision and panel conclusions

The panels captured the existent diversity amongst the regions, and at the same time, similarities characteristic of the present stage of the coffee business in the country in function of the external to the property factors, like legislation, non-tariff barriers in the consumer countries, rise in labor cost, and need of mechanization for the growth in productivity and betterment in the quality of the bean.

Table 2 points to a summarized view of the panels in relation to each critical factor investigated. One can observe that the Minas Savannah presents a more modern coffee business with middle-size and large production units, which constantly search for productivity and quality in the beans. Besides, it is noticeable that there is a higher organization of the coffee producers to reach common aims as maximizing the seal of denomination of origin, by means of participating in international fairs to divulge the coffee of the region, as well as work alongside the roasting companies to adopt and divulge the Minas Savannah blend on the coffee packaging.

The Minas Gerais Atlantic Rain Forest region is represented by the force of the family agriculture and that of the sharecroppers. There is a strong appeal for sustainability certification, fair trade and carbon credit. International buyers in search of certified coffee of good quality have approached the producers. Nevertheless, these producers in their majority still recur to the traditional sales channels because they are unaware of the benefit other alternatives can generate or because they believe that the coffee produced does not attend the demands of these buyers. The region is characterized by little mechanization due to the topography, and also the rise in the processing cost due to maintenance cost and/or acquisition of more modern machinery. Few belong to associations, and there is still a lot of distrust in relation to the existing cooperatives.

The Southern Minas Gerais region has a majority of traditional coffee businesses mixed with more professionalized properties. All orbit around the main cooperatives of the region like Cooparaíso and Cooxupé that determine the quality of the coffee and exert great influence over the management of the plantation by technically indicating the use of pesticides and machinery. The cost of production is high for the majority, considering the expressive participating of labor on the plantations, and the dependent income of the standardized price established by the buyers.

Table 2. Producing regions and their characteristics in light of the critical factors.

Critical Factors	The Minas Gerais Savannah	The Minas Gerais Atlantic Rain Forest	Southern Minas Gerais
Technology and Management	Intense use of agricultural implements and modern management techniques	Minimal mechanization due to the topography of the region. High cost in processing for the small property and absence of crop management (pruning, harvesting, labor, costs, etc.)	Mixes mechanization in flat areas and little use of machinery in mountainous areas.
Labor	Uses qualified labor, with investment in training and differentiated payment	Intensive use sharecroppers and family labor.	Mixes mechanization and hired labor, which is still not too qualified.
Quality	Denomination of origin and coordinated efforts to market the coffee of the region.	The region is going through a certification process. The traditional middlemen have not considered the quality of the bean and thus have not taken advantage of this in commercialization.	Sold mainly to the cooperatives. The quality depends on the demands of the buyers of the cooperative.
Cost management and productivity	A growing number of producers who adopt modern instruments for cost and productivity management.	Traditional management by the local producers who are in the majority family nuclei. There is an absence of cooperatives and governmental agencies to give them support.	Adopted mainly by middle size and big properties, but still in simplified form. .
Financing	Access to official credit and alternative forms. .	Access to PRONAF –National Family Financing Agricultural Program and alternative forms. The challenge is the efficient allocation of resources.	Access to official credit and alternative forms.
Commercialization	Utilization of different sales channels (cooperatives, direct trade, export, etc....) including protection tools such as future contracts and derivatives.	Counts on the presence of the traditional middleman, but sees a growing participation in direct trade, sales to exporters and participation in competitions that aim at quality.	Sales mainly to local cooperatives, the major part being to the Coxupé Cooperative, and directing the special coffee to exporters or direct trade.
Sustainability	Adjustments that conflict with bureaucracy.	Few properties with sustainable certification and fair trade, but with a tendency to be adopted by the families.	Producers concerned in adjusting to the demands of the buyers. Lack of support from the cooperatives.
Legislation	Increasingly more important for the development of the activity- need for specialized support.	Increasingly more important for the development of the activity- need for specialized support	Increasingly more important for the development of the activity- need for specialized support

Source: Elaborated by the authors

2.6 CONCLUSION AND RECOMMENDATIONS

Aiming at deepening the knowledge on the future form of organization in the Brazilian coffee business, this study started analyzing the factors that outlined the present organizational format in the Brazilian coffee business to these days. Profound research was conducted with specialists and producers on the new drivers of change that have induced and will continue to influence the manner in which the properties, the producing regions and the coffee agribusiness chain will develop.

Despite the advanced in the complexity in the coffee farm management, the producer demonstrated optimism in the future of the activity, especially with the perception of gains in income, originated by the growth of coffee consumption around the world and in the national market, besides the growing adoption of quality coffee, which has proportioned higher income.

Concerning the organizational forms, the main change has been in the growing possibility of the polarization of the producing units. In other words, the gradual disappearance of the middle-sized properties giving space to large ones that are professionally organized and managed, and the small properties in their majority managed by families. The reason for the disappearance of the middle-size property is due to the structure of cost based on labor vis-a-vis the volatility of prices that incurs in tighter and tighter margins, despite using cost and productivity management. This scenario was found and discussed principally in the Minas Savannah and Southern Minas regions. The middle-sized property was characterized by being around 200 hectares with an average investment of R$13 thousand reais per hectare (around US$3.7 thousand/2016); therefore, with a working capital of R$ 2, 6 million reais (around, US750 thousand/2016), for a 15 month cycle, employing around 60 fixed workers plus another 180 at harvest time. Many of these properties are in the mountains. Some specialists project the sale of these properties with the substitution of reforesting activity.

Another important determining factor in the configuration of the productive units refers to the successory process of the small and middle-size properties, which in most cases, the successors are studying or working in the cities, and the rural activity has little appeal to these young people in detriment to the many existing possibilities in the urban scene.

Below are the main drivers of change that are considered important for the future of the Brazilian coffee business in the next 10, 20 years. These were extracted from the regularity of perceptions in the interviews with specialists and in the results obtained from the regional panel discussions. They are present demands as well as future expectations and uncertainties for the coffee business in the country.

Drivers of change

1. Increasing complexity in the activity

If 2 years ago the management of the coffee farm was based principally on optimizing factors of production to obtain the productivity, today and in the next 20, 30 years, other competences will be demanded that go beyond the spectrum of production. Producers will have to have strategic vision to manage all the aspects of the producing unit: insertion of technology in the planting, the harvesting and the processing; amplifying and perfecting mechanization; adoption of geoprocessing to identify the properties and consequently the final quality of the coffee produced; the adoption of more sophisticated forms of financing and the management of credit risk; management of the harvest sale; conformation with certifications and environmental legislation; labor legislation in the domestic and international markets; managing human resources; professionalizing management and adoption of a sucessory process.

2. *Succession in the rural property*

Succession is a driver of change that imposes an important challenge to all the participants in the coffee chain: who will be the successor of the present properties? According to FAO, the number of family framers in Brazil will reduce in the next 50 years in case it is not possible to revert the tendency of population decline of young people in the rural areas. In the Southern region, there was a decline of 48% of the rural population in the 70's. According to Biasi, migration is selective by age and gender - women and young people were the ones who most left the rural areas. (RuralBR, 2014)

Besides, in the middle-size and in the large properties, most of the successor cases are not planned, and only with the death of the founder does this concern surface. There has been more awareness on the part of producer of this aspect, as seen in the panels, but the main complaint is the lack of preparation and lack of knowledge of when and how to start this process.

Another point is the lack of attraction for young people, who see in the urban centers more career and leisure opportunities. So, another question arises: how to attract young people to the management of rural business? Many are uninformed about the coffee business and do not get involved, going to the cities in search of a job or career. There are those that even though they are interested, due to the growing complexity, need a period of trainning and need to be accompanied in order to understand all the nuances of the business.

Whether through planned succession, or the return of the university graduate to the property, or through the professionalization of the property, it is priority for the producers as well as the agribusiness coffee companies to discuss the future management of the productive unit.

3. *Amplification of mechanization*

The growing difficulty to find qualified labor for the coffee plantation associated with the rise in costs to hire and maintain workers in the activities on the coffee farm, have led producers to amplify the level of mechanization of their plantations. Mechanization helps reduce the problem but does not extinguish it.

The reports of the producers mention some of the problems that occur with the change to mechanization. Many are not prepared and need support and technical assistance to conduct the process to optimize the financial resources and the production factors involved. Many report the lack of support for this change from the dealers that sell the machinery as well as the cooperatives. There is also the questions on how the bean will be affected positively or negatively by the machinery. For some of those interviewed, there are many producers that buy the machines without knowing the impact on the entire productive process.

Therefore, there is the need to involve the companies that produce the machinery, the technical assistance organisms, the cooperatives and the coffee producers for a more ample discussion on the mechanization alternatives, adjusting these to the reality of the size of the properties, regions, and guiding the producer to make better use of this resource in favor of the productivity and quality of the coffee.

4. *Growing use of pesticides*

The growing use of pesticides contrasted with the growth in phytosanitary demands of the consumer markets has imposed a positive and urgent agenda for the agents in the agribusiness coffee chain. There is a need for a joint effort to understand the impact of pesticides on the environment to be prepared for the demands, by refuting

them or adopting them depending on the justification presented and debated by all in the chain, becoming protagonist in this change.

In the producers' discourse as well as in the specialists' discourse, this issue is not being approached nor being given the importance of its impact on all the coffee chain. Therefore, there is a need of a movement for more awareness of this theme and the impacts on the production and commercialization of the coffee crop.

5. *Climate change*

This *driver* has been a critical factor not only the coffee chain, but for many other ones. The theme will be a focal point for many players in the next years, especially with the unpredictability of the climate, which will make the crops more vulnerable and therefore, the market more volatile. The risks associated to the coffee business in certain regions will grow from harvest to harvest. Nevertheless, this does not seem to be a factor of concern today for the producers, but it is necessary to make them aware and to prepare them for the challenges that will need to be overcome with the management of climatic risks.

6. *Consumer behavior*

The present and future demands of buyers, define how the productive units will have to organize themselves. In the last years, there has been a growing increase in quality coffee in the world, along with a growing awareness of the consumer about the producing countries, the differences in blends, the production and their peculiarities. This has provoked a bigger concern of the coffee producer to be closer to this public to attend to their demands.

More recently, another tendency has been a driver of change: the growing consumption of coffee in the coffee producing countries. Besides the growth of consumption in general, the consumption of more sophisticated products has increased, like the mono doses, gourmet coffees and consumption at specialized coffee stores. According to ICO- International Coffee Organization (2014) the consumption in the coffee producing countries is growing twice as quickly as that in importing countries like the USA and Italy. The internal market of producing countries like Brazil, Colombia and Vietnam, are consuming better quality coffee thanks to the increase in the e buying power of its population. This scenario opens many opportunities to the coffee producers and coffee industry.

It is important to observe the change in consumer behavior to assure the future of the business, anticipating the competitors to better attend your target public.

7. *Risk Management in the coffee business*

The dimensioning of risks associated with the coffee business should have a special role in the conduction of the business in the years to come. If before the concern with the productive unit was on the production factors, this vision today and for the future is nearsighted. It is necessary to think beyond the plantation, incorporating the management of elements that minimize risk and that impact directly on the future of the properties, such as: I) the adoption of technology
in all processes, from planting to the processing of coffee; ii) Commercial planning with adoption of future contracts, barter operations, use of rural bank loans to protect income, beside the use of secondary market instruments for income protection like option contracts; iii) professionalized management with the adoption of software to consolidate data and produce management reports to accompany the day by day of the business; iv) adoption of modern policies based on meritocracy for the management of people, retaining workers vis-a-vis involving them and generating more interest in the

business and consequently qualifying labor; v) approximating the productive unit to the center of knowledge, either through cooperatives, governmental organizations, or industry in order to increase the effective exchange of tacit knowledge and the advancements in academia, generating critical mass to advance in the most diverse aspect of the coffee business management; vi) developing a leadership in the sector to advanced in defense of the common interests of all players, specially to amplify the competitiveness in the Brazilian coffee business against international competitors.

This last driver is, in its essence, a catalyst of all the previous ones, demonstrating the importance of incorporating management aligned with future challenges that have been pointed out by those interviewed. In this sense, the management of the coffee business should advanced to modernization, for another jump as was registered at the beginning of this paper, culminating in new organizational formats, to be prepared for the panorama of changes presented here within.

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3 RISK ASSESSMENT FOR PESTICIDE CONTAMINATION OF COFFEE

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EXECUTIVE SUMMARY

This report presents a panorama of the regulatory aspects and the technological contamination risks of coffee with pesticides. Regarding the regulation of sanitary surveillance, contamination of an agricultural product is defined by the presence of a determined active ingredient of a registered pesticide by the regulatory body above the maximum limit of MRL residues. This indicator measures the ingredient in milligrams per kilo of food and indicates its safety for consumption according to the toxicity of the ingredient. For forbidden ingredients, the contamination occurs at any detected level.

Throughout the years the MRL regulation of active ingredients for coffee has been modified in Brazil and in importing countries. In the export transactions, if the MRL of the ingredient in Brazil is superior to that of the importing country, there is the risk of coffee lots being rejected if contamination is detected. This situation provokes an interruption in the supply chain of companies like Illy Coffee, that imports the coffee beans from Brazil for roasting, milling, packing at their installations in Italy and later global distribution. That is why having information on the risk of contamination is relevant for the company. This helps them guide producers in the best practices and in the choice of pesticides.

The aim of this research is to analyze the regulatory and technological aspects of the risk of contamination by pesticides of the coffee produced in Brazil. The specific aims are: (1) analyze the relevant regulatory aspects involving the laws, regulations and the role of public agencies in Brazil and abroad; and (2) analyze the technological issues involving the main pests, available pesticides and those still to come to Brazil

The methodology involved 2 stages, the first being documental research and the second interviews with specialists to obtain the information that would permit a detailed qualitative analysis. The documental research dealt with norms and regulations related to the sanitary surveillance in Brazil and in some importing countries, as well as articles from specialized publications in Economics, Business and in the Coffee sector. The research with specialist involved 5 phases: (1) finding contacts of specialists, considering researchers and businessmen, (2) elaboration of a questionnaire based on the documental research, (3) a letter of presentation and the questionnaire sent via email, (4) setting up interviews based on the questionnaire, and (5) analysis of the results of the interviews and those received by email. From the twenty-five initial contacts, eight interviews were conducted.

Below are the regulatory systems of Brazil, the Multilateral Codex Alimentarius agreement integrated by Brazil, the European Union, the United States and Japan. In Brazil, pesticides are registered by three bodies with distinct competences: ANVISA, The Federal Agency of Sanitary Surveillance, connected to the Ministry of Health; IBAMA, Brazilian Institute for Environmental and Renewable Natural Resources, connected to the Ministry of Environment; and MAPA, Ministry of Agriculture, Livestock and Supply.

In this registration system, it is up to MAPA to evaluate the agricultural efficiency of the pesticides in the production, storage and processing sectors of agricultural products, in the planted forest and pastures. It is up to the Ministry of Health, via ANVISA, to evaluate and classify the pesticides toxicologically. The Ministry of Environment is responsible for evaluating the environment impact of pesticides, establishing their classification with regards to their danger in the environment.

The Program for the Analysis of Pesticide Residues in Food (PARA) of The Federal Agency of Sanitary Surveillance (ANVISA) was created in 2001 as a Project aiming at structuring a service to evaluate and promote the quality of food in relation to the use of pesticides. In 2003, the project was transformed into a program, which developed annually under the National System of Sanitary Surveillance.

In MAPA's (Ministry of Agriculture, Livestock and Supply) scope, the National Plan for the Control of Residues and Contaminants (PNCRC) is a federal program that inspects and oversees the productive food chains, based on a risk analysis, that aims at monitoring the effectiveness of the controls implemented by the producing systems and the respective quality and security of products of animal and vegetal origin available on the market and for consumption. This official monitoring is done by means of verifying the presence and the levels of residues of chemical substances that are potentially harmful to the consumer's health. These are residues of veterinary products, pesticides and other contaminants as aflatoxins, heavy metals, inorganic contaminants, dioxenes amongst others. Coffee is part of the products the PNCRC-Vegetal evaluates.

Codex Alimentarius is an international forum for the standardization of food trade established by the United Nations (UN), in an act of the FAO and the WHO. Created in 1963, the forum aims to protect the health of consumers and assure equitable practices in regional and international food trade. The CODEX standards cover the main processed, semi-processed or raw food. It also deals with the substances and products used to produce food.

Their guidelines refer to hygienic aspects and the nutritional properties of food, ranging from the code of practice to the standards in food additives, pesticides, residues of veterinary medication, contaminating substances, labeling, classifying, sampling methods and risk analysis.

In the European Union, there is a regulation of the European Parliament and from the European Council that establishes the principles and general standards in the food regulation, which applies to the stages of production, processing and distribution of food and feed. Importers of food and feed should be capable of identifying and recommending the provider for export of the country of origin that can satisfy the traceability demands. The European Safety Authority (EFSA) provides the European Commission independent scientific advice on all issues that have direct or indirect influence on food safety

For the present regulation, the MRLs should be continually monitored and altered taking into account new data. The MRLs should be fixed at the lowest level of analytical determination in the cases where the use of authorized vegetal protection products do not result in detectable levels of pesticide residues.

For uses still not authorized by the European Union the MRLs should be fixed at a level appropriately low to protect the consumption of excessive pesticide residues. To help this control, the standard of 0.01 mg / kg value was established as the level of residue in products for which there are no established limits.

In the United States, the pesticide regulation is done by three federal agencies. The first is the EPA, *Environmental Protection Agency* that approves and records the use of pesticides and establishes the tolerance levels of residues in food. The second is the FDA, *Food and Drug Administration,* who is responsible for applying and controlling the limits for imported and local foods commercialized between states. The exception to this rule is beef, poultry and some products derived from eggs that are the

responsibility of the FSIS, *Food Safety and Inspection Service.* The third agency involved is the AMS, *Agricultural Marketing Service* under the USDA, *and U.S. Department of Agriculture.* They have conducted the Pesticide Data Program (PDP) since 1991, which tests the residues of pesticides. This program is directed to raw agricultural raw materials and several processed foods, which is made possible through contracts with the states for sampling and analysis. FSIS and AMS report their data on pesticide residues independently.

In Japan, the regulatory system for health security of food consists of three regulations. The first is the Plant Protection Law, which refers to the sanitary quarantine of imported plants, which includes vegetables, fruit, grains, flowers and seeds. The executive organ of this regulation is the Plant Protection Station (PPS), under the Ministry of Agriculture, Forestry and Fisheries (MAFF). The second law is the Livestock Epidemic Prevention Law that deal with the quarantine for animal products and includes live animals. The executive institution for this law is the Animal Quarantine Service (AQS) under the MAFF. The third law is the Food Sanitation Law: sanity of all foods in the domestic market that regulates the sanitation of all foods that circulate in the domestic market, and also imported food. The executive institution is the *FSQS – Food Sanitary Quarantine Station* under the *MHLW – Ministry of Health, Labor and Welfare.* The Japan Food Chemical Research Foundation defines the MRLs.

Next, the paper discusses the technological aspects of pesticide contamination risks, involving the main pests and diseases, the active ingredients adopted and the contamination risks due to MLR issues. The main pests and diseases that affect coffee are related to the presence of weeds, insects, funguses, bacteria and nematodes. Weeds are controlled with post-emergence herbicides, mainly Glyphosate. An insect, specially the Stem borer (Hypothenemus hampei Ferrari), is one of the main pests that affect the Brazilian coffee production. The Stem borer is a beetle, whose female lays eggs that become larvae that eats the coffee berry, and provokes its loss in weight and quality. It can be controlled with pesticides that contain Endosulfan, which has been largely used since the 70s. However, since August 2014, Brazil has forbidden the sale of this product due to recent evidence of toxicity.

The main diseases provoked by funguses are rust, cercospora leaf spot or "brown eye" and, phoma leaf spot. Rust is caused by *Hemileia vastatrix,* which has been present in Brazil since 1970. This disease is still an important economic problem, demanding constant control measures to avoid damage and loss in the coffee production. Furthermore, the chemical control elevates the costs of production. The disease continues to evolve, either through the emergence of new lineages of the fungus that make it difficult to control the loss of genetic material of the coffee trees, or a broader tolerance to fungicides, reducing the efficiency of chemical control demanding new solutions.

Cercospora leaf spot or "brown eye" is one of the oldest diseases of coffee trees caused by *Cescospora coffeicola.* It attacks the fruit and leaves, causing the loss of productivity, also affecting the quality and type of coffee produced. It can appear due to nutritional deficiency, excess of isolation and drop in temperature. The Phoma leaf spot, caused by the fungus *Phoma spp,* is considered a disease relevant to the coffee tree, because of the significant damages to coffee production. The Phoma fungus attacks the leaves, the flowers, the berry and the coffee branches, producing characteristic lesions. As a consequence, production is affected, because the berry falls, and the flowers die.

The Haloed spot, is caused by the bacteria *Pseudomonas syringae.* It is a disease that causes damage to coffee trees in colder regions, situated in the southern states of Paraná and São Paulo. In the last years however, the Haloed spot became a serious problem in the Triangulo/Alto Paranaíba coffee region and in the south of Minas Gerais State, and in the high altitude region of Zona da Mata in the State of Minas Gerais. As the symptoms of the disease can be confused with those provoked by other funguses such as the

Phoma/Ascochyta and the Colletotrichum, it has been observed that in some cases the incorrect use of products was recommended.

The nematodes cause great damages to the coffee plantations in Brazil depending on the species and the type of soil. The visualization of these parasites is only possible via microscope, which makes it difficult for producers and technicians to identify. Six Meloidogyne species occur in the Brazilian coffee plantations. *Meloidogyne exigua* being the most disseminated, especially in the older plantations in the Southern part of Minas Gerais State. Its presence can be verified by the visual presence of nodules in the root system, known as galls, which burst to liberate the eggs, rotting this part of the root system. The species *Meloidogyne paranaenses* is extremely damaging to the coffee tree and may cause its death.

Next the paper presents the results of four research studies with specialists and the recommendation to the agents in the productive coffee chain.

1) What is the present regulatory situation of sanitary surveillance of pesticides for coffee in Brazil in the next stages?

a. Registering pesticides

- Increase professionalization in the responsible technical organizations.
- Provide more rigors in the evaluation of products, approximating the kinds of operation and prohibition of products in developed countries.
- Perceive the deficiencies in the structure for operation, considering the availability of specialized technicians, equipment and financial resources.
- Unpredictable Performance of the Public Ministry, questioning the evaluation processes and the great disparity amongst public prosecutors in each region.
- The slow process to evaluate the requests for registration, with more costs and delay in the availability of innovations to the producers.
- There is the need to develop a centralized division at MAPA (Ministry of Agriculture, Livestock and Supply) to take care of these processes.

b. Use of pesticides by the producer.

- Indication of the responsibility of the Labor Ministry
- Lack of federal government employees to monitor the producers.
- Higher risks related to the contamination of the producers in comparison to contamination of coffee,
- The growing adherence of producers to the various private socio-environmental certifications contributing to the adoption of Best Agricultural Practices, partially suppressing the enforcement deficiencies in the public sector.
- Professionals, who often do not have technical background or ethics, besiege the coffee producer. Thus, in regions where the cooperative system is not consolidated, there is inadequate use of pesticides.

c. Residue control of pesticides on harvested coffee

- PARA program (Program for the Analysis of Pesticide residues in Food) under ANVISA (the Federal Agency of Sanitary Surveillance) is in expansion of which respondents knew little about it.
- PNCRC-Vegetal (National Plan for the control of Residues and Contaminants) under MAPA, was well evaluated by the respondents that knew it.
- The programs are able to collect representative samples, from a variety of product, geographically ample and expressive.
- Up to now no inconformity in pesticide residues was found in coffee for internal consumption.
- When coffee is exported, samples are taken for analysis regarding the main

pesticides. If the analysis has any inconformity with the legislation of the importing country, this coffee does not leave the country. The importing country also analyses residues before deciding if it can entre the country or not.

2) *What is the present sanitary surveillance of pesticides regulation for coffee in the major importing countries? Indicate a country with the largest difficulties to abide to the maximum limits of residues of Brazilian exporters.*
   - Japan is considered the country with the most rigors in the definition of limits of residues and control of imported products. It has a regulatory system made up of many bodies, which are operated very efficiently.
   - The European Union comes in second place in terms of strict limits on residues. The adoption of a MRL in 0,01 as the standard for any active ingredient can create problems for the importation of Brazilian coffee. This value of maximum limit can increase with the scientific studies, but it is not always available for all active ingredients. The criteria for banning or restricting the use of pesticides have been more political than scientific.
   - The United States presents more permissiveness for the use of agrochemicals, as it follows the list of ingredients in the Codex Alimentarius, which has a smaller quantity of products and MRLs superior to those adopted in Japan and the European Union, in many cases.
3) *What are the active ingredients that have the highest contamination risk for coffee according to the MRLs in Brazil? Please indicate the class of product (herbicide, pesticides, fungicides and nematode control)*
   - Endosulfan (pesticides): forbidden product that can still be used and found in clandestine stocks.
   - Triazoles (fungicide): risk in excessive use to combat various diseases caused by funguses.
4) *What are the active ingredients with the highest contamination risk for coffee according to the MRLs abroad? Please indicate the class of product (herbicide, pesticide, fungicide and nematode control) and the countries that will reject the product.*
   - The active ingredients with the highest risk of causing problems regarding the MRLs of importing countries are those whose use is regulated in Brazil and which have restricted use or are banned by importing countries.
     - Carbofuran, terbufos, cadusafos (nematicides);
     - Paraquat (herbicide);
     - Triazoles (pesticide);
     - Triazoles (fungicide).
     - Endosulfan (pesticide): forbidden product that can still be used and found in clandestine stocks.
     - Glyphosate (herbicide): increasing control in residues in the European Union.
     - Dichlorvos (pesticide): forbidden in Japan.
     - Pyraclostrobin (fungicide): restricted in Japan.
     - Flutriafol: restricted in Japan
5) *What are the agrochemicals or technological packages in development that can increase or decrease the contamination risks of coffee in relation to the current situation in the same class of products? Please indicate the class of products.*
   - 2-4 D (herbicide): although not an (radical) innovation, development of Enlist package product at Dow Agrosciences aims to reduce toxicity compared to current solutions.
   - The development of insecticides against Helicoverpa caterpillar is still awaited.

Below are the final considerations of this paper.

- The institutional environment for health monitoring seems to be rationally structured, with the participation of the Ministry of Agriculture and Supply, Ministry of Health and Ministry of Environment.
- The legislation has been adequately constructed considering the comparisons with the more developed importing countries.
- In the registration stage of agrochemicals, the attributions of each body are clearly defined and obey an acceptable rationale. However, there are deficiencies in the operation of the functions provided by the legislation, mainly the lack of human, material and financial resources. Therefore, the evaluation processes and the approval of agrochemicals are slow, causing loss to the producers and lack of innovative products.
- In the agrochemical use stage, deficiencies in the inspection of public bodies that need to minimize the inadequate use of these products were identified.
- The institutional environment in the importing countries are challenging to the Brazilian coffee producers, especially in the European Union and Japan. In the European Union the MRLs have become more restricted. A peculiarity is the adoption of a 0,01 mg/kg initial standard limit for all products that can be flexibilized with scientific studies that prove the absence of risks for higher levels. Some respondents alleged a political use of these limits as a non-tariff barrier of Brazilian products.
- In Japan, the regulatory system is quite complex, but is operated very efficiently. They also practice restrictive MRLs. Apparently there are historical reasons for this behavior, which is recurrent from contamination problems in the past from products imported from China. The recent case of the prohibition of Brazilian products was resolved with diplomatic negotiations, which reveals itself as a future solution, especially as often times the limits are established restrictively without the existence of scientific evidence.
- The coffee business has the challenge to guarantee the sanitary health of the plantations and the security of the final product due to the quantity of diseases and pests present in Brazil. In the report identifies the main diseases caused by insects, funguses, bacteria and nematodes. The variety of climate, soil and management in different regions increases the complexity for elaborating recommendations on better agricultural practices related to the use of agrochemicals.

Below are the recommendations for the customer.

- Create internal mechanisms to accompany the MRLs in the major importing countries.
- Elaborate policies and routines to transfer the information collected on the eventual changes in the MRLs to present and potential suppliers.
- Create training programs on good agricultural practices for supplier producers in Brazil, due to the deficiencies identified in this field.
- Introduce the debate in organizations in the international private sector interested in the issue of maximum residue limits in the European Union, focusing on the existence of established levels without scientific evidence, in order to develop coordinated strategies to influence the change of these limits.

3.1 INTRODUCTION

The use of agrochemicals in Brazil no Brazil has increased in the last decades. The survey of the National Union for the Agrochemical Industry indicates that the national market in 2013 reached US$ 11,45 billion, 18% above US$ 9,71 billion in 2012. The result reinforces the leadership Brazil conquered in the global market, ahead of the US$ 8 billion in the EUA in 2013. For coffee, the expenditures with agrochemicals reached US$ 293 million in 2013, a 14% fall in relation to the previous year. (Caetano, 2014b). This movement is part of the intensification of the use of technological inputs, sowing and agricultural management that contributes to the rise in agricultural productivity observed in the Brazilian agribusiness. However, the use of agrochemicals can be associated to contamination risk of foods like coffee, which is the focus of this research.

According to sanitary surveillance regulation, contamination of an agricultural product is defined by the presence of a determined active agrochemical ingredient above the MRLs registered by the regulatory body. This indicator is measured in milligrams of the ingredient per kilogram of the food and indicates a safe level for the consumption according to the toxicity of the ingredient. For ingredients forbidden by the regulatory body, contamination is if products reveal any level.

Throughout the years the regulation of the MRLs of active ingredients for coffee have been modified in Brazil and importing countries. In the export transaction, if the MLRs of the ingredient in Brazil are superior to that of the importing country, there is a risk of rejection of lots if contamination is detected. This situation provokes an interruption in the supply chain of companies like Illy Cafè that imports coffee beans from Brazil for roasting, milling, and packaging at their factories in Italy for future global distribution. Thus, it is relevant for this company to get information on the contamination risks to guide the supplier producers in the best practices in relation to the choice of agrochemicals.

This paper is divided into four sections, which include the introduction. The second section discusses the institutional environment, with the presentation of regulations, public bodies and policies related to the registration of agrochemicals and the control of residues in food in Brazil and for some coffee importing countries. The third section analyses the technological environment with the description of the main pests, diseases and forms of control in coffee, like the contamination risks for the principle registered products and the MRLs in Brazil and abroad. The fourth and last section presents the final considerations that include recommendations of policies for the client directed to the institutional and technological aspects in the agrochemical segment for coffee.

3.1.1 Aims

The aim of this research is to analyze the contamination risks by agrochemicals in the coffee produced in Brazil, considering the regulatory and technological aspects involved. The specific aims are: (1) analyze the relevant regulatory aspects, involving the laws, norms and role of the public Brazilian bodies and those abroad; (2) analyze the relevant technological aspects involving the principle pests and available agrochemicals and those to come in Brazil.

3.1.2 Methodology

The methodology involved two stages, the first a documental research and the second interview with specialists to obtain information that allows a detailed qualitative analysis of the theme. The documental research treats the norms and regulations related to the sanitary surveillance in Brazil and in some importing countries, as well as articles in specialized economic, business and coffee sector publications. The interviews were conducted by university researchers and research with related to the subject, companies and regulatory bodies.

The research with specialists involved the following stages: (1) identification and search for contacts with coffee specialists such as researchers, and company professionals, (2) elaboration of a questionnaire based on the documental research, (3) letters about the project with the questionnaires via email, (4) making appointments for the interviews based on the questionnaires that had been mail out, and (5) tabling and analysis of the results of the interviews.

The topics treated in the questionnaire were: (1) present situation of sanitary surveillance for coffee in Brazil, for the registering, use and control of agrochemical contamination, (2) present situation of sanitary surveillance for coffee for the main importing countries, (3) active ingredients with higher contamination risk based on Brazilian regulation, (4) active ingredients with higher contamination risk based on the regulation of importer countries and (5) agrochemicals being developed that can alter the risks of contamination.

3.2 INSTITUTIONAL ENVIRONMENT FOR AGROCHEMICALS

This section presents the principal characteristics of institutional environment for regulation of agrochemicals in Brazil and some relevant importing countries. The paper presents how the registration of activities for the use and the control of agrochemical residues works, describing the laws and the public bodies that are involved.

3.2.1 Sanitary Surveillance in Brazil

According to the 1st article in Law 9.782, January 26, 1999: " The Federal Agency of Sanitary Surveillance comprehends a group of actions defined by the 1st paragraph of the 6th article and by the 15th to 18th articles in Law 8.080, September 19, 1990, executed directly or indirectly by the public Administration Institutions of the Union, the States and the Federal District and the Municipalities, that exert regulatory activities in the area of sanitary surveillance." (ANVISA, 2013).

The Health Ministry, the Federal Agency of Sanitary Surveillance (ANVISA), The National Health Council, The National Council for the State Secretaries of Health, the National Council for the Municipal Secretaries of Health, The State Sanitary Surveillance Centers, The Federal District and Municipalities, The Central Public Health Laboratories, The Oswaldo Cruz Foundation and the State, District and Municipal Health Councils, are all participants of the sanitary surveillance actions that include the monitoring and control of substances that represent health risks. (ANVISA, 2013).

3.2.1.1 The Registering System of Agrochemicals

The Agrochemical Law number 7.802, July 11, 1989, establishes that agrochemicals can only be used in a country if they are registered at a competent federal body, according to the directives and demands of the bodies responsible for the health, environmental and agricultural sectors. Regarding this, the decree number 4.074, January 04, 2002, which regulated the law, establishes the competences for the three agencies involved in the registration: ANVISA (The Federal Agency of Sanitary Surveillance), connected to the Ministry of Health; IBAMA (Brazilian Institute for Environment and Renewable Natural Resources), connected to the Ministry of Environment; and MAPA (Ministry of Agriculture, Livestock and Supply). (ANVISA, 2013)

To request the registration of a new agrochemical, the company has to submit studies that prove the efficiency and safety of the product to the three agencies. These studies are conceived and conducted by laboratories the company hires. The agencies just evaluate the studies, comparing them to other ones published in scientific literature. (Morya, 2013)

In this registration system MAPA (Ministry of Agriculture, Livestock and Supply) "evaluates the agronomic efficiency of the agrochemicals for their use in the production, stocking and processing of agricultural products." The Ministry of Health, through ANVISA

(The Federal Agency of Sanitary Surveillance), evaluates and classifies the agrochemicals toxicity. The Ministry of Environment is responsible for " evaluating the environmental effects of agrochemicals and their components, establishing their classification as to their potential environmental danger." (Brazil, 2002)

The results of the toxicological studies by ANVISA (The Federal Agency of Sanitary Surveillance) are used to calculate the safety parameter that consists in the Acceptable Daily Ingestion (ADI) of each active ingredient (AI). According to the Decree 3, January 16, 1992, the Acceptable Daily Ingestion (ADI) is the maximum quantity that, if ingested daily for ones life, appears to not offer any important risks to ones health, in light of present knowledge. It is stated in mailgrams of the agrochemical per kilogram of body weight (mg/kg b..). Agricultural crops are included in the registration of an agrochemical based on studies of residues in the field, conducted according to the Best Agricultural Practices (BAP)

Based on the analysis of these studies, ANVISA (The Federal Agency of Sanitary Surveillance) establishes the MRLs and the Security Interval. The MRL is established by means of an evaluation of studies conducted in the fields by those requesting the registration or to alter a post-registration. They analyze the concentration of residues that remain on the crops after the agrochemicals were applied, respecting the Best Agricultural Practices (BAP)

According to the Decree 3, January 16, 1992, the security interval is the interval of time between the last application of the agrochemical and the harvesting or commercialization. For the cases of post-harvest treatment, the time interval between the last application and commercialization will be considered. (ANVISA, 2013)

ANVISA, jointly with MAPA, is also in charge of monitoring the residues of these products in foods of vegetable origin. For the toxicological evaluation for the registration of agrochemicals ANVISA also calculates the Maximum Theoretical Daily Intake (MTDI), defined by the quotient: sum of the products of medium consumption per capita daily in each food and the respective MRL/ body weight (Equation 1.1)

$$MTDI = \frac{\sum(MRL \times food\ consumption)}{Body\ weight} \quad (1.1)$$

The MRLs established for an agrochemical for various crops are considered safe for the consumer's health when the MTDI does not surpass the ADI (WHO, 1999). In other words, the MTDI estimates the maximum quantity of agrochemicals in foods that theoretically an individual could ingest daily. The refinement of the calculation of the ingestion of agrochemical residues can be conducted when the data of the residues obtained by the programs that monitor the foods substitutes the MRL (WHO, 2005)

According to the 2nd Article, sub-section VI, in Decree nº 4.074/02, it is the three Ministries responsibility, in their respective areas of competence, to re-evaluate the registration of agrochemicals, and their components (1) when new information appears that indicates the need of a revision of the conditions to use them and does not recommend the use of registered products; (2) when the country is alerted by international organizations responsible for the health, food or environment, to which Brazil is a member or signatory of agreements; (3) or when any substance is banned or suffers restrictions of use in other countries.

ANVISA re-evaluates the agrochemicals that fit these cases, adopting pertinent measures in function of the product and its adverse effects decurrent of dietary and occupational exposure. Below are the active ingredients banned in the country decurrent of re-evaluation processes: benomyl, heptachlor,

monocrotophos, lindane, pentachlorophenol, trichlorfon, cyexatine, endosulfan and methamidophos, and others as captan, folpet, carbendazim, chlorpiriphos, metaldehyd e phosmet, whose use has been restricted. (ANVISA, 2013).

3.2.1.2 The Program for the Analysis of Pesticide Residues in Food

The Program for the Analysis of Pesticide Residues in Food (PARA) of ANVISA was created in 2001 as a project aimed at structuring a service to evaluate and promote the quality of foods in relation to the use of agrochemicals. In 2003, the project became a Program, through the Resolution of the Collegiate Direction - RDC 119/03, which annually was developed under the National Sanitary Surveillance System. (SNVS).

PARA (Program for the Analysis of Pesticide Residues in Food) is aimed at verifying if the commercialized retail foods' agrotoxic residue levels are in accordance to the MRLs established by ANVISA and publish a specific monograph for each agrochemical. They also check if the agrochemicals used are registered and if they have been used only on crops for which they have been authorized. (ANVISA, 2013)

The annual reports of the Program have constituted one of the main indicators of food quality acquired in the retail market, consumed by the population. Amongst the actions developed by the participants of the National Sanitary Surveillance System, the educational measures for the use of agrochemicals according to the Best Agricultural Practices (BAP) stand out. The presentation and discussion of results with representatives of the retail market, whose food distribution chain is stimulated to exert a stronger control of quality and traceability of the foods to the producer; and the articulation, at the federal and state levels, amongst the different actors involved in the production, consumption and control of the pesticides (ANVISA, 2013)

The results permit refining the evaluation of the exposure of the pesticide residues present in foods and subsidizing the re-evaluation of active ingredients for the decision making on the restriction and banning of dangerous pesticides for the health. Additionally, the results stimulate research on the impact of pesticides on health.

In the divulging of results, the Program recommends that consumers acquire certified foods which are traceable to the rural producers, and that they in turn adopt the Best Agricultural Practices (BAP) aiming at reducing the ingestion of agrochemical residues and preventing health damages caused by these substances (ANVISA, 2013)

The food samples collected by the Sanitary Surveillance (State and Municipal) are in accordance with the accepted international principals and guidelines like the *Codex Alimentarius.* This document recommends that the samples be collected where the population buys the food, so as to obtain samples that have similar characteristics of the food to be consumed. Therefore, the sampling is done weekly in the retail market, such as supermarkets and produce markets, following a program that involves previous selection of collecting spots and the samples that will be collected (ANVISA, 2013).

The choice of foods that are monitored by PARA, is based on consumption data obtained by POF (Research on Family Budgets), the availability of foods at the supermarkets in various states of Brazil and in the use of pesticides on the crops the chronogram sample is approved previously during the national meetings of the Program. Until 2010, PARA monitored 20 crops: pineapple, lettuce, rice, banana, potato, beat, onion, carrot, kale, bean, orange, apple, papaya, mango, strawberry, cucumber, pepper, cabbage, tomato and grape. In the period from 2012 to 2015, 25 crops will be monitored. Two new crops were monitored in 2012: zucchini and corn meal (ANVISA, 2013).

Following is the analysis in the distribution of the pesticide residues in the 1.628 samples analyzed in 2011. It was noted that 64% of the samples monitored were considered satisfactory with regards to active ingredients

researched, being that in 22% no residues were detected and 42% presented residues within the established MRLs. Of the monitored samples, 36% were considered unsatisfactory, with the following irregularities:

- presence of pesticides in levels above the MRLs in 38 samples, corresponding to 2,3% of the total;
- presence of unauthorized pesticides (UP) for the crop in 520 samples, corresponding to 32% of the total;
- residues above the MRL and unauthorized pesticides (UP) simultaneously in 31 samples, corresponding to 1,9% of the total (ANVISA, 2013).

3.2.1.3 National Plan for the Control of Residues and Contaminants

Under MAPA (Ministry of Agriculture, Livestock and Supply), the National Plan for the control of Residues and Contaminants (PNCRC) is a federal program that inspects and monitors the productive food chains based on a risk analysis, that aims at monitoring the effectiveness of the controls implemented by the production systems and the respective quality and security in the products of animal and vegetable origin available on the market for consumption. This official monitoring is done through verifying the presence and the levels of residues of chemical substances potentially hazardous to the consumer's health, such as veterinary products, pesticides or other chemical contaminants such as (aflotoxines, heavy metals, inorganic contaminants, dioxine amongst others). Its principal aims are:

1. Verify and evaluate the Best Agricultural Practices (BAP), the Best Production Practices (BPF), the best practices in stoking and other self-controls in the stages of the agrifood chain ;
2. Verify the quality factors and the hygiene-sanitary security of the products of animal and vegetable origin, their subproducts and by-products of imported economic value.
3. Furnish guarantees of a system that provides security and the innocuousness of the foods available to consumers and that it be equivalent to the international sanitary requisites
   Established by MERCOSUL, CODEX, OMC, and auxiliary bodies (FAO, OIE, WHO) (Brazil, 2008).

Within MAPA Ministry of Agriculture, Livestock and Supply, the Secretary of Agricultural and Livestock Monitoring (SDA) houses in its structure the Coordination of Residues and Contaminants (CRC), which is responsible for coordinating the actions to guarantee the quality and chemical security in the products of vegetable origin, by means of sampling and laboratory analysis, with the collaboration of other sectors of the SDA, like the Department of Inspection of Products of Vegetable Origin (DIPOV), the Department of Monitoring Agricultural Inputs (DFIA) and General Coordination for Laboratorial Support (CGAL). The directives, programs, work plans and corresponding actions are in the National Plan for the Control of Residues and Contaminants in Products of Vegetable Origin (PNCRC/Vegetal), instituted by the Normative Instruction SDA (Secretary of Agricultural and Livestock Monitoring) number 42, December 31, 2008 (Brazil, 2008).

The National Plan for the Control of Residues and Contaminants in Products of Vegetable Origin (PNCRC/Vegetal) aims at inspecting and monitoring the quality of products of vegetable origin produced in national territory, in relation to the presence of pesticide residues and chemical and biological contaminants. They monitor products of vegetable origin destined to the internal market and to export. Presently, approximately 80% of the analyses are for the internal market, being that as of this year, there will be a sampling of imported products in customs. This program analyses the following products: pineapples, lettuce, peanuts, rice, bananas, potatoes, coffee, nuts, beans, oranges, lemons, limes, apples, papayas, mangoes, melons, corn, strawberries, black pepper, chilies, soya, tomatoes, wheat and grapes (Brazil, 2008).

3.2.2 Sanutary Surveillance in Importing Countries

In this item the regulatory systems regarding the Multilateral Codex Alimentarius Agreement, of which Brazil is a part, the European Union, United States and Japan will be presented.

3.2.2.1 Multilateral Codex Alimentarius Agreement

The Codex Alimentarius is an international forum for the normalization of the commerce of foods established by the United Nations (UN), by an Act of the Food and Agriculture Organization (FAO) and the World Health Organization (WHO). Founded in 1063, the forum's aim is to protect consummers' health and assure equitative practices in the regional, and international food commerce. The CODEX norms cover the main foods, be these processes, semi processed or raw. They also treat substances and products used in the elaboration of foods. Their directives refer to the hygienic aspects and nutritional properties of foods, considering the code of practice and norms of additives, pesticides, vertenary medicine residues, contaminant substances, labels, classification, sampling methods and risk analysis (Brazil, 2014)

The Codex Aliment Arius Committee of Brazil's (CCAB) main activity is participating and defending national interests on international committees of the Codex Alimentarius. It also is responsible for observing the Codex norms as reference for the elaboration and updating of legislation and the national regulation of foods.

The Brazilian committee is composed of private organizations and public bodies such as the national institutes of Industrial Measurement Quality Standardization Institute (Inmetro) and Consumer Defense Institute (IDEC); the Foreign Affair Ministry (MRE), Ministry of Health (MS), Ministry of Economy (MF), Ministry Science and Technology (MCT), Ministry of Justice (MJ/DPC) and Ministry of Development, Industry and Commerce (MDIC/SECEX); the Brazilian Association of Industry and Food (ABIA) and the Technical Norms (ABNT); the National Confederations of the Industries (CNI), Agriculture (CNA) and Commerce (CNC) (Brazil, 2014).

The structure of the board of the Codex Alimentarius is composed of three bodies:

- Codex Alimentarius Committee - CAC, highest body of the Joint Program FAO/WHO, with representatives of the member countries, which approves the Codex norms. The board is composed of a president and 3 vice-presidents;
- Secretary FAO/WHO – supports the Committee and the auxiliary bodies operationally in the process of elaborating the norms; and
- The Executive Committee: implementing the Committees decisions and representing it during the periods in between meetings (Brazil, 2014).

There are yet two other bodies of assessors: the JECFA (a FAO/WHO group of expects on Additives and Contaminants) and the JMPR (a FAO/WHO group of experts on Residues and Pesticides). They have 27 auxiliary committees distributed as follows: 9 Committees on General Subjects, 9 Committees of Products, 3 Task Forces e 6 Regional Coordinating Committees (Brazil, 2014).

Within the committees of general subjects there is the Codex Committee on Pesticide Residues – CCPR. Its functions are: to establish MRLs of pesticides in certain foods or groups of foods; to establish MRLs for pesticide residues in some feed products that are distributed in the international market, when there is a justification to protect human health; to prepare priority lists of pesticides for their evaluation by the JMPR (*The Joint FAO/OMS Meeting on Pesticide Residues*); to examine the sampling and analysis methodology to determine the residues of pesticides in foods and feed; to examine other related subjects with the innocuousness of food and feed that contain pesticide residues; and to establish

MRLs for environmental and industrial contaminants that have chemical characteristics or another natural analogy to pesticides in certain foods or groups of food. The host country of this committee is the Netherlands (Brazil, 2014).

3.2.2.2 European Union

The central aim of the European Union legislation regarding food safety is to guarantee a high level of protection to human health and of the interest of consumers in relation to food products. The rules of the European Union related to feed for animals aims at protecting human and animal health as well as the environment (Brazil, 2013).

The Regulation (CE) nº 178/2002 of the European Parliament and of the Council, that establishes the principles and general norm of the food legislation, applies to all phases of production, transformation and distribution of food and feed. The food and feed importers should be capable of identifying and indicating the name of the person that furnished the product for export in the country of origin, satisfying the traceability demands (Brazil, 2013).

The European Authority for the Safety of Foods (AESA) furnishes the European Commission independent scientific opinion on all the issues that have a direct or indirect influence on food safety. It is an entity with a legal personality independent of all other European Union institutions (Brazil, 2013).

The import of food has to respect general conditions and measures that include:

- The principals and the general norms of food legislation established in the Regulation (CE) nº 178/2002 of the European Parliament and of the Council;
- The general hygiene rules of food and the specific hygiene rules applicable to food of animal origin in conformity, with the Regulation (CE) nº 852/2004 of the European Parliament and of the Council and with the Regulation (CE) nº 853/2004, according to later alterations;
- The measures related to the presence of residues, pesticides, veterinary medication and food contaminants;
- The special regulations relative to genetically modified organisms destined to human and animal feed, to the bio-proteins and new foods;
- The special rules regarding certain groups of food products such as, mineral waters, cocoa, frozen foods and those destined to satisfy the nutritional needs of specific populations groups like small children and babies (Brazil, 2013).

The Regulation (CE) nº 396/2005, February 25, 2005, treats the MRLs of pesticides in food and animal and vegetable feed and modifies the directives of the Council 91/414/EEC. The text presents some basic premises that are presented below.

The regulation refers to public health and is relevant for the functioning of the internal market. Considering that the differences in the MRLs in each country generate commercial barriers between Member States and that the commerce among third world nations and the European Community for listed products and the respective derived products, the text affirms that in the interest of free trade amongst Member States, as well as an elevated protection to the consumer, the maximum level of MRLs for vegetable and animal products be established for all the Community, taking into account the Best Agricultural Practices (EU, 2005)

The text affirms that regarding the placement of vegetable protection products on the market, the priority should be for public health over the interests of vegetable protection. That is why it is necessary to guarantee that residues should not be present at levels that present unacceptable risks for humans and animals. The MRLs should be fixed at the lowest levels possible consistent with the Best Agricultural Practices for each pesticide, aiming to protect vulnerable groups such as children and fetuses (EU, 2005).

The document indicates that the MRLs should be continuously monitored and should be altered taking into account new data and

information. The MRLs should be fixed at the lowest level of analytical determination in cases where the authorized use of products of vegetable protection do not result in detectable levels of pesticide residues. For uses still not authorized at the Community level, the MRLs should be fixed at an appropriately low level to protect the excessive consumption of pesticide residues. To facilitate the control of pesticide residues, the standard value of 0,01 mg/kg was established as the level of residues in products for those without established limits (EU, 2005).

The document informs that the business partners in the Community should be consulted by the World Commerce Organization about the MRLs proposed and their observations should be taken into account before the MRLs are adopted. The MRLs established at the international levels by the Codex Alimentarius Comission should also be considered when the MRLs of the Community are deliberated taking into account the best correspondent agricultural practices (EU, 2005).

3.2.2.3 United States

Three federal agencies do the regulation of pesticides in the United States. The first is the EPA, *Environmental Protection Agency, which* approves and registers the use of pesticides and establishes the tolerance levels of residues in food. The second is the FDA, *Food and Drug Administration* that is responsible for applying and controlling the limits on imported foods and of places where food is commercialized between states. The exception to this rule is beef, poultry and some products derived from eggs that are the responsibility of the FSIS, *Food Safety and Inspection Service.*

The FDA also collects data on the specific combinations of foods and pesticides by researching consumption baskets in the TDS, *Total Diet Study,* (FDA, 2011).

The third agency involved is the AMS, *Agricultural Marketing Service, of the* USDA, *U.S. Department of Agriculture.* This body since 1991 has a program that tests the pesticide residues called PDP, *Pesticide Data Program.* It is directed to raw agricultural commodities and several processed foods, supported by contracts with the states for the sampling and analysis. The FSIS and AMS present their data on pesticide residues independently (FDA, 2011).

The Monitoring Pesticide Program of the FDA adopts a regulatory approach based on focused sampling. The data on the presence and levels of pesticide residues is furnished by the TDS program, which analyses market baskets of around 300 products four times a year. The FDA collects individual lots of local and imported products and analyses them regarding pesticide residues to make sure they are at the tolerant limits established by the EPA. The local products are collected at places near the production stage in the distribution system such as the producers, the packaging places, and the wholesalers. The samples of the imported products are obtained at entry points into the US market. Even though they are considered processed products, the emphasis of the program is in agricultural products, which are analyzed whole, non-processed and unwashed (FDA, 2011).

In this program if illegal residues are found in levels superior to that tolerated by the EPA and the manual Levels of Action of the FDA (an inevitable list of cancelled pesticides which persist in the environment), or pesticide residues at levels of significant regulation for which the EPA has established the absence of tolerance for a determined food, the lot, will be withdrawn from the market. The FDA can also emit Warning Letters for the responsible producer and invoke other sanctions like destroying the product and terms of conduct to correct the cause of violation (FDA, 2011). The shipping of imported products with illegal residues is prohibited from entering into the USA. The responsible companies will be included in a list of “Import Warning” and the DWPE, *Detention Without Physical Examination* can be evoked for future lots based on the one occurrence of irregular shipping (FDA, 2011).

Congress authorized the FDA to refuse the entry of regulated products based on other information besides the results of the lots

examined, that provoke the suspicion that the product violates the FDCA, *Food Drug and Cosmetic Act*, such as lots of imported products suspected of containing illegal pesticide residues due to results in previous exams of the same food. The DWPE procedure can be applied to determined producers, processors, transporters, for regions or countries, in case the problems are considered sufficiently widespread (FDA, 2011).

3.2.2.4 Japan

The regulatory sanitary safety system of food in Japan is composed of three norms. The first is the *Plant Protection Law*, which refers to the sanitary quarantine of imported plants, including vegetables, fruit, cereals, flowers and seeds. The executive body of this norm is the *PPS – Plant Protection Station* of the *MAFF – Ministry of Agriculture, Forestry and Fisheries*) (Shi, 2013).

The second legislation if the *Livestock Epidemic Prevention Law* that treats the sanitary quarantine for products of animal origin, including live animals. The executive institution for this is the *AQS – Animal Quarantine Service*) of *MAFF* (Shi, 2013).

The third law is the *Food Sanitation Law* that regulates the sanitation of all foods that circulate in the domestic market and its objectives include imported foods. The executive institution is the *FSQS – Food Sanitary Quarantine Station* of the *MHLW – Ministry of Health, Labor and Welfare*) (Shi, 2013).

The vegetable and plant quarantine systems of the first two laws, have distinct aims from those of the sanitary food system, the third law. The quarantine inspection of plants and animals aims at preventing plant diseases and pests or epidemic diseases that may have an impact on the domestic agricultural production, as well as guarantee the entry of qualified agricultural products into the country. These systems do not refer directly to the guarantee of food safety (Shi, 2013).

The function of the sanitary quarantine of foods is to examine if they are safe or not. Just the products that pass inspection at the Food Sanitary Quarantine Station can be imported and commercialized on the domestic market in Japan (Shi, 2013)

The Medicine and Sanitary Food Council of the MHLW- Ministry of Health, Labor and Welfare formulated the residue pesticide standards for vegetables.

Three aspects were considered for the definition of these standards: (1) *ADI – acceptable daily intake*, (2) the average daily intake of certain foods and (3) the pesticide residues in agricultural products (Shi, 2013).

In this system, the ADI is the quantity of agrochemical residues in agricultural products consumed that does not harm human health, even if the food is consumed daily during a lifetime. This is measured in mg/kg/day and calculated based on the values obtained in toxicological tests on animals, with the application of a 1% safety coefficient for human consumption. The other indicator considered is the *TMDI – theoretically maximal daily intake* calculated by multiplying (1) daily average intake of agricultural products and (2) pesticide residues in agricultural products. With these methods, the TMDI tends to be higher than the real quantity of pesticide residues consumed. On the other hand, the ADI– *acceptable daily intake* is normally inferior to the real quantity of residues that causes a negative impact on human health, because it is calculated by the daily consumption of the agricultural product. If the TMDI is inferior to the ADI, the pesticide residue on agricultural products is considered as the standard residues for that agrochemical. If the TMDI is superior to the ADI, the standard residue of the agrochemical is defined by the ADI, generally with an 80% reduction (Shi, 2013).

As the TMDI tends to be superior to the real consumption of residues residues, and the ADI is normally less than the real quantity of residues that causes damage to the human health, some standards of residues were calculated based on the ADI, becoming more restrictive in Japan than in other countries. Another source of deviation is the possible

variation in the daily intake of vegetables amongst countries. In recent years, the MRLs of pesticides have been elevated, but the scope of the quantity of active controlled ingredients has been amplified. The patterns of residues are applied to around 8 thousand cases, involving 214 kinds of agrochemicals and 130 agricultural products (Shi, 2013)

The health surveillance policies in Japan for imported foods have made some changes since 2000, principally in response to cases of products imported from China contaminated with agrochemicals. With relation to the labeling of foods, the Agency for Consumer Subjects was instituted September 1st, 2009, to become responsible for the theme, assuming the attributions of the MHLW- *Ministry of Health, Labor and Welfare* and of the MAFF– *Ministry of Agriculture, Forestry and Fisheries that* were responsible for applying the law *JAS* (*Japanese Agricultural Standards*, de 1950). They also became responsible for the measures to guarantee the abidance of the Codex Alimentarius norms (JETRO, 2011).

Regarding the food specifications and norms, besides the Act for Food Sanitation, there is the *Health Promotion Act,* under the jurisdiction of the MHLW- *Ministry of Health, Labor and Welfare (*except for the topics referring to labeling, which are treated by the Agency for Consumer Subjects); the Law regarding the Standardization and Appropriate Labeling for agricultural and forest products - *JAS - Japanese Agricultural Standards, under the jurisdiction of MAFF – Ministry of Agriculture, Forestry and Fisheries* (except for labeling topics, treated by the Agency for Consumer Subjects), and the *Agricultural Chemicals Regulation Law.* The evaluation of food security in general is governed by the *Food Safety Basic Act,* under the jurisdiction of the Government Cabinet, under which a *Food Safety Commission* was created to evaluate the security of additives and genetically modified foods (JETRO, 2011). The Japan Food Chemical Research Foundation defines the MRLs. The values for coffee beans are presented in Table 4.

3.3 TECHNOLOGICAL ENVIRONMENT FOR AGROCHEMICALS

This section discusses some technological aspects that affect the demand of agrochemicals by coffee producers and the offer of these products, that depends on the decision of the industry in the areas of development, production and distribution. Initially, this section discusses the principal pests and diseases that affect the coffee crop, as well as the products and methods of control. Following, it discusses the risk of coffee contamination by residues, considering the present registered products, the differences in MRLs and the products in development.

3.3.1 Pests, Diseases and Agrochemical Coffee Classes

This item describes the principal pests and diseases in the coffee crops as well as the respective forms of control.

3.3.1.1 Invasion and Control of Weeds

The most widely control system of weeds in the coffee crops involves the use of post-emergency herbicides, generally combined with other systems, predominantly made of products with a *glyphosate* base. However, its use has been contested by some technicians that point out that this active herbicide is capable of affecting the susceptibility of the plants to diseases and diminish their productivity. Matiello, Mendonça & Leite Filho (2008) report on recent reseach that, planted in vases, *glyphosate* did not affect the development of coffee seedlings and that a more recent study also showed favorable effect on the production of coffee plants in the fields (12% more) with the use of systems with post-emergency herbicides.

The researchers conducted an experiment in Martins Soares, MG, comparing two weed

controls: one using the glyphosate herbicide Roundup, and the other with brush cutting. Data shows that there was superior productivity of the treatment where the weed control was done though glyphosate herbicide in relation to the brush cutting, and these compared to no treatment, with the worst performance in the treatment combining the lack of weed control with the lack of fertilization of the coffee crops. The best productivity was obtained where the weed control was the most efficient, without any damaging effect of the use of glyphosate. The lack of weed control provoked a decrease in productivity of around 33% in relation to the best control, and the absence of control and fertilization the decrease of 57%.

The levels of infection by rust do not show significant differences. Therefore, the use of glyphosate or fertilizers was not identified on the susceptibility to this disease in coffee crops. (Matiello, Mendonça e Leite Filho, 2008).

The use of this product, by pulverizing, should be done directly over the weeds because glyphosate is harmful for the coffee tree. Should adult coffee trees be sprayed, there will be no damage, but it may reduce the growth of a few lateral branches, at the bottom of the tree. However, should a young coffee tree, specially in its first year, as well as trees that have been pruned, the product can reach the top of the tree and provoke a serious reduction in growth in the leaves and the buds. Thus, using glyphosate in young coffee crops should be done very carefully to avoid phytotoxicity of the herbicide (Matiello e Almeida, 2013a).

3.3.1.2 Pests and Insect Controls

Coffee Stem Borer

The Coffee Stem Borer (*Hypothenemus hampei Ferrari*) is one of the main pests that affects the Brazilian coffee crops. The borer is a beetle, whose female lays eggs that transform into larvae that eat the coffee berry, which in turn provokes its loss in weight and the quality. The damage the borer causes are: (1) the loss in the quality of the product by allowing the entry of pathogenic organisms, (2) the reduction in the weight of the perforated berry, that does not drop/fall during the harvest and (3) the attack in the storage, when the product is stocked with excessive humidity (CEPICAFE, 2013).

The stem borer can be controlled with insecticides that contain the active principle Endosulfan, widely used since the 1970's. But as it is toxic, its sale has been forbidden in Brazil since August 2014, according to ANVISA's (The Federal Agency of Sanitary Surveillance) August 2010 resolution.

Three years later, as this was not followed, this insecticide can reach 20% of the national production in the 2014/15 harvest, according to the National Coffee Council (CNC) (Ferreira, 2014).

Banned in 45 countries, Endosulfan was on a list of 14 agrochemicals submitted to the re-evaluation of ANVISA- The Federal Agency of Sanitary Surveillance, due to suspects of causing serious health problems. The Ministry of Agriculture informs that presently there are three active principles that can be used to combat the stem borer: Neen extract, Chlorpyrifos e o Etofenprox. Despite having been tested, they lack efficiency according to coffee producers reports (Ferreira, 2014).

At the beginning of August 2014 there was a meeting of the Technical Advisory Committee on Agrochemicals, formed by MAPA – Ministry of Agriculture, Livestock and Supply, by ANVISA- The Federal Agency of Sanitary Surveillance and by IBAMA – The Brazilian Institute for Environment and Renewable Natural Resources, to discuss the agricultural choice for the two other alternatives to Endossulfan: the Cyantraniliprole molecule and the other the result of the combination of Chlorantraniliprole and Abamectine. These products were developed by multinational companies and represent a new group of insecticides, according to the researcher Júlio César de Souza, of EPAMIG – Minas Gerais State Agricultural Research Company. They are considered "blue seal" - medium and low

toxicity, while Endosulfan is "red seal"- extremely toxic. These molecules were tested over four years, and according to technicians, are effective. Before Endosulfan, the borer infested almost 100% of the crops. Today it varies between 3% and 5% (Ferreira, 2014).

With the prohibition in sales, residues of Endosulfan in the crops that use it (coffee, sugar cane, cotton and soya) would be accepted as "regular" until July 31st, 2014. According to ANVISA -The Federal Agency of Sanitary Surveillance, the deadline for the withdrawal of

Endosulfan from the market ended mid September. However, there may still be residues of legal use that justifies a tolerance until 2015 (Ferreira, 2014).

3.3.1.3 Diseases and Funguses Control

Rust

Rust is a disease caused by the fungus *Hemileia vastatrix*, which has been present in Brazil since 1070. This disease is still an important economic problem for the coffee crops, demanding the use of constant control measures to avoid the damages decurrent of the losses in production. Furthermore, the chemical control elevates the costs in the management of the crops. The disease continues to evolve, be it by the emergence of new lineages of the fungus that make it difficult to control the loss in the resistance of genetic materials of the coffee tree, or by more tolerance of the fungus to the fungicides used, reducing the efficiency of the chemical control, demanding new solutions, many times more costly (Almeida e Matiello, 2010).

Despite understanding the damage caused, the most important factors of the seriousness of the disease and the technological control, known by the technicians, it is still not well used by the producers. It is known that damage to the productivity of the coffee crops results from the intense leaf loss, which occurs before the budding, resulting a less berries. Besides this, the plants with low foliar density emit orthotropic branches that should be cut through the removal of sprouts, increasing the cost of production. If the sprout thinning does not occur, the coffee tree's architecture becomes compact, which favors the intensity of the disease, because the moisturizing time of the leaves takes longer. The intensity of the disease if favored by : (a) adequate climatic conditions, present in the rainy season (temperature and humidity); (b) foliar density at the beginning of the rainy season; (c) potential for the inoculant (reminiscent leaves affected by the previous cycle of the disease); (d) the amount of berries which is the most important factor; (e) density in the plantation (spacing); (f) varieties Mundo Novo and Bourbon are the most susceptible; (g) self-shadow; () moisturizing time of the leaves; and (i) deficient or unbalanced nutrition.

The infection period of the rust fungus occurs from November/December to April/May, staring earlier in regions with lower altitudes and higher temperatures. At the beginning the passage occurs from the old leaves, with leftover pustules to the new ones. However, the presence of the inoculant is not limiting, once the fungus spores can dessiminate long distances by the wind (Almeida e Matiello, 2010).

The chemical control systems can be grouped into four types: the first if the curative-protective control, using copper based protecting fungicides ; the second is the curative-protective, via foliage, with the combination of systemic triazoles and strobirulins with two or three applications in the cycle; the third is curative-protective via soil, with specific triazoles, based on triadimenol, cyproconazole e flutriafol, and a fourth type, today the most widely used which is a combination of the former systems used, associating the via soil with the foliar, combining products (Almeida e Matiello, 2010).

As mentioned, there are new physiological races of the rust fungus in Brazil that have been attaching varieties once considered resistant like Icatus, Catucias, Catimores and even hybrids like Sarchimores (Obatã). However, these races present less virulence, in

other words, smaller levels of infection in relation to the first races. In practice this represents easier chemical control on the tolerant varieties, where

In the majority of the cases just one application of the fungicide has worked well. Regarding the presence of populations of the fungus tolerant to the triazoles, the efficiency of the control with this group of fungicides, when used isolatedly, has dropped a lot in the last years, despite not having any scientific proof. That is why producers have adopted an association of new groups, like the strobirulins and the combination with cupric fungicides (Almeida e Matiello, 2010).

There is a suspicion that the drop in efficiency of the control of the triazoles fungicides specially the via soil modality, is provoked by the resistance to the fungus and the possibility of the decomposition of the fungicide by microorganisms in the soil. This situation has led some researchers to experiment with concentrated applications, similar to the normal ones via solo, but via leaves, according to Matiello & Almeida (2013).

These authors relate studies with the use of normal soil doses, or for products not recommended via soil, a dose totally recommended via leaves with the addition of 30%, in a once time application. The treatments with elevated and concentrated doses of triazoles show good efficient results.

Triazoles fungicides, when used in excessive doses, especially with flaws in the application, can cause toxicity to coffee crops, even in adult plants. The commercial formulations most used today are Verdadero (cyproconazole + thiametoxan), Premier Plus (triadimenosil + imidacloprid) and Impact Mix (flutriafol + imidacloprid). Isolatedly, via soil, formulations with flutriafol (Impact and others) are the ones most used. Besides controlling rust, the triazoles have a tonic/hormonal effect, bettering the aspect and vigor of the coffee trees, by bettering their fine root system. When used in excessive doses, by concentrated applications of trizoles in some plants, the reduction of foliage and branch growth reaches a toxicity point. The leaves get shriveled, small and dark green. There is great fructification, but the berries are smaller and maturity is delayed (Matiello & Almeida, 2014b).

Cercosporiosis

Cercospora leaf spot or "brown eye" is one of the oldest diseases in the coffee crops, caused by the fungus *Cescospora coffeicola*. It attacks the fruits and leaves, causing loss in productivity, also affecting the quality of the coffee produced. Its appearance can be due to nutritional deficiency, excess of sum and drop in temperatures (Soler *et al*, 2013).

Phoma

Phoma leaf spot caused by the fungus *Phoma spp*, is a disease that causes significant damage to the production. The Phoma fungus attacks leaves, flowers, berries and the branches of the coffee tree, producing characteristic lesions. Consequently, production is affected because the berry falls, the buds die; due to the defoliation, the berries fall and there is bad quality of the fruit. The gravity of the disease is associated to the crops in regions with high altitudes where the temperatures are predominantly low, there are cold winds and elevated humidity. The susceptibility of our commercial cultivars, their exposure to the high capacity in the multiplication of the fungus, their adaptation, resistance and/or survival are also factors connected to the seriousness of the disease. The chemical control programs of Phoma recommended today, foresee pre and post flowering application, with two from September to December. In highly susceptible regions, more than one application in the winter is needed to reduce the inoculant on the branches (Krohling e Matiello, 2014).

Some research done with various fungicides to control Phoma, show that the applications to control it also have effect against other diseases that occur simultaneously, like rust and cercosporiosis, "brown eye". The explanation for the parallel action of the fungicides against other diseases is in the active principles oxicarboxin, strobilurinsurin e

triazole that are recognized as acting against rust and "brown eye". This, even during the ideal control period of these two diseases, may be due to the reduction of the inoculant of the funguses, and by their tonic effect and eventual prolonged protection (Krohling e Matiello, 2014).

Fusariosis

Fusariosis is a less serious disease in the coffee crops, and maybe because of this less known to the technicians, and also less studied in Brazil. However, in other crops, such as black pepper, pineapple and passion fruit amongst others, fusariosis causes severe damage and kills a great quantity of plants. Fusariosis is caused by a fungus of the genus *Fusarium,* of different species, a fungus that lives in the soil and in many cases, enters the plant through sores. In the adult coffee crops in Brazil, fusariosis can be observed by its symptoms on the trunk and at the base of the thick lateral branches. Cutting the wood tissue under the bark, dark red longitudinal stretch marks are found that accompany the vessels. They result in the clogging of the vessels, reducing the flow of sap. The plants that are attacked start getting yellow, the leaves start dropping and the branches start drying from top to bottom. After a few years, the plant ends up dying (Matiello e Almeida, 2014a).

The biggest occurrence observed in coffee crops in Brazil, seems to be related to three factors: the increasing age of the coffee crops, the use of more frequent pruning and the use of mechanical harvesting. In Costa Rica there is the mention of an association of fusariosis with the occurrence of nematodes provoking sores in the roots (Matiello e Almeida, 2014a).

Fusariosis in Brazil occurs in different varieties of Arabica coffee crops (MN, Catuaí and others), and as mentioned above, specially in older coffee crops. Some of the plantations, which today are 20-30 years old, are affected 20% or more by the disease. There is no efficient fungicide to control it. What if effective at the initial stages, is a cut in the trunk a little below the affected area, eliminating the clogging. It seems the plant recuperates, at least for some time (Matiello e Almeida, 2014a).

3.3.1.4 Diseases and Bacteria Control

Haloed Spot

According to Matiello & Almeida (2007), haloed spot is caused by the bacteria *Pseudomonas seryngae,* a disease that causes damage to coffee crops in the colder regions, situated in the southern part of Brazil, in the state of Paraná and São Paulo. In the last years however, the haloed spot has become serious in the Triangulo/Alto Paranaíba, and in the southern part of the State of Minas Gerais, and in the high altitude areas of the Zona da Mata – Atlantic forest in the state of Minas Gerais. As the symptoms of the disease can be confused by those provoked by other funguses, such as Phoma/Ascochyta and Colletotrichum, some cases have been noted where there was orientation in the incorrect use of the products.

The haloed spot attacks normally begin in November or December, with the beginning of the cold fronts, winds and humidity. Bacteriosis is problematic in nurseries and young plantations that are unprotected from the wind. The disease always occurs in the higher regions, and is not present in the crops situated in the valleys, crevasses and lower protected areas (Matiello e Almeida, 2007).

The typical symptoms are dark stains with a yellowish halo on new leaves, especially transparent on the inner side of the halo, which can be observed by looking at the leaf against the light. The drying up and death of lateral branches, as well as the tip of the young coffee trees also occurs (Matiello e Almeida, 2007).

Technicians and producers need to pay attention to bacteriosis, always carefully examining the crops, and when in doubt, take the material to a specialist, to be correctly identified, so as not to be confused with other symptoms caused by other diseases like *Phoma/Ascochyta*, that can easily be confused in seedlings and *Colletotrichum*. Doing this they can adequately control the origin of the

problem. To help control the problem areas, the installation of temporary windbreakers with "guandu bean" (Cajanus cajan) and lines of corn is ideal. Chemical control is done by spraying, using products with a copper or dithane base mixing with single superphosphate, being able to add antibiotics and kasugamycin. When haloed spot is associated with *Phoma/Ascochyta* and *Colletotrichum,* which is common, special fungicides can be associated with the spray (Matiello e Almeida, 2007).

3.3.1.5 Diseases and Nematode Control

Meloidogyne

Nematodes cause great damage to the Brazilian coffee crops depending on the species and type of soil. The visualization of these parasites is only possible through a microscope, which makes it difficult for the producers and technicians to identify. Sic species of Meloidogyne occur in the Brazilian coffee crops, with the *Meloidogyne exigua* species being the one that is most disseminated in the coffee producing regions, especially in the old plantations of south of Minas Gerais State. It's presence can be seen by the visual nodules on the root system known as gals, which burst to liberate eggs, rotting this part of the root system.

The *Meloidogyne paranaensis* species is extremely damaging to the coffee crops and can cause the death of the plants. In 2003, some of the plantations in the municipalities of Serra de Salitre and Patrocínio, of the Alto Paranaíba region in Minas Gerais State noticed its presence in defoliated plants, with reduced root systems, thick roots with a soft surfaces, peeling and lesions with the aspect of canker. These facts are worrying because the focus of this nematode in this region might be more widespread and the producers are unaware of the parasite and the damages it can cause.

Besides its aggressiveness, another *M. paranaensis* species has some characteristics that make its control difficult: (a) an ample range of hosts, (b) high persistence in the soil in the absence of host plants and (c) the habit of infecting the main root in the coffee tree. This last characteristic hinders the efficient chemical control, because even if the nematode population is reduced in the soil and in the roots, the root system is unable to recuperate from the damages caused by this pathogen. The occurrence of more than a hundred host plants impedes an effective chemical control or by rotating crops.

3.3.2 Agrochemical Contaminations Risks for Coffee

3.3.2.1 The Maximum Residue Limits in Brazil and Abroad

The more intensive use of agrochemicals in the Brazilian coffee crops can bring serious problems to the export to the main importing countries. In 2005, all the Brazilian coffee exported to Japan was analyzed for residues of the insecticide dichlorvos. As of 2008 an excess of the fungicides piraclostrobina and flutriafol were detected. In 2011, after intense negotiations with the Japanese authorities, it was possible to suspend the obligatoriness to previously analyze all the coffee lots exported to Japan for dichlorvos.

The threat in the apprehension of Brazilian coffee lots by importing countries remains, as Brazil uses one hundred and seven active registered ingredients to formulate the agrochemicals used on coffee crops. There are fifty nine active ingredients with MRLs in Brazil superior to those adopted in Japan, such that one of the active ingredients regulated for use in Brazil can not be detected in Japan. There are twenty-one active ingredients regulated by the Codex Alimentarius, four of which have superior MRLs in Brazil. There are twelve active ingredients in use in Brazil with severe restrictions for use or are banned in the USA and EU. (Table 1)

Another relevant issue that producers that export need to observe is the application date of the MRLs in the market. In the data bank disposable on the Internet, it is possible to

accompany the MRLs and their respective dates for application, and changes in the permitted levels, or the deadline for the MRLs of products not yet contemplated. In the case of the Codex Alimentarius, the MRLs and the respective dates are presented in Table 2. Table 3 presents the MRLs and the application dates for the European Union. In many cases the reduction in the permitted level of residues is already foreseen. On the other hand, if the MRL is 0,01, adopted as a standard, there are situations in which this level can be elevated by conducting new scientific toxicity studies. For Japan, the MRL active ingredients for coffee beans appear in Table 4. For this country there are only two cases for the future application of the MRLs with their respective dates.

For the internal consumption, there are risks in the identification of agrochemical residues above the regulated MRLs. This is based on the fact that coffee is part of the foods analyzed by PARA –Program for the Analysis of Pesticide Residues in Food under ANVISA- The Federal Agency of Sanitary Surveillance. In several situations, poorly oriented coffee producers have used unregistered agrochemicals on their crops. Even if the agrochemicals have been duly registered, there may be problems of residues above the tolerated level, due to the non-observance of the Best Agricultural Practices (BPA).

In a research to analyze contamination risks, Araújo (2013) the sales of agrochemicals for coffee crops by the Cooxupé Cooperative in the years of 2009 2010, 2011 and 2012. One hundred and twelve commercial products and 55 active ingredients were used (Table 5).

This research allowed the identification of the following active ingredients in agrochemicals commercialized by the Cooxupé Cooperative:

- Two active ingredients (aldicarb and dychloretparaquat) are included in the "Dirty Dozen Pesticides" list;
- One active ingredient (triazofos) can not even be detected in the coffee exported to Japan;
- Four active ingredients (alachlor, carbofuran, endosulfan and triazofos) have restricted use in the European Union;
- Two active ingredients (carbofuran and endosulfan) have restricted use in the The United States;
- Twelve active ingredients are regulated by the Codex Alimentarius Comission;

Of the active ingredients with heavy restriction by importing countries, just Dicloreto de Paraquate and Triazofos continue to be commercialized in a large scale. Dicloreto de Paraquat is one of the ingredients of the herbicide Gramocil, and Triazofos is present in the insecticides and acaricides Deltaphos EC and Hostathion BR. The three agrochemicals are commercialized at the Coxupé Units. The other active ingredients, with strong restriction of use are not used anymore and the volume of sales has fallen abruptly in the last 2 years (Table 5).

On the other hand, many recent active ingredientes present in pesticides commercialized at Cooxupé for use on the coffee crops still have not been regulated by the main consumer countries, by the Codex Alimentarius Comission, or present lower MRLs than those established in Brazil, with the following quantities (Table 5):

- twenty four cases for Japan;
- forty three cases not evaluated by the Codex Alimentarius Comission;
- twenty seven cases for the European Union;
- forty four cases for the United States;
- fifty cases for South Korea.

Research identifies the application of 117 different commercial products in three modalities of use, being that seven products do not have a register for use on coffee in Brazil, and five products have heavy restrictions by importing countries (Tables 6,7,8 and 9) (Araújo, 2013).

3.3.2.2 Agrochemical Contamination Evidence

The Ministry of Agriculture published at the beginning of September 2014 the result of a control plan for residues and contaminants in foods regarding the 2012/13 harvest, which

identified that at least 20% of samples presented some kind of inconformity principally related to the use of chemicals not permitted for the crop, or agrochemicals which are forbidden in Brazil. Of a total of 163 samples that were analyzed for 12 crops (pineapple, peanut, rice, coffee, beans, papaya, mango, corn, soya, tomato, wheat and grapes), 33 had some sort of problem. Federal agricultural inspectors of the Ministry in rural properties, processors, collected the samples and in distribution centers in all the southern States, and in the states of Tocantins, Minas Gerais, Goiás, São Paulo, Esprírito Santo, Paraíba, Bahia and Rio Grande do Norte. The samples were sent to the Laboratories of the National Network of Agricultural Laboratories (Batista, 2014).

In the case of papaya, 40 samples were analyzed, out of which 13 had some kind of problem. The main incidence was found in samples from Bahia, where 5 of the 12 samples were not in accordance to the use of agrochemicals, according to MAPA's survey (Ministry of Agriculture, Livestock and Supply). In the mango production problems were also identified. Of the 15 samples analyzed, five had some kind of inconformity such as 60% of the samples from Minas Gerais. They found the presence of the active principle ometoate, which is forbidden in Brazil, besides four other agrochemicals not permitted for this crop (Batista, 2014)

In corn, the analysis indicated an inconformity of 2 in 12 samples, one in the State of Bahia and the other in a sample in the State of São Paulo. The samples of wheat, and tomatoes collected in Rio Grande do Sul also presented problems. For wheat, four of the fifteen samples presented inconformity. They found the presence of the active principle trichloform, prohibited in Brazil, besides two agrochemicals not permitted for this crop. In the case of the tomatoes, the problem occurred in 3 out of 5 samples. The laboratory identified the presence of ometoate, forbidden in the country, besides agrochemicals not permitted for this crop (Batista, 2014).

3.3.2.3 Present Agrochemical and Industrial Strategies

Endosulfan Pesticide and Substitute Products

Sold until July 31, 2014 and used in the coffee, sugar cane and soya crops, the active principle endosulfan generated a market estimated in 21 million liters per year. The product was commercialized at R$13,00 per liter, for retail. The National Union for the Agriculutral Industry (SINDIVEG) does not inform the gross income that was generated by the product, but the amount included in the US$ 2,944 billion generated by the entire pesticide segment in the country in 2011 (Ferreira, 2014).

Nufarm, a multinational with Australian capital, produced endosulfan in the State of Ceará and commercialized it in Brazil. It represented around 10% of the gross income of the country in Brazil according the president in Latin America, Valdemar Fischer. Nufarm stopped producing endosulfan last year, according to the ANVISA resolution that estimated a gradual reduction in the production of the substance until the total cancelation July 31st. It was hard to find the product on the market last year, and according to the director Luís Henrique Rahmeier, there are no more stocks, as the three or four industries did not want to run the risk of a stock that could re-export the product (Ferreira, 2014).

Nufarm's industrial unit that produced endosulfan was readjusted to produce other agrochemicals, which have been growing in the last years. The company also produces another product that can be utilized for the control of the stem borer, but it costs 5 to 6 times more than endosulfan, and with approximately 60% efficiency according to Rahmeier. The cost of two or three applications of endosulfan in the recommended doses varies between R$100 to R$150 per hectare, with a 90% efficiency. "No other product has the cost-benefit as endosulfan", e affirms. According to him, it had an elevated degree of control if used correctly, and is safe for the environment (Ferreira, 2014).

As an alternative to endosulfan, the Ministry of Agriculture authorized in July 18, 2014, the importation of agrochemicals that have as active ingredient cyantraniliprole solely for the use of coffee producers in the State of Minas Gerais. Published in the "Diário Oficial da União"- Official Governement Newspaper, the authorization was given in emergency and temporary character, in a decree that established a sanitary defense measure for the combat of stem borer on coffee. The Decree 711/2014 of MAPA is a result of another one. By means of the Decree 188/2014, published March 13, 2014, MAPA had already declared a phytosanitary state of emergency in Minas Gerais, for one year, because of the " risk of an eminent epidemic by the infestation of the *Hypothenemus Hampei* pest" in the coffee plantations (Izaguirre, 2014).

Besides authorizing importation, the Ministry established how the chemical control of the pesticide based on Ciantraniliprole, should be done and should be monitored. According to the text, "the control can only be done in the field when the infestation reaches 3% or more of the bored berries. The dose of the active ingredient should be 175 grams per hectare, admitting the maximum of two applications of the agrochemical (Izaguirre, 2014).

Buscalid Fungicide

The two new production units of the agricultural division of Basf, one of the major chemical companies in the world, is being constructed in it industrial complex in Guratinguetá in the State of São Paulo this year. " We expect that one of the plants be finalized between July and August, and the other in December", affirmed Markus Heldt, president of Basf Crop Protection, during a conference in Durham, North Carolina, USA (Caetano, 2014a).

The company is investing € 50 million on these units, which aims at amplifying the formulation and production capacity of agrochemicals. The expectation is to produce two new agrochemicals for the Brazilian soya market, used to combat weeds and fungus diseases. The amplification of the factory will also synthesize the fungicide Boscalid, used in the coffee, grain and fruit crops, but in this case, the aim is to supply not only Brazil, but also the world market with the active principle (Caetano, 2014a).

Basf announced a plan to invest € 1,8 billion globally to amplify the production infrastructure of its agricultural division, and part of this will be used to conclude the project in Guaratinguetá. According to Heldt, Basf still has not defined new investments in Brazil, but considers Guaratinguetá a strategic nucleus for supplying the world market (Caetano, 2014a).

3.4 RESEARCH WITH SPECIALISTS

This section presents and discusses the results obtained form the Second Stage of the project, which was constituted by research done with specialists. As indicated in the Introduction, this stage was conducted by applying an open questionnaire by email and telephone interviews based on the questionnaire to deepen the knowledge on the position of the respondents on each topic. The results are grouped according to the topics : institutional environment (question 1 and 2), technological (questions 3, 4 and 5), followed by the structure of the documental research.

3.4.1 Institutional Environment for Agrochemicals

1) *What is the present situation for the regulation of the sanitary surveillance of agrochemicals for coffee in Brazil in the following stages?*

a. Registration of agrochemicals

- The growing professionalization in the responsible technical bodies.
- The demand for more rigor in the evaluation of products, approximating the forms of operation and the prohibition of products in developing countries.

- The perception of the deficiencies in the structure to operate, considering the availability of specialized technicians, equipment and financial resources.
- The unpredictable performance of the Public Ministry, questioning the evaluation processes and the great disparity amongst public prosecutors in each region..
- The slow process to evaluate the requests for registration, with higher costs for the industry and delay in the availability of innovation to the producers.
- The need to create a centralized division at MAPA- Ministry of Agriculture, Livestock and Supply, to take care of these processes.

b. The use of agrochemicals by the producer

- Indication of the responsibility of the Labor Ministry.
- Lack of federal government workers to monitor the producers.
- Higher risks related to the contamination of the producers, in comparison to the coffee.
- A growing adherence of the producers to the different private socio-environmental certifications that contribute to the adoption of Best Agricultural Practices, partially supplying the deficiencies of control in the public sector.
- Professionals, who many times do not possess the technical background or ethics, approach the coffee producer. So, in regions where there is no consolidated cooperative system, there is inadequate use of agrochemicals.

c. Residue controls of agrochemicals in harvested coffee

- ANVISA's PARA Program in expansion which I not very known by the respondents.
  (ANVISA - The Federal Agency of Sanitary Surveillance; PARA- The program for the Analysis of Pesticides and Residues in Food)
- MAPA's PNCRC- Vegetal Program (National Plan for the Control of Residues and Contaminants), is well evaluated by the respondents that know it.
- The programs are able to collect representative samples, from a variety of products and expressive geographical amplitude.
- Until now no inconformity of agrochemical residues was found for coffee for internal consumption.
- When coffee is exported, samples are taken before shipping and analyzed with regards to the principle agrochemicals. If the analysis accuses any inconformity with the legislation of the importing country, this coffee is not shipped. At the importing country, analysis of residues is also made to allow the disembarkation of coffee or not.

2) *What is the present situation of the sanitary surveillance of agrochemicals for coffee in the principle importing countries? Indicate a country with the biggest difficulties to attend the MRLs of Brazilian exporters.*

- Japan is considered the country with the most rigors in the definition of the MRLs and control of imported products. It has a regulatory system composed of many bodies that are operated efficiently.
- The European Union comes in second place regarding strictness of limits on residues. The adoption of the MRLs in 0,01 as a standard for any active ingredient can create a problem for importing Brazilian coffee. This value of maximum limit can be increased with the realization of scientific studies, not always available for all active ingredients. The criteria for banning or restricting the use of pesticides have been more political than scientific.

- The United States presents more permissiveness in the use of agrochemicals because it follow the active ingredients of the Codex Alimentarius, that has a smaller quantity of products and MRLs superior to those adopted in Japan and the European Union, in many cases.

3.4.2 Technological Environment for Agrochemicals

3) *What are the active ingredients with a higher risk of contaminating coffee following the MRLs in Brazil? Please indicate the class of the product (herbicide, pesticide, fungicide, nematode control)*

- Endosulfan (pesticides): forbidden product that can still be used and found in clandestine stocks.
- Triazoles (fungicide): risk in excessive use to combat various diseases caused by funguses.

4) *What are the active ingredients with the highest contamination risk for coffee according to the MRLs abroad? Please indicate the class of product (herbicide, pesticides, fungicides and nematode control) and the countries that will reject the product.*

- The active ingredients with the highest risk of causing problems regarding the MRLs of importing countries are those whose use is regulated in Brazil and which have restricted use or are banned by importing countries.
    - Carbofuran, terbufos, cadusafos (nematicides);
    - Paraquat (herbicide);
    - Triazoles (pesticide);
    - Triazoles (fungicide).
    - Endosulfan (pesticide): forbidden product that can still be used and found in clandestine stocks.
    - Glyphosate (herbicide): increasing control in residues in the European Union.
    - Dichlorvos (pesticide): forbidden in Japan.
    - Pyraclostrobin (fungicide): restricted in Japan.
    - Flutriafol: restricted in Japan

5) *What are the agrochemicals or technological packages in development that can increase or decrease the contamination risks of coffee in relation to the current situation in the same class of products? Please indicate the class of products.*

- 2-4 D (herbicide): although not an (radical) innovation, development of Enlist package product at Dow Agroscience aims to reduce toxicity compared to current solutions.
- The development of insecticides against Helicoverpa caterpillar is still awaited

3.5 FINAL CONSIDERATIONS

In this section, the conclusions of the research project are presented, considering the objectives and results obtained with the documental research and the one done with specialists.

3.5.1 Panorama of the Contamination Risk with Agrochemicals

- The institutional environment for health monitoring seems to be rationally structured, with the participation of the Ministry of Agriculture and Supply, Ministry of Health and Ministry of Environment. Legislation has been constructed adequately considering the comparison with the more developed importing countries.
- In the registration stage of agrochemicals, the attributions of each body are clearly

defined and obey an acceptable rationale. However, there are deficiencies in the operation of the functions provided by the legislation, mainly the lack of human, material and financial resources. Therefore, the evaluation processes and the approval of agrichemicals are slow, causing loss to the producers and lack of innovative products.

- In the agrochemical use stage, deficiencies in the inspection of public bodies that need to minimize the inadequate use of these products were identified.
- The institutional environment in the importing countries are challenging to the Brazilian coffee producers, especially in the European Union and Japan. In the European Union the MRLs have become more restricted. A peculiarity is the adoption of a 0,01 mg/kg initial standard limit for all products that can be flexibilized with scientific studies that prove the absence of risks for higher levels. Some respondents alleged a political use of these limits as a non-tariff barrier of Brazilian products.
- In Japan, the regulatory system is quite complex, but is operated very efficiently. They also practice restrictive MRLs. Apparently there are historical reasons for this behavior, which is decurrent from contamination problems in the past from products imported from China. The recent case of the prohibition of Brazilian products was resolved with diplomatic negotiations, which reveals itself as a future solution, especially as often times the limits are established restrictively without the existence of scientific evidence.
- The coffee business has the challenge to guarantee the sanitary health of the plantations and the security of the final product due to the quantity of diseases and pests present in Brazil. In the report identifies the main diseases caused by insects, funguses, bacteria and nematodes. The variety of climate, soil and management in different regions increases the complexity for elaborating recommendations on better agricultural practices related to the use of agrochemicals.
- The highest contamination risks for coffee are still related to the following active ingredients, for the reasons exposed:
    - Carbofuran, terbufos, cadusafos (nematicides): differences in MRL;
    - Paraquat (herbicide): differences in MRL;
    - Triazofos (pesticide) differences in MRL;
    - Triazolis (fungicide): differences in MRL.
    - Endosulfan (pesticide): forbidden product that can still appear in stocks and clandestine uses.
    - Glyphosate (herbicide): increase in the control of residues in the European Union.
    - Dichlorvos (pesticide): forbidden in Japan.
    - Pyrachlostrobin (fungicicd): restricted in Japan.
    - Flutriafol: restricted in Japan.

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Table 1 – Maximum residue limits (MRL) in mg/kg coffee grains for Brazil, Japan, Codex Alimentarius, European Union, and the USA.

#	Active Ingredient	Brazil	Japan	Codex	EU	USA	EUA
1	Abamectin	0,002	0,008		0,02		
2	Acetamiprid	0,2	0,01		0,1		
3	Acetochlor	0,2	0,01		0,01		
4	Gibberellic Acid	NR	NR		5		
5	4-Indol-3-Ylbutyric Acid	NR	NR				
6	Alachlor	0,05	0,01		0,05		
7	Aldicarb	0,1	0,1	0,1	0,1	0,1	0,1
8	Alpha-Cypermethrin	0,01	0,05	0,05			
9	Ametryn	0,05	0,01				
10	Azadirachtin	NR	NR		0,01		
11	Azoxystrobin	0,05	0,05		0,1		
12	Bacillus Thuringiensis	NR	NR				
13	Beta-Cyfluthrin	0,05	0,02				
14	Cypermethrin	0,30	0,05		0,1		
15	Boscalid	0,05	0,05	0,05	0,5		
16	Methyl Bromide	50	60		70	75	75
17	Cadusafos	0,05	0,01				
18	Carbofuran	0,1	1	1	0,05	0,1	0,1
19	Carfentrazone-Ethyl	0,05	0,1		0,02	0,1	0,1
20	Kasugamycin		0,01				
21	Cyfluthrin	0,01	0,02		0,1		
22	Kinetin	NR	NR				
23	Cypermethrin	0,05	0,05	0,05	0,1		
24	Cyproconazole	0,1	0,01		0,1	0,1	0,1
25	Clethodim	0,5	0,01		0,1		
26	Chlorantraniprole	0,03	0,01		0,02		
27	Benzalkonium Chloride	1	0,01				
28	Cartap Hydrochloride	0,1	0,01				
29	Chlorothalonil	0,2	0,2		0,1	0,2	0,2
30	Chlorpyrifos	0,05	0,05	0,05	0,2		
31	Kresoxim-Methyl	0,05	0,01		0,1		
32	Deltamethrin	1	2		2		
33	Diquat Dibromide	0,1	0,05		0,1	0,05	0,05
34	Paraquat Dichloride	0,05	0,05		0,05	0,05	0,05
35	Difenoconazole	0,5	0,01		0,05		
36	Disulfoton	0,1	0,2	0,2	0,05		
37	Diuron	1	0,02		0,1		
38	Endosulfan	0,05	0,1	0,2	0,1		
39	Sulfur	NR	NR		5		
40	Epoxiconazole	0,1	0,01		0,05	0,05	0,05
41	Esfenvalerate	0,05	0,01		0,05		
42	Spinosad	0,2	0,01		0,02		
43	Spirodiclofen	0,03	0,01	0,03	0,05		
44	Ethanol	NR	NR				
45	Ethephon	1	0,1		0,1	0,5	0,5
46	Fenamiphos	0,1	0,01		0,05		
47	Fenpyroximate	0,05	0,02		0,1		
48	Fenpropathrin	0,5	0,01		0,02		
49	Fenthion	0,1	0,01		0,05		
50	Flazasulfuron	0,03	0,02		0,02		
51	Fluazifop-P-Butyl	0,03	0,1		0,1	0,1	0,1
52	Flumioxazin	0,05	0,01		0,1		

53	Fluquinconazole	0,07	0,01		0,05		
54	Flutriafol	0,05	0,01		0,05		
55	Phorate	0,05	0,02	0,05	0,1	0,02	0,02
56	Fosetyl	0,05	0,5		5		
57	Aluminium Phosphide	0,1	0,01		0,05	0,1	0,1
58	Magnesium Phosphide	0,1	0,01		0,05	0,1	0,1
59	Fosthiazate	0,1	0,01		0,05		
60	Gamma-Cyhalothrin	0,05	0,01				
61	Glyphosate	1,0	1		0,1	1	1
62	Glufosinate-Ammonium	0,05	0,01		0,1		
63	Hexythiazox	0,1	0,01		0,05		
64	Cooper Hidroxide	SR	SR		50		
65	Imidacloprid	0,07	0,7	1	1	0,8	0,8
66	IminoctadineTris(Albesilate)	0,1	0,02				
67	Iprodione	2	0,05		0,1		
68	Lambda-Cyhalothrin	0,05	0,01		0,05		
69	Lufenorun	0,05	0,01		0,02		
70	Mancozeb	0,3**	5**	0,1 **	0,1		
71	Methanol	NR	NR				
72	Metconazole	0,2	0,01		0,02		
73	Metribuzin	0,1	0,01		0,1		
74	Metsulfuron-Methyl	0,02	0,01		0,1		
75	Myclobutanil	0,1	0,01		0,05		
76	Msma	0,07	0,01				
77	Novaluron	0,50	0,01		0,01		
78	Mineral Oil	NR	NR				
79	Copper Oxychloride	NR	NR		50		
80	Cuprous Oxide	NR	NR		50		
81	Oxyfluorfen	0,05	0,05		0,05	0,05	0,05
82	Pencycuron		0,01		0,05		
83	Pendimethalin	0,1	0,01		0,1		
84	Permethrin	0,01	0,05	0,05	0,1		
85	Picoxystrobin	0,01	0,01		0,1		
86	Pyraclostrobin	0,5	0,3	0,3	0,2		
87	Pyridaphenthion	0,5	0,01				
88	Pyriproxyfen	0,1	0,01		0,05	0,1	0,1
89	Profenofos	0,03	0,01		0,1		
90	Propargite	0,3	0,01		0,02		
91	Propiconazole	0,05	0,1	0,02	0,1		
92	Simazine	0,02	0,01		0,05		
93	Copper Sulfate	NR	NR		50		
94	Sulfentrazone	0,5	0,05				
95	Tebuconazole	0,2	0,2	0,1	0,1	0,3	0,3
96	Teflubenzuron	0,5	0,02		0,05		
97	Terbufos	0,05	0,05	0,05	0,01	0,05	0,05
98	Tetraconazole	0,08	0,01		0,02		
99	Thiamethoxan	0,02	0,05	0,2	0,05	0,05	0,05
100	Thifluzamide	0,05	0,01				
101	Thiophanate-Methyl	0,03**	5**	0,1 **	0,1		
102	Triadimenol	0,5	0,1	0,5	0,2		
103	Triazophos	0,01	ND		0,02		
104	Trifloxystrobin	0,05	0,05		0,05		
105	Zeta-Cypermethrin	0,05	0,05	0,05	0,1		
106	2,4-D	0,1	0,01		0,1		
107	5,9-Dimethylpentadecane	NR	NR				

Sources: Adapted from Araújo (2013), with data from Brazilian Ministry of Agriculture –MAPA (Agrofit- MAPA's Agrochemical data bank); National Agency of Sanitary Vigilance – ANVISA (agrotoxic products thesis); National Union for the Industry of Vegetable Defense Products (SINDIVEG); Giagro- Group of experts that discuss and propose a sustainable scenario for pesticides in Brazil; Codex Alimentarius; FAO/WHO Food Standards: http://.codexalimentarius.net/mrls/pestdes/jsp/pest_q-e.jsp

European Union: http://ec.europa.eu/food/plant/protection/pesticides/index_en.htm

Subtitles

** Maximum residue limits (**MRL**) determined as carbon dissulfied (CS2);

ND: *not detected*;

NR: no restrictions

Table 2 – Maximum residue limits (MRL) in mg/kg and year of validity for active ingredients in coffee beans of the Codex Alimentarius

Active Ingredient	MRL (mg/kg)	Year of validity
Saflufenacil	0.01	2012
Propiconazole	0.02	2008
Azoxystrobin	0.02	2012
Haloxyfop	0.02	2010
Spirodiclofen	0.03	2010
Phorate	0.05	2006
Permethrin	0.05	
Cypermethrins (including alpha- and zeta-cypermethrin)	0.05	2009
Chlorpyrifos	0.05	2003
Clothianidin	0.05	2011
Terbufos	0.05	2006
Boscalid	0.05	2010
Tebuconazole	0.1	2012
Carbendazim	0.1	2001
Aldicarb	0.1	
Flutriafol	0.15	2012
Disulfoton	0.2	1995
Thiamethoxam	0.2	2011
Endosulfan	0.2	2007
Pyraclostrobin	0.3	2007
Triadimenol	0.5	2008
Triadimefon	0.5	2008
Carbofuran	1	1999
Imidacloprid	1	2009

Table 3 – Maximum residue limits (MRL) in mg/kg and date of validity for active ingredients in coffee beans in the European Union.

Active Ingredient	MRL (mg/kg)	Date of validity
1,1-dichloro-2,2-bis(4-ethylphenyl)ethane (Perthane)(Ethylan)	0.1*	2/9/2008
1,2-dibromoethane (ethylene dibromide)	0.02*	2/9/2008
1,2-dichloroethane (ethylene dichloride)	0.02*	2/9/2008
1,3-Dichloropropene	0.05*	2/9/2008
1-Naphthylacetamide	0.05*	2/9/2008
1-Naphthylacetic acid	0.05*	2/9/2008
1-methylcyclopropene	0.02*	2/9/2008
2,4 DB	0.05*	2/2/2014
2,4,5-T	0.05*	2/9/2008
2,4-D (sum of 2,4-D, its salts, its esters and its conjugates, expressed as 2,4-D)	0.1*	6/7/2014
8-hydroxyquinoline sulphate	0.01*	20/10/2013
Abamectin (sum of avermectin B1a, avermectinB1b and delta-8,9 isomer of avermectin B1a)	0.02*	26/5/2011
Acephate	0.05*	26/4/2013
Acequinocyl	0.02*	1/9/2013
Acetamiprid	0.05*	25/8/2014
Acetamiprid	0.1*	5/6/2013
Acetochlor	0.01*	2/9/2008
Acibenzolar-S-methyl (sum of acybenzolar-S-methyl and acibenzolar acid (CGA 210007) expressed as acybenzolar-S-methyl)	0.05*	16/1/2015
Acibenzolar-S-methyl (sum of acybenzolar-S-methyl and acibenzolar acid (CGA 210007) expressed as acybenzolar-S-methyl)	0.05*	22/10/2012
Aclonifen	0.05*	2/9/2008
Acrinathrin	0.05*	2/9/2008
Alachlor	0.05*	26/4/2013
Aldicarb (sum of aldicarb, its sulfoxide and its sulfone, expressed as aldicarb)	0.1	21/10/2011
Aldrin and Dieldrin (Aldrin and dieldrin combined expressed as dieldrin)	0.02*	2/9/2008
Ametoctradin	0.01*	5/6/2014
Amidosulfuron	0.05*	28/3/2012
Aminopyralid	0.02*	10/2/2014
Amisulbrom	0.01*	22/10/2012
Amitraz (amitraz including the metabolites containing the 2,4 - dimethylaniline moity expressed as amitraz)	0.1*	2/9/2008
Amitrole	0.02	2/9/2008
Anilazine	0.05*	26/4/2013
Aramite	0.1*	2/9/2008
Asulam	0.05*	2/9/2008
Atrazine	0.1*	2/9/2008
Aureobasidium pullulans strains DSM 14940 and DSM 14941	0.01*	27/1/2013
Azadirachtin	0.01*	2/9/2008
Azimsulfuron	0.1*	2/9/2008
Azimsulfuron	0.05*	11/10/2014

Azinphos-ethyl	0.05*	2/9/2008
Azinphos-methyl	0.1*	2/9/2008
Azocyclotin and Cyhexatin (sum of azocyclotin and cyhexatin expressed as cyhexatin)	0.05*	26/4/2013
Azoxystrobin	0.1*	5/6/2014
Barban	0.1*	2/9/2008
Beflubutamid	0.05*	6/7/2014
Benalaxyl	0.1*	2/9/2008
Benalaxyl including other mixtures of constituent isomers including benalaxyl-M (sum of isomers)	0.1*	28/5/2011
Benfluralin	0.05*	2/9/2008
Benfuracarb	0.1*	26/4/2013
Bentazone (sum of bentazone and the conjugates of 6-OH and 8-OH bentazone expressed as bentazone)	0.1*	28/3/2012
Benthiavalicarb (Benthiavalicarb-isopropyl (KIF-230 R-L) and its enantiomer (KIF-230 S-D) and diastereomers (KIF-230 R-L and KIF-230 S-D)	0.05*	13/11/2014
Benthiavalicarb (Benthiavalicarb-isopropyl (KIF-230 R-L) and its enantiomer (KIF-230 S-D) and diastereomers (KIF-230 R-L and KIF-230 S-D)	0.01*	2/9/2008
Bifenazate	0.05*	19/8/2014
Bifenazate	0.02*	28/3/2013
Bifenox	0.05*	2/9/2008
Bifenthrin	0.1*	14/6/2012
Binapacryl	0.1*	2/9/2008
Biphenyl	0.05*	5/10/2011
Bitertanol	0.05*	6/6/2014
Bixafen	0.01*	1/9/2013
Boscalid	0.5	14/6/2012
Bromide ion	70	2/9/2008
Bromophos-ethyl	0.1*	2/9/2008
Bromopropylate	0.05*	21/10/2011
Bromoxynil (bromoxynil including its esters expressed as bromoxynil)	0.1*	2/9/2008
Bromuconazole (sum of diasteroisomers)	0.05*	2/9/2008
Bupirimate	0.05*	2/9/2008
Buprofezin	0.05*	28/5/2011
Butralin	0.05*	25/8/2014
Butralin	0.02*	2/9/2008
Butylate	0.05*	26/4/2013
Cadusafos	0.01*	14/6/2012
Camphechlor (Toxaphene)	0.1*	2/9/2008
Captafol	0.1*	26/4/2013
Captan	0.05*	28/3/2013
Carbaryl	0.05*	26/4/2013
Carbendazim and benomyl (sum of benomyl and carbendazim expressed as carbendazim)	0.1*	1/1/2012
Carbetamide	0.05*	2/9/2008
Carbofuran (sum of carbofuran and 3-hydroxy-carbofuran expressed as carbofuran)	0.05*	26/4/2013

Carbosulfan	0.05*	26/4/2013
Carboxin	0.05*	2/9/2008
Carfentrazone-ethyl (determined as carfentrazone and expressed as carfentrazone-ethyl)	0.02*	2/9/2008
Chlorantranilipole (DPX E-2Y45)	0.02*	10/2/2014
Chlorbenside	0.1*	2/9/2008
Chlorbufam	0.1*	2/9/2008
Chlordane (sum of cis- and trans-chlrodane)	0.02*	2/9/2008
Chlordecone	0.02	2/9/2008
Chlorfenapyr	0.05*	26/4/2013
Chlorfenson	0.1*	2/9/2008
Chlorfenvinphos	0.05*	6/6/2014
Chloridazon	0.1*	2/9/2008
Chlormequat	0.1*	30/7/2014
Chlormequat	0.1*	11/9/2009
Chlorobenzilate	0.1*	2/9/2008
Chloropicrin	0.02*	2/9/2008
Chlorothalonil	0.1*	14/6/2012
Chlorotoluron	0.05*	25/8/2014
Chlorotoluron	0.05*	2/9/2008
Chloroxuron	0.1*	2/9/2008
Chlorpropham (chlorpropham and 3-chloroaniline, expressed as chlorpropham)	0.05*	19/8/2014
Chlorpropham (chlorpropham and 3-chloroaniline, expressed as chlorpropham)	0.1*	2/9/2008
Chlorpyrifos	0.2	2/9/2008
Chlorpyrifos-methyl	0.1*	2/9/2008
Chlorsulfuron	0.05*	2/9/2008
Chlorthal-dimethyl	0.05*	26/4/2013
Chlorthiamid	0.05*	26/4/2013
Chlozolinate	0.1*	2/9/2008
Chromafenozide	0.02*	2/9/2008
Cinidon-ethyl (sum of cinidon ethyl and its E-isomer)	0.1*	2/9/2008
Clethodim (sum of Sethoxydim and Clethodim including degradation products calculated as Sethoxydim)	0.1	2/9/2008
Clodinafop and its S-isomers and their salts, expressed as clodinafop	0.1*	6/3/2014
Clofentezine	0.05*	2/9/2008
Clomazone	0.05*	6/3/2014
Clopyralid	0.5	7/5/2012
Clothianidin	0.05*	5/6/2013
Copper compounds (Copper)	50	2/9/2008
Cyanamide including salts expressed as cyanamide	0.1*	2/9/2008
Cyazofamid	0.05*	13/11/2014
Cyazofamid	0.02*	22/10/2012
Cyclanilide	0.1*	6/7/2014
Cycloxydim including degradation and reaction products which can be determined as 3-(3-thianyl)glutaric acid S-dioxide (BH 517-TGSO2) and/or 3-hydroxy-3-(3-thianyl)glutaric acid S-dioxide (BH 517-5-OH-	0.05*	5/6/2014

TGSO2) or methyl esters thereof, calculated in total as cycloxydim		
Cyflufenamid (sum of Cyflufenamid (Z-isomers) and its E-isomer)	0.05*	30/7/2014
Cyflufenamid (sum of Cyflufenamid (Z-isomers) and its E-isomer)	0.05*	10/2/2014
Cyfluthrin (cyfluthrin including other mixtures of constituent isomers (sum of isomers))	0.1*	30/7/2014
Cyfluthrin (cyfluthrin including other mixtures of constituent isomers (sum of isomers))	0.1*	5/6/2014
Cyhalofop-butyl (sum of cyhalofop butyl and its free acids)	0.1*	13/11/2014
Cyhalofop-butyl (sum of cyhalofop butyl and its free acids)	0.05*	2/9/2008
Cymoxanil	0.05*	5/10/2011
Cypermethrin (cypermethrin including other mixtures of constituent isomers (sum of isomers))	0.1*	28/5/2011
Cyproconazole	0.1	20/10/2013
Cyprodinil	0.05*	20/10/2013
Cyromazine	0.05*	2/9/2008
Cyromazine	0.1*	14/8/2014
Cyromazine	0.05*	1/1/2012
DDT (sum of p,p'-DDT, o,p'-DDT, p-p'-DDE and p,p'-TDE (DDD) expressed as DDT)	1	2/9/2008
DNOC	0.1*	2/9/2008
Dalapon	0.1	2/9/2008
Daminozide (sum of daminozide and 1,1-dimethyl-hydrazine, expressed as daminazide)	0.1*	25/8/2014
Daminozide (sum of daminozide and 1,1-dimethyl-hydrazine, expressed as daminazide)	0.1*	2/9/2008
Dazomet (Methylisothiocyanate resulting from the use of dazomet and metam)	0.02*	2/9/2008
Deltamethrin (cis-deltamethrin)	2	14/6/2012
Desmedipham	0.1*	2/9/2008
Diallate	0.1*	2/9/2008
Diazinon	0.05*	1/9/2013
Dicamba	0.05*	30/7/2014
Dicamba	0.05*	14/6/2012
Dichlobenil	0.05*	26/4/2013
Dichlorprop, incl. Dichlorprop-p	0.05*	5/10/2011
Dichlorvos	0.02*	2/9/2008
Diclofop (sum diclofop-methyl and diclofop acid expressed as diclofop-methyl)	0.05*	2/9/2008
Dicloran	0.01*	2/9/2008
Dicofol (sum of p, p' and o,p' isomers)	0.1*	26/4/2013
Diethofencarb	0.05*	2/9/2008
Difenoconazole	0.05*	1/9/2013
Diflubenzuron	0.05*	2/9/2008
Diflufenican	0.05*	22/10/2012
Dimethachlor	0.02*	2/9/2008
Dimethenamid-p (dimethenamid-p including other mixtures of constituent isomers (sum of isomers))	0.02*	2/9/2008
Dimethipin	0.1*	26/4/2013
Dimethoate (sum of dimethoate and omethoate expressed as dimethoate)	0.05*	7/6/2010

Dimethomorph (sum of isomers)	0.05*	2/2/2014
Dimoxystrobin	0.01*	22/10/2012
Diniconazole (sum of isomers)	0.05*	6/7/2014
Dinocap (sum of dinocap isomers and their corresponding phenols expressed as dinocap)	0.1*	14/6/2012
Dinoseb	0.1*	2/9/2008
Dinoterb	0.1*	2/9/2008
Dioxathion	0.1*	2/9/2008
Diphenylamine	0.05*	2/3/2014
Diquat	0.1*	2/9/2008
Disulfoton (sum of disulfoton, disulfoton sulfoxide and disulfoton sulfone expressed as disulfoton)	0.05*	26/4/2013
Dithianon	0.01*	2/9/2008
Dithiocarbamates (dithiocarbamates expressed as CS2, including maneb, mancozeb, metiram, propineb, thiram and ziram)	0.1*	27/1/2013
Diuron	0.05*	6/3/2014
Dodine	0.1*	6/6/2014
EPTC (ethyl dipropylthiocarbamate)	0.05*	21/10/2011
Emamectin benzoate B1a, expressed as emamectin	0.02*	6/4/2013
Endosulfan (sum of alpha- and beta-isomers and endosulfan-sulphate expresses as endosulfan)	0.1*	2/9/2008
Endosulfan (sum of alpha- and beta-isomers and endosulfan-sulphate expresses as endosulfan)	0.1*	21/10/2011
Endrin	0.01*	2/9/2008
Epoxiconazole	0.05*	5/10/2011
Ethalfluralin	0.01*	6/3/2014
Ethephon	0.1*	1/1/2012
Ethion	0.02*	2/9/2008
Ethion	0.05*	21/10/2011
Ethirimol	0.05*	2/9/2008
Ethofumesate (sum of ethofumesate and the metabolite 2,3-dihydro-3,3-dimethyl-2-oxo-benzofuran-5-yl methane sulphonate expressed as ethofumesate)	0.1*	29/5/2011
Ethoprophos	0.02*	2/9/2008
Ethoxyquin	0.1*	16/1/2015
Ethoxyquin	0.05*	2/9/2008
Ethoxysulfuron	0.05*	2/1/2015
Ethoxysulfuron	0.1*	2/9/2008
Ethylene oxide (sum of ethylene oxide and 2-chloro-ethanol expressed as ethylene oxide)	0.2*	2/9/2008
Etofenprox	0.01*	6/4/2013
Etoxazole	0.05*	1/9/2013
Etridiazole	0.05*	2/9/2008
Famoxadone	0.05*	7/11/2009
Fenamidone	0.05*	10/10/2010
Fenamiphos (sum of fenamiphos and its sulphoxide and sulphone expressed as fenamiphos)	0.05*	1/1/2012
Fenarimol	0.05*	17/10/2014
Fenarimol	0.05*	7/6/2010

Fenazaquin	0.01*	10/10/2010
Fenbuconazole	0.05*	5/6/2014
Fenbutatin oxide	0.1*	7/11/2009
Fenchlorphos (sum of fenchlorphos and fenchlorphos oxon expressed as fenchlorphos)	0.1*	2/9/2008
Fenhexamid	0.1*	1/9/2013
Fenitrothion	0.05*	26/4/2013
Fenoxaprop-P	0.1	2/9/2008
Fenoxycarb	0.05*	2/9/2008
Fenpropathrin	0.02*	2/9/2008
Fenpropidin (sum of fenpropidin and its salts, expressed as fenpropidin)	0.05*	14/8/2014
Fenpropidin (sum of fenpropidin and its salts, expressed as fenpropidin)	0.05*	2/9/2008
Fenpropimorph	0.1*	2/9/2008
Fenpyrazamine	0.01*	5/6/2013
Fenpyroximate	0.1	5/5/2014
Fenthion (fenthion and its oxigen analogue, their sulfoxides and sulfone expressed as parent)	0.05*	21/10/2011
Fentin acetate	0.1*	2/9/2008
Fentin hydroxide	0.1*	2/9/2008
Fenvalerate and Esfenvalerate (Sum of RR & SS isomers)	0.1*	19/8/2014
Fenvalerate and Esfenvalerate (Sum of RR & SS isomers)	0.05*	2/9/2008
Fenvalerate and Esfenvalerate (Sum of RR & SS isomers)	0.1*	19/8/2014
Fipronil (sum fipronil + sulfone metabolite (MB46136) expressed as fipronil)	0.005*	22/8/2010
Flazasulfuron	0.02*	2/9/2008
Flazasulfuron	0.05*	11/10/2014
Flonicamid (sum of flonicamid, TNFG and TNFA)	0.05*	10/10/2010
Florasulam	0.05*	6/7/2014
Fluazifop-P-butyl (fluazifop acid (free and conjugate)	0.1	2/9/2008
Fluazinam	0.05*	28/3/2013
Flubendiamide	0.02*	5/5/2014
Flucycloxuron	0.05*	2/9/2008
Flucythrinate	0.1*	2/9/2008
Fludioxonil	0.05*	19/8/2014
Fludioxonil	0.05*	1/9/2013
Fludioxonil	0.05*	19/8/2014
Flufenacet (sum of all compounds containing the N fluorophenyl-N-isopropyl moiety expressed as flufenacet equivalent)	0.05*	2/9/2008
Flufenoxuron	0.05*	7/11/2009
Flufenzin	0.1*	26/4/2013
Flumioxazine	0.1*	2/9/2008
Fluometuron	0.02*	2/9/2008
Fluopicolide	0.02*	30/7/2014
Fluopicolide	0.02*	28/3/2013
Fluopyram	0.01*	5/6/2014
Fluoride ion	5	2/9/2008
Fluoroglycofene	0.02*	2/9/2008

Fluoxastrobin	0.1*	2/9/2008
Flupyrsulfuron-methyl	0.05*	2/9/2008
Fluquinconazole	0.05*	2/9/2008
Flurochloridone	0.1*	2/9/2008
Fluroxypyr (fluroxypyr including its esters expressed as fluroxypyr)	0.1*	11/9/2009
Flurprimidole	0.02*	2/9/2008
Flurtamone	0.05*	2/9/2008
Flusilazole	0.05*	16/1/2015
Flusilazole	0.05*	29/5/2010
Flutolanil	0.05*	2/9/2008
Flutriafol	0.15	30/7/2014
Flutriafol	0.15	5/6/2014
Fluxapyroxad	0.01*	5/6/2014
Folpet	0.05*	28/3/2013
Fomesafen	0.05*	21/10/2011
Foramsulfuron	0.05*	2/9/2008
Foramsulfuron	0.05*	11/10/2014
Forchlorfenuron	0.05*	13/11/2014
Forchlorfenuron	0.05*	2/9/2008
Formetanate: Sum of formetanate and its salts expressed as formetanate (hydrochloride)	0.05*	14/8/2014
Formetanate: Sum of formetanate and its salts expressed as formetanate(hydrochloride)	0.05*	2/9/2008
Formothion	0.05*	2/9/2008
Fosetyl-Al (sum fosetyl + phosphorous acid and their salts, express as fosetyl)	5*	30/7/2014
Fosetyl-Al (sum fosetyl + phosphorous acid and their salts, express as fosetyl)	5*	29/5/2010
Fosthiazate	0.05*	2/9/2008
Fuberidazole	0.05*	2/9/2008
Furathiocarb	0.05*	26/4/2013
Furfural	1	2/9/2008
Gibberellic acid	5	2/9/2008
Glufosinate-ammonium (sum of glufosinate, its salts, MPP and NAG expressed as glufosinate equivalents)	0.1*	5/6/2014
Glyphosate	0.1	6/4/2013
Guazatine	0.1*	2/9/2008
Halosulfuron methyl	0.02*	2/9/2008
Haloxyfop including haloxyfop-R (Haloxyfop-R methyl ester, haloxyfop-R and conjugates of haloxyfop-R expressed as haloxyfop-R)	0.05	2/9/2008
Heptachlor (sum of heptachlor and heptachlor epoxide expressed as heptachlor)	0.02*	2/9/2008
Hexachlorobenzene	0.02*	2/9/2008
Hexachlorociclohexane (HCH), sum of isomers, except the gamma isomer	0.02*	2/9/2008
Hexaconazole	0.05*	26/4/2013
Hexythiazox	0.05*	26/7/2012
Hymexazol	0.05*	2/9/2008
Imazalil	0.1*	22/8/2010

Imazamox	0.1*	2/9/2008
Imazaquin	0.05*	2/9/2008
Imazosulfuron	0.02*	2/9/2008
Imazosulfuron	0.05*	11/10/2014
Imidacloprid	1	5/6/2014
Indoxacarb (sum of indoxacarb and its R enantiomer)	0.05*	30/7/2014
Indoxacarb (sum of indoxacarb and its R enantiomer)	0.05*	5/6/2014
Ipconazole	0.02*	2/9/2008
Iprodione	0.1*	2/9/2008
Iprovalicarb	0.05*	6/3/2014
Isoproturon	0.05*	25/8/2014
Isoproturon	0.1*	2/9/2008
Isopyrazam	0.01*	5/5/2014
Isoxaben	0.02*	2/9/2008
Isoxaflutole (sum of isoxaflutole, RPA 202248 and RPA 203328, expressed as isoxaflutole)	0.1*	16/1/2015
Isoxaflutole (sum of isoxaflutole, RPA 202248 and RPA 203328, expressed as isoxaflutole)	0.1*	2/9/2008
Kresoxim-methyl	0.1*	5/5/2014
Lactofen	0.05*	26/4/2013
Lambda-Cyhalothrin	0.05*	1/9/2013
Lenacil	0.1*	2/9/2008
Lindane (Gamma-isomer of hexachlorocyclohexane (HCH))	0.1	2/9/2008
Linuron	0.1*	2/9/2008
Lufenuron	0.02*	2/9/2008
MCPA and MCPB (MCPA, MCPB including their salts, esters and conjugates expressed as MCPA)	0.1*	5/6/2014
Malathion (sum of malathion and malaoxon expressed as malathion)	0.02*	28/3/2012
Maleic hydrazide	0.05*	6/3/2014
Mandipropamid	0.02*	30/7/2014
Mandipropamid	0.02*	14/8/2011
Mecarbam	0.1*	2/9/2008
Mecoprop (sum of mecoprop-p and mecoprop expressed as mecoprop)	0.1*	2/9/2008
Mepanipyrim	0.05*	6/3/2014
Mepiquat	0.1*	10/2/2014
Mepronil	0.05*	26/4/2013
Meptyldinocap (sum of 2,4 DNOPC and 2,4 DNOP expressed as meptyldinocap)	0.1*	14/6/2012
Mercury compounds (sum of mercury compounds expressed as mercury)	0.02*	2/9/2008
Mesosulfuron-methyl expresssed as mesosulfuron	0.02*	2/9/2008
Mesosulfuron-methyl expresssed as mesosulfuron	0.05*	11/10/2014
Mesotrione (Sum of mesotrione and MNBA (4-methylsulfonyl- 2-nitro benzoic acid), expressed as mesotrione)	0.1*	2/9/2008
Metaflumizone (sum of E- and Z- isomers)	0.1*	17/10/2014
Metaflumizone (sum of E- and Z- isomers)	0.1*	28/5/2011
Metalaxyl and metalaxyl-M (metalaxyl including other mixtures of constituent isomers including metalaxyl-M (sum of isomers))	0.1*	10/2/2014
Metaldehyde	0.05*	30/7/2014

Metaldehyde	0.05*	26/7/2012
Metamitron	0.1*	2/9/2008
Metazachlor	0.2*	29/5/2010
Metconazole (sum of isomers)	0.1*	30/7/2014
Metconazole (sum of isomers)	0.1*	6/3/2014
Methabenzthiazuron	0.05*	21/10/2011
Methacrifos	0.1*	2/9/2008
Methamidophos	0.05*	26/4/2013
Methidathion	0.1*	21/10/2011
Methidathion	0.1*	2/9/2008
Methiocarb (sum of methiocarb and methiocarb sulfoxide and sulfone, expressed as methiocarb)	0.1*	2/9/2008
Methomyl and Thiodicarb (sum of methomyl and thiodicarb expressed as methomyl)	0.1*	7/6/2010
Methoprene	0.1*	26/4/2013
Methoxychlor	0.1*	2/9/2008
Methoxyfenozide	0.05*	5/6/2014
Metolachlor and S-metolachlor (metolachlor including other mixtures of constituent isomers including S-metolachlor (sum of isomers))	0.05*	6/7/2014
Metosulam	0.01*	2/9/2008
Metrafenone	0.05*	5/6/2013
Metribuzin	0.1*	2/9/2008
Metsulfuron-methyl	0.05*	2/1/2015
Metsulfuron-methyl	0.1*	2/9/2008
Mevinphos (sum of E- and Z-isomers)	0.02*	2/9/2008
Milbemectin (sum of milbemycin A4 and milbemycin A3, expressed as milbemectin)	0.1*	6/7/2014
Molinate	0.05*	16/1/2015
Molinate	0.1*	2/9/2008
Monocrotophos	0.05*	26/4/2013
Monolinuron	0.1*	2/9/2008
Monuron	0.05*	26/4/2013
Myclobutanyl	0.05*	2/9/2008
Napropamide	0.05*	2/9/2008
Nicosulfuron	0.05*	2/1/2015
Nicosulfuron	0.05*	2/9/2008
Nitrofen	0.02*	2/9/2008
Novaluron	0.01*	14/6/2012
Orthosulfamuron	0.01*	2/9/2008
Oryzalin	0.02*	2/9/2008
Oxadiargyl	0.05*	2/9/2008
Oxadiazon	0.05*	2/9/2008
Oxadixyl	0.02*	26/7/2012
Oxamyl	0.05*	14/8/2014
Oxamyl	0.02*	2/9/2008
Oxasulfuron	0.1*	2/9/2008
Oxasulfuron	0.05*	11/10/2014

Oxycarboxin	0.05*	26/4/2013
Oxydemeton-methyl (sum of oxydemeton-methyl and demeton-S-methylsulfone expressed as oxydemeton-methyl)	0.05*	26/4/2013
Oxyfluorfen	0.05*	2/9/2008
Paclobutrazol	0.02*	2/9/2008
Paraquat	0.05*	28/5/2011
Parathion	0.1*	2/9/2008
Parathion-methyl (sum of Parathion-methyl and paraoxon- methyl expressed as Parathion-methyl)	0.05*	2/9/2008
Parathion-methyl (sum of Parathion-methyl and paraoxon- methyl expressed as Parathion-methyl)	0.05*	26/4/2013
Penconazole	0.1*	2/9/2008
Pencycuron	0.05*	2/9/2008
Pendimethalin	0.1*	20/10/2013
Penoxsulam	0.02*	2/9/2008
Penthiopyrad	0.02*	5/6/2014
Permethrin (sum of isomers)	0.1*	2/9/2008
Pethoxamid	0.02*	2/9/2008
Phenmedipham	0.1*	2/9/2008
Phenothrin	0.05*	2/9/2008
Phorate (sum of phorate, its oxygen analogue and their sulfones expressed as phorate)	0.1*	2/9/2008
Phorate (sum of phorate, its oxygen analogue and their sulfones expressed as phorate)	0.05*	26/4/2013
Phosalone	0.05*	26/4/2013
Phosmet (phosmet and phosmet oxon expressed as phosmet)	0.1*	30/7/2014
Phosmet (phosmet and phosmet oxon expressed as phosmet)	0.1*	6/4/2013
Phosphamidon	0.02*	2/9/2008
Phosphines and phosphides: sum of aluminium phosphide, aluminium phosphine, magnesium phosphide, magnesium phosphine, zinc phosphide and zinc phosphine	0.05	2/9/2008
Phoxim	0.1	2/9/2008
Picloram	0.01*	30/7/2014
Picloram	0.01*	2/9/2008
Picolinafen	0.1*	2/9/2008
Picoxystrobin	0.05*	25/8/2014
Picoxystrobin	0.1*	2/9/2008
Pinoxaden	0.05*	2/9/2008
Pirimicarb: sum of pirimicarb and desmethyl pirimicarb expressed as pirimicarb	0.05*	22/8/2010
Pirimiphos-methyl	0.05*	2/9/2008
Prochloraz (sum of prochloraz and its metabolites containing the 2,4,6-Trichlorophenol moiety expressed as prochloraz)	0.2	28/5/2011
Procymidone	0.05*	26/4/2013
Profenofos	0.05*	1/9/2013
Profoxydim	0.1*	2/9/2008
Prohexadione (prohexadione (acid) and its salts expressed as prohexadione-calcium)	0.1*	20/3/2013
Propachlor: oxalinic derivate of propachlor, expressed as propachlor	0.1*	26/4/2013
Propamocarb (Sum of propamocarb and its salt expressed as	0.2*	10/2/2014

propamocarb)		
Propamocarb (Sum of propamocarb and its salt expressed as propamocarb)	0.05*	11/10/2014
Propanil	0.1*	2/9/2008
Propaquizafop	0.05*	2/9/2008
Propargite	0.02*	2/9/2008
Propham	0.1*	2/9/2008
Propiconazole	0.1*	5/6/2013
Propineb (expressed as propilendiamine)	0.1*	2/9/2008
Propisochlor	0.01*	2/9/2008
Propoxur	0.1*	2/9/2008
Propoxycarbazone (propoxycarbazone, its salts and 2-hydroxy-propoxy-propoxycarbazone, calculated as propoxycarbazone)	0.1*	16/1/2015
Propoxycarbazone (propoxycarbazone, its salts and 2-hydroxy-propoxy-propoxycarbazone, calculated as propoxycarbazone)	0.05*	2/9/2008
Propyzamide	0.05*	30/7/2014
Propyzamide	0.05*	2/9/2008
Proquinazid	0.05*	28/3/2013
Prosulfocarb	0.05*	6/3/2014
Prosulfuron	0.05*	2/1/2015
Prosulfuron	0.1*	2/9/2008
Prothioconazole (Prothioconazole-desthio)	0.02*	1/9/2013
Pymetrozine	0.1*	13/11/2014
Pymetrozine	0.1*	28/3/2013
Pyraclostrobin	0.3	2/2/2014
Pyraflufen-ethyl	0.1*	16/1/2015
Pyraflufen-ethyl	0.05*	2/9/2008
Pyrasulfutole	0.02*	2/9/2008
Pyrazophos	0.1*	2/9/2008
Pyrethrins	0.5	2/9/2008
Pyridaben	0.05*	2/9/2008
Pyridalyl	0.02*	7/11/2009
Pyridate (sum of pyridate, its hydrolysis product CL 9673 (6-chloro-4-hydroxy-3-phenylpyridazin) and hydrolysable conjugates of CL 9673 expressed as pyridate)	0.1*	28/3/2013
Pyrimethanil	0.05*	25/8/2014
Pyrimethanil	0.1*	5/10/2011
Pyriproxyfen	0.05*	30/7/2014
Pyriproxyfen	0.05*	2/9/2008
Pyroxsulam	0.02*	2/9/2008
Quinalphos	0.1*	2/9/2008
Quinclorac	0.05*	26/4/2013
Quinmerac	0.1*	2/9/2008
Quinoclamine	0.05*	16/1/2015
Quinoxyfen	0.05*	10/2/2014
Quintozene (sum of quintozene and pentachloro-aniline expressed as quintozene)	0.05*	2/9/2008
Quintozene (sum of quintozene and pentachloro-aniline expressed as	0.1*	26/4/2013

quintozene)		
Quizalofop, incl. quizalfop-P	0.05*	5/6/2013
Resmethrin (resmethrin including other mixtures of consituent isomers (sum of isomers))	0.2*	2/9/2008
Rimsulfuron	0.05*	2/1/2015
Rimsulfuron	0.1*	2/9/2008
Rotenone	0.02*	2/9/2008
Saflufenacil (sum of saflufenacil, M800H11 and M800H35, expressed as saflufenacil)	0.03*	30/7/2014
Silthiofam	0.05*	13/11/2014
Silthiofam	0.1*	2/9/2008
Simazine	0.05*	21/10/2011
Spinetoram (XDE-175)	0.1*	5/6/2014
Spinosad: sum of spinosyn A and spinosyn D, expressed as spinosad	0.02*	30/7/2014
Spinosad: sum of spinosyn A and spinosyn D, expressed as spinosad	0.02*	6/4/2013
Spirodiclofen	0.05*	27/1/2013
Spiromesifen	0.02*	5/6/2013
Spirotetramat and its 4 metabolites BYI08330-enol, BYI08330-ketohydroxy, BYI08330-monohydroxy, and BYI08330 enol-glucoside, expressed as spirotetramat	0.1*	5/5/2014
Spiroxamine	0.1*	2/9/2008
Sulfosulfuron	0.05*	2/1/2015
Sulfosulfuron	0.1*	2/9/2008
Sulfuryl fluoride	0.02*	2/9/2008
Sum of 2-Phenylphenol, its salts and conjugates, expressed as 2-phenylphenol	0.1*	30/7/2014
Sum of 2-Phenylphenol, its salts and conjugates, expressed as 2-phenylphenol	0.1*	1/10/2012
TEPP	0.02*	2/9/2008
Tebuconazole	0.1	14/8/2014
Tebuconazole	0.1	5/6/2013
Tebufenozide	0.1	10/10/2010
Tebufenpyrad	0.1	27/1/2013
Tecnazene	0.1*	2/9/2008
Teflubenzuron	0.05*	17/10/2014
Teflubenzuron	0.05*	2/9/2008
Tefluthrin	0.05	2/9/2008
Tembotrione	0.05*	28/3/2013
Terbufos	0.01*	2/9/2008
Terbuthylazine	0.05*	2/9/2008
Tetraconazole	0.02*	27/1/2013
Tetradifon	0.05*	21/10/2011
The sum of tepraloxydim and its metabolites that can be hydrolysed either to the moiety 3-(tetrahydro-pyran-4-yl)-glutaric acid or to the moiety 3-hydroxy-(tetrahydro-pyran-4-yl)-glutaric acid, expressed as tepraloxydim	0.1*	6/3/2014
Thiabendazole	0.1*	2/9/2008
Thiacloprid	0.05*	5/5/2014
Thiamethoxam (sum of thiamethoxam and clothianidin expressed as	0.2	5/6/2013

thiamethoxam)		
Thifensulfuron-methyl	0.05*	2/1/2015
Thifensulfuron-methyl	0.1*	2/9/2008
Thiobencarb	0.05*	19/8/2014
Thiobencarb	0.1*	2/9/2008
Thiophanate-methyl	0.1*	1/1/2012
Thiram (expressed as thiram)	0.2*	11/9/2009
Tolclofos-methyl	0.1*	2/9/2008
Tolylfluanid (Sum of tolylfluanid and dimethylaminosulfotoluidide expressed as tolylfluanid)	0.1*	26/4/2013
Topramezone (BAS 670H)	0.02*	2/9/2008
Tralkoxydim	0.05*	2/9/2008
Tri-allate	0.1*	2/9/2008
Triadimefon and triadimenol (sum of triadimefon and triadimenol)	0.2*	29/5/2010
Triasulfuron	0.1*	1/1/2012
Triazophos	0.02*	14/6/2012
Tribenuron-methyl	0.02*	2/9/2008
Trichlorfon	0.05*	26/4/2013
Triclopyr	0.1*	22/8/2010
Tricyclazole	0.05*	2/9/2008
Tridemorph	0.05*	26/4/2013
Trifloxystrobin	0.05*	30/7/2014
Trifloxystrobin	0.05*	5/6/2014
Triflumizole: Triflumizole and metabolite FM-6-1(N-(4-chloro-2-trifluoromethylphenyl)-n-propoxyacetamidine), expressed as Triflumizole	0.1*	2/9/2008
Triflumuron	0.05*	2/9/2008
Trifluralin	0.05*	26/4/2013
Triflusulfuron	0.05*	2/9/2008
Triforine	0.05*	21/10/2011
Trimethyl-sulfonium cation, resulting from the use of glyphosate	0.05*	2/9/2008
Trinexapac	0.05*	25/8/2014
Trinexapac	0.05*	2/9/2008
Triticonazole	0.02*	1/1/2012
Tritosulfuron	0.02*	2/9/2008
Valifenalate	0.02*	22/8/2010
Valiphenal	0.02*	2/9/2008
Vinclozolin (sum of vinclozolin and all metabolites containing the 3,5-dichloraninilinemoiety, expressed as vinclozolin)	0.1*	6/6/2014
Warfarin	0.01*	16/1/2015
Ziram	0.2*	2/9/2008
Zoxamide	0.05*	28/5/2011
ethametsulfuron-methyl	0.02	14/8/2011
Imazapic	0.01*	28/3/2012
iodosulfuron-methyl (iodosulfuron-methyl including salts, expressed as iodosulfuron-methyl)	0.05*	2/9/2008
Iodosulfuron-methyl (Iodosulfuron-methyl including salts, expressed as Iodosulfuron-methyl)	0.05*	11/10/2014
Ioxynil, including its esters expressed as Ioxynil	0.05*	6/3/2014

Isoprothiolane	0.01*	30/7/2014
Isoprothiolane	0.01*	26/7/2012
Sulcotrione	0.05*	2/9/2008
tau-Fluvalinate	0.01*	2/9/2008

(*) determines the lower determined analytical limit

Table 4 – Maximum residue limits (MRL) in ppm e date of validity for active ingredients in coffee beans in Japan.

Active Ingredient	MRL (ppm)	Date of validity
Aldicarb And Aldoxycarb	0.1	
Aldrin And Dieldrin	0.1	
Asulam	0.02	
Azocyclotin, Cyhexatin	0.5	
Azoxystrobin	0.05	
Bensulide	0.03	
Bentazone	0.02	
Benzyladenine	0.02	
Bilanafos (Bialaphos)	0.004	
Bioresmethrin	0.1	
Boscalid	0.05	
Brodifacoum	0.001	
Bromide	60	
Sec-Butylamine	0.1	
Carbendazim, Thiophanate, Thiophanate-Methyl And Benomyl	0.1	
Carbofuran	1	
Carfentrazone-Ethyl	0.1	
Chlorantraniliprole	0.4	
Chlorfluazuron	0.05	
Chlorothalonil	0.2	
Chlorpyrifos	0.05	
Clodinafop-Propargyl	0.02	
Clofentezine	0.02	
Clomazone	0.02	
Clothianidin	0.05	
Copper Nonylphenolsulfonate	0.04	
4-Cpa	0.02	
Cycloprothrin	0.02	
Cycloxydim	0.05	
Cyfluthrin	0.02	
Cymoxanil	0.05	
Cypermethrin	0.05	
Cyproconazole	0.1	
Dbedc	0.5	
Deltamethrin And Tralomethrin	2.0	
Demeton-S-Methyl	0.05	
Diafenthiuron	0.02	
Dichlorvos And Naled	0.2	
Diclomezine	0.02	
Difenzoquat	0.05	
Diflubenzuron	0.05	

Diflufenican	0.002	
Diflufenzopyr	0.05	
Dimethipin	0.04	
Diquat	0.05	
Disulfoton	0.2	
Dithiocarbamates	5	
Diuron	0.02	
2,2-Dpa	0.05	
Endosulfan	0.1	
Endrin	N.D.	
Ethephon	0.1	
Ethylene Dibromide (Edb)	N.D.	
Fenbutatin Oxide	0.05	
Fenoxycarb	0.05	
Fenpyroximate	0.02	02/04/2015
Fentin	0.1	
Fipronil	0.002	
Flazasulfuron	0.02	
Fluazifop	0.1	
Flucythrinate	0.05	
Fluometuron	0.02	
Fluoroimide	0.04	
Flutriafol	0.2	
Fosetyl	0.5	
Glufosinate	0.1	
Glyphosate	1.0	
Hexaconazole	0.05	
Hydrogen Cyanide	1	
Hydrogen Phosphide	0.06	
Hymexazol	0.02	
Imazaquin	0.05	
Imazethapyr Ammonium	0.05	
Imidacloprid	0.7	
Iminoctadine	0.02	
Iprodione	0.05	
Isouron	0.02	
Lindane	0.002	
Linuron	0.02	
Malathion	0.5	
Maleic Hydrazide	0.2	
Methidathion	1	
Molinate	0.02	07/02/2015
Napropamide	0.1	
Nitenpyram	0.03	
Oryzalin	0.1	
Oxamyl	0.10	

Oxyfluorfen	0.05
Paraquat	0.05
Permethrin	0.05
Phenothrin	0.02
Phorate	0.02
Phoxim	0.02
Pindone	0.001
Probenazole	0.03
Prochloraz	0.2
Prohexadione-Calcium	0.02
Propiconazole	0.1
Pyraclostrobin	0.3
Pyrazolynate	0.02
Pyrethrins	0.05
Saflufenacil	0.03
Spirodiclofen	0.03
Sulfentrazone	0.05
Sulfuryl Fluoride	1
Tebuconazole	0.2
Tebuthiuron	0.02
Teflubenzuron	0.02
Tepraloxydim	0.05
Terbufos	0.05
Thiamethoxam	0.2
Thiodicarb And Methomyl	1
Triadimefon	0.05
Triadimenol	0.1
Triclopyr	0.03
Tricyclazole	0.02
Trifloxystrobin	0.05
Triflumizole	0.05
Triflumuron	0.02
Warfarin	0.001

Source: Elaborated with data from datas de FFCR(2014). Data base 15 set 2014.

Table 5 – Maximum residue limits (MRL) of the active ingredientes sold by the Coxupé Cooperative from 2009 to 2012 for the coffee crops.

Nº	Active ingredient	Maximum Residue Limit (mg/kg)				
		Brazil	Japan	Codex	EU	USA
1	2,4-D	0,1	0,01		0,1	
2	abamectin	0,002	0,008		0,02	
3	4- inde-3 ylbutyric acid	SR	SR			
4	gibberrellic Acid	SR	SR		5	
5	alachlor	0,05	0,01		0,05	
6	aldicarb	0,1	0,1	0,1	0,1	0,1
7	alfa-cypermethrin	0,01	0,05	0,05		
8	azoxistrobin	0,05	0,05		0,1	
9	Boscalid	0,05	0,05	0,05	0,5	
10	carbofuran	0,1	1	1	0,05	0,1
11	carfentrazone-ethyl	0,05	0,1		0,02	0,1
12	cypermethrin	0,05	0,05	0,05	0,1	
13	ciproconazole	0,1	0,01		0,1	0,1
14	clorantraniliprole	0,03	0,01		0,02	
15	benzalkonium chloride	1	0,01			
16	cartap hydrochloride	0,1	0,01			
17	chlorpyrifos	0,05	0,05	0,05	0,2	
18	deltamethrin	1	2		2	
19	dissulfoton	0,1	0,2	0,2	0,05	0,2
20	diuron	1	0,02		0,1	
21	endosulfan	0,05	0,1	0,2	0,1	
22	epoxiconazole	0,1	0,01		0,05	0,05
23	spirodiclofen	0,03	0,01	0,03	0,05	
24	fenpyroximate	0,05	0,02		0,1	
25	fenpropathrine	0,5	0,01		0,02	
26	flumioxazine	0,05	0,01		0,1	
27	flutriafol	0,05	0,2		0,05	
28	glyphosate	1,0	1		0,1	1
29	hexytiazox	0,1	0,01		0,05	
30	copper hidroxide	SR	SR		50	
31	imidacloprid	0,07	0,7	1	1	0,8
32	iminoctadine tris(albesilate)	0,1	0,02			
33	iprodione	2	0,05		0,1	
34	lambda-cyalothrina	0,05	0,01		0,05	
35	lufenuron	0,05	0,01		0,02	
36	mancozeb	0,3**	5**	0,1 **	0,1	
37	metconazole	0,2	0,01		0,02	

38	metsulfuron-methyl	0,02	0,01		0,1	
39	novaluron	0,50	0,01		0,01	
40	mineral oil	SR	SR			
41	copper oxychloride	SR	SR		50	
42	oxifluorfen	0,05	0,05		0,05	0,05
43	paraquat dichloride	0,05	0,05		0,05	0,05
44	picoxystrobin	0,01	0,01		0,1	
45	pyraclostrobin	0,5	0,3	0,3	0,2	
46	profenofos	0,03	0,01		0,1	
47	glufosinate - ammonium	0,05	0,01		0,1	
48	tebuconazole	0,2	0,2	0,1	0,1	0,3
49	teflubenzuron	0,5	0,02		0,05	
50	terbufos	0,05	0,05	0,05	0,01	0,05
51	thiamethoxam	0,02	0,05	0,2	0,05	0,05
52	tiophanatr-methyl	**0,03****	**5****	**0,1 ****	0,1	
53	triadimenol	0,5	0,1	0,5	0,2	
54	triazofos	0,01	**ND**		0,02	
55	trifloxystrobin	0,05	0,05		0,05	

Source : Adapted from Araújo (2013)

Table 6 – Active Ingredients with restrictions abroad sold by the Coxupé Coopeartive from 2009 to 2012 for coffee.

Nº	Active Ingredient	USA[1]	EU[2]	PAN Dirty Dozen[3]	Nº
1	fentin acetate		X		1
2	alachlor		X		2
3	aldicarb			X	3
4	cadusafos		X		4
5	carbofuran	X	X		5
6	paraquat dichloride			X	6
7	endosulfan	X	X		7
8	fenthion		X		8
9	permethrin		X		9
10	simazine		X		10
11	triazophos		X		11
12	trichlorphon		X		12

Source: Adapted from Araújo (2013)

Subtitle:

[1]Pesticides banned or severly restricted in the USA

[1]Pesticides banned or severly restricted in the European Union

[3] Pesticides present in the "Dirty Dozen Pesticides" list[3]Pesticidas presentes na lista "Dirty Dozen Pesticides"

Table 7 – Herbicides sold by the Coxupé Cooperative from 2009 to 2012 for coffee.

Comercial Product	Active Ingredients	# of Users	Register of the Comerical Product for Coffee in Brazil	Restricted use for countries that import
Ally	metsulfuron-methyl	16	yes	no
Aurora	carfentrazone-ethyl	24	yes	no
Crucial	glyphosate	2	yes	no
Flumizin	flumioxazine	96	yes	no
Fusilade 250 Ew	fluazifop-p-butyl	1	no	no
Gesaprim	atrazine	1	no	no
Glyphosate	glyphosate	9	yes	no
Goal	oxifluorfen	3	yes	no
Gramocil	diuron+parquat dicholoride	5	yes	yes
Provence	isoxaflutole	1	no	no
Roundup	glyphosate	156	yes	no
Stinger	glyphosate	4	yes	no
Sumizin	flumioxazine	1	no	no
verdict	chlorimuron-ethyl	1	no	no

Source: Adapted from Araújo (2013)

Table 8 – Agrochemicals applied to soil (fungicides, insecticides e nematicides) sold by Coxupé Cooperative from 2009 to 2012 for coffee crops.

Comercial Product	Active Ingredient	# of Users	Register of the Comerical Product for Coffee in Brazil	Restricted use for countries that import
Rugby	cadusafos	1	yes	yes
Baysiston	disulfoton+triadimenol	2	yes	yes
Impact	flutriafol	30	yes	no
Premier	imidacloprid	24	yes	no
Warrant	imidacloprid	1	yes	no
Impact Mix	imidacloprid+flutriafol	7	yes	no
Premier Plus	imidacloprid+triadimenol	30	yes	no
Counter	terbufos	1	yes	yes
Actara	thiamethoxam	33	yes	no
Verdadero	tiametoxam+cyproconazole	96	yes	no
Não Usaram		11		

Source: Adapted from Araújo (2013)

Table 9 – Foliar agrochemicals sold by Coxupé Cooperative from 2009 to 2012 for coffee crops.

Comercial Product	Active Ingredient	# of Users	Register of the Comerical Product for Coffee in Brazil	Restricted use for countries that import
Grimectin	abamectin	1	no	no
Vertimec	abamectin	4	yes	no
Fastac	alfa-cypermethrin	1	yes	no
Amistar	azoxistrobin	20	yes	no
Priorixtra	azoxistrobin+cyproconazole	77	yes	no
Authority	azoxistrobin+flutriafol	1	yes	no
Cantus	boscalid	36	yes	no
Kasumin	kasugamycin	5	yes	no
Polytrin	cipermetrin+profenofos	1	yes	no
Alto 100	cyproconazole	4	yes	no
Lorsban	clorpirifos	3	yes	no
Endosulfan	endosulfan	3	yes	yes
Thiodan	endosulfan	3	yes	yes
Opus	epoxiconazole	1	yes	no
Rubric	epoxiconazole	1	yes	no
Garra	copper hydroxide	1	yes	no
Kocide	copper hidroxide	2	yes	no
Supera	copper hidroxide	49	yes	no
Tutor	copper hidroxide	10	yes	no
Stimulate	plant hormones	2	yes	no
Rovral	iprodione	2	yes	no
Curyom	lufenuron+profenofos	1	yes	no
Dithane	mancozebe	1	yes	no
Aureo	mineral oil	2	yes	no
Nimbus	mineral oil	26	yes	no
Cobre	copper oxycloride	1	yes	no
Cuprogarb	copper oxycloride	1	yes	no
Recop	copper oxycloride	4	yes	no
Cuprozeb	copper oxycloride +mancozeb	7	yes	no
Red Shield	cuprous oxide	1	yes	no
Comet	pyraclostrobin	3	yes	no
Shake	pyraclostrobin	2	yes	no
Ópera	pyraclostrobin+epoxiconazole	71	yes	no
Folicur	tebuconazole	8	yes	no
Riza	tebuconazole	6	yes	no
Nomolt	teflubenzuron	1	yes	no
Cercobin	thiophanate-methyl	12	yes	no
Metiltiofan	thiophanate-methyl	1	no	no
Sphere Max	trifloxystrobin+cyproconazole	16	yes	no
Did not use anything		15		

4 STRATEGIC SUPPLY CONTRACTS FOR HIGH QUALITY COFFEE

Decio Zylbersztajn, Samuel Ribeiro Giordano, Christiane Leles Rezende De Vita

4.1. INTRODUCTION

The fundamental strategy defined by Illycaffè is offering the global Market a product recognized by its elevated standard of quality, which is also it's mission: offer the "best coffee in the global Market".

This research focuses on guaranteeing the acquisition of special coffees and explores the potential innovations in the relationships between Illycaffè industry and its suppliers to guarantee the supply. In particular it analyses the potential in the establishment of formal contracts and other forms of long-term relationships

The supply of special coffees was the center of attention since Illy arrived in Brazil in 1990. The country was going though a deregulation process that affected agriculture and principally the coffee agribusiness. The scenario of fixed prices, the interference in the agricultural policies from the Brazilian Coffee Institute- changed, and in its place the markets started to operate more freely, with sensitive impacts in the pricing of the product. If in the previous period producers did not have incentives to invest in the production of special coffees, after the deregulation of the Market, prices started signaling more efficiency, giving rise to the emergence of a specialized system of coffee production alongside commodity coffees.

Illy arrived in Brazil at the exact moment this window of opportunity opened. Its strategies demonstrated that the company knew how to take advantage of this. Before any other company, Illy established close ties with the producers. It created a network of organizations that operated and still do coordinately, and established a pattern of management innovation never seen before. The addition of the Illy quality prize, the payment of a compensating price, the establishment of communication channels between the company and the producers, the establishment of the Illy Club, and the Università del Caffè Brazil (from now on UDC Brazil) and the research done by PENSA, created the conditions of establishing a reputation for the company in Brazil.

As time passed the market for special coffees developed. If in the past the guarantee of the acquisition of special coffees by part of the industries demanded specialized coordinated actions, in the 2010's it is possible for any roasting company to buy excellent quality coffee of different origins, from established producers and commercializers. The central questions of this research stems from this. How to lead the innovation process in the agribusiness relationships to guarantee that Illy maintain its leadership and reaches the aim mentioned above to guarantee the supply of coffee in quantity, quality ad adequate prices.

The research aims to further study two aspects: the process of innovation in coffee growing and the potential for the establishment of contractual relations with the producers. Therefore, the present report tis structured in 7 parts.

After this introduction, chapter 2 describes the method used. Part 3 describes the Coffee Agribusiness System based on the method developed by PENSA. Part 4 describes the results of the interviews with the producers. Part 5 discusses the strategy for establishing long-term contracts with the producers, and the relationship of Illy with the producers in Brazil. Part 6 discusses the theme of innovation. Finally, part 7 presents conclusions and propositions.

4.2. METHODOLOGY

This research was elaborated with a focus on the issues of: contracts, innovation and relationship.

The research used the following methodological procedures:

- Review of the literature;
- Face to face interviews with coffee producers in three principal regions in the State of Minas Gerais;
- Interviews with Research Centers;
- Distant research via telephone and internet;

All the chapters, even the more theoretical ones, base their propositions on field surveys.

4.2.1 PENSA's Method to Analyze Agribusiness Systems

This research uses as basis the PENSA Method to analyze agribusiness systems (AIS).

In this methodology, the AIS is defined as a set of transactions between companies and specialized agents whose aim is to guarantee the process in the transmission of information, incentives and controls along the agro chain. (ZYLBERSZTAJN, 1995; ZYLBERSZTAJN e FARINA, 1999).

PENSA Method is based on the theory of the Industrial Economics and the New Institutional Economics, principally the Transaction Costs Economics (TCE) which is based on the premise that the strategic decisions of the economic agents suffer influence of the institutional environment, formally (Laws and Judiciary) or informally NEVES; CALEMAN, 2015).

4.2.2 Samples and Interviews

The sample of coffee producers was intentional. It was based on data furnished by Illy Coffee Club, the mailing of the UDC Brazil, COCAPEC (Coffee and livestock producers' Cooperative), SCAMG (Specialty Coffee Association of Minas Gerais), the Council of Região das Matas, Minas, FUNDACCER (Federation of the Savannah Coffee producers), AMOCA (Association of the Coffee producers of Monte Carmelo), and COOPARAO (Agriculture and cattle raising Cooperative of the Vertentes do Caparaó). Besides these contacts, we also included contacts of producers who had attended special coffee producing events. In all, 67 coffee producers participated in the research:

- 29 were interviewed personally
- 38 answered via Internet or phone

Among those interviewed 35,82% belonged to the Illy Coffee Club. The face-to-face interviews with coffee producers were done in the following regions: Southern Minas, Savannah and Atlantic Forest. The Instituto Agronômico de Campinas (Agronomical Institute of Campinas—IAC) and the Fundação Pró Café em Varginha (Pro-coffee Foundation in Varginha) were also interviewed.

4.2.3 Questionnaire

The questionnaire (Appendix 1) has 47 questions divided into three sections:

A) Profile of the Producer

B) Characteristics of the Production

C) Commercial Aspects

The first section was developed aiming at identifying the characteristics of the producer such as: how long they have been in the area, main source of income, and participation in collective actions, amongst other questions.

The second section aimed at obtaining information on the coffee production, based on questions that involved crop handling, mechanization, and hiring of services. The third, and last section collected information from the coffee producers on the commercialization and the intention to contract.

The questionnaire was developed for the respondent to fill it in on the Internet whenever it was better for them. It was widely disseminated by the producer organizations.

The data collection will continue in 2016, because the research will contribute to Gustavo Oliveira's MA Thesis for the Dept. of Administration of the Faculty of Economics, Administration and Accountability of the University of São Paulo. The temporary title is:

The Coffee Agribusiness System in Brazil: an analysis of the mechanization and commercialization transaction.

4.2.4 Results, conclusions and propositions

The results of the questionnaire, which have been summarized in Chapter 4, were analyzed by descriptive statistics: the presentation of central tendency measures, as well as dispersion. The conclusion will resume the aspects from all chapters and relate them with the results obtained in the research with the coffee producers.

The deeper statistical analysis will be part of Gustavo Oliveira's studies for his MA at the Faculty of Economics, Administration and Accountability of the University of São Paulo.

4.3 THE COFFEE AGRIBUSINESS SYSTEM

4.3.1 The General Coffee Agribusiness System (AS)

The coffee system is represented by a model that encompasses the inputs industry used in coffee production, the agricultural section, the industrial processing section, distribution and the final consumer – where all transactions are coordinated influenced by the institutional environment (laws and norms), and organizational environment (financial and research support, and certification).

The PENSA method of analyzing the AS is based on the economic theory of the New Economics, and the Transaction Cost Economics (TCE), as well as the Industrial Organization. This technique is worried in adopting a mesoanalytical view, which considers the institutional environment and its influence on transactions and its consequences for all the system.

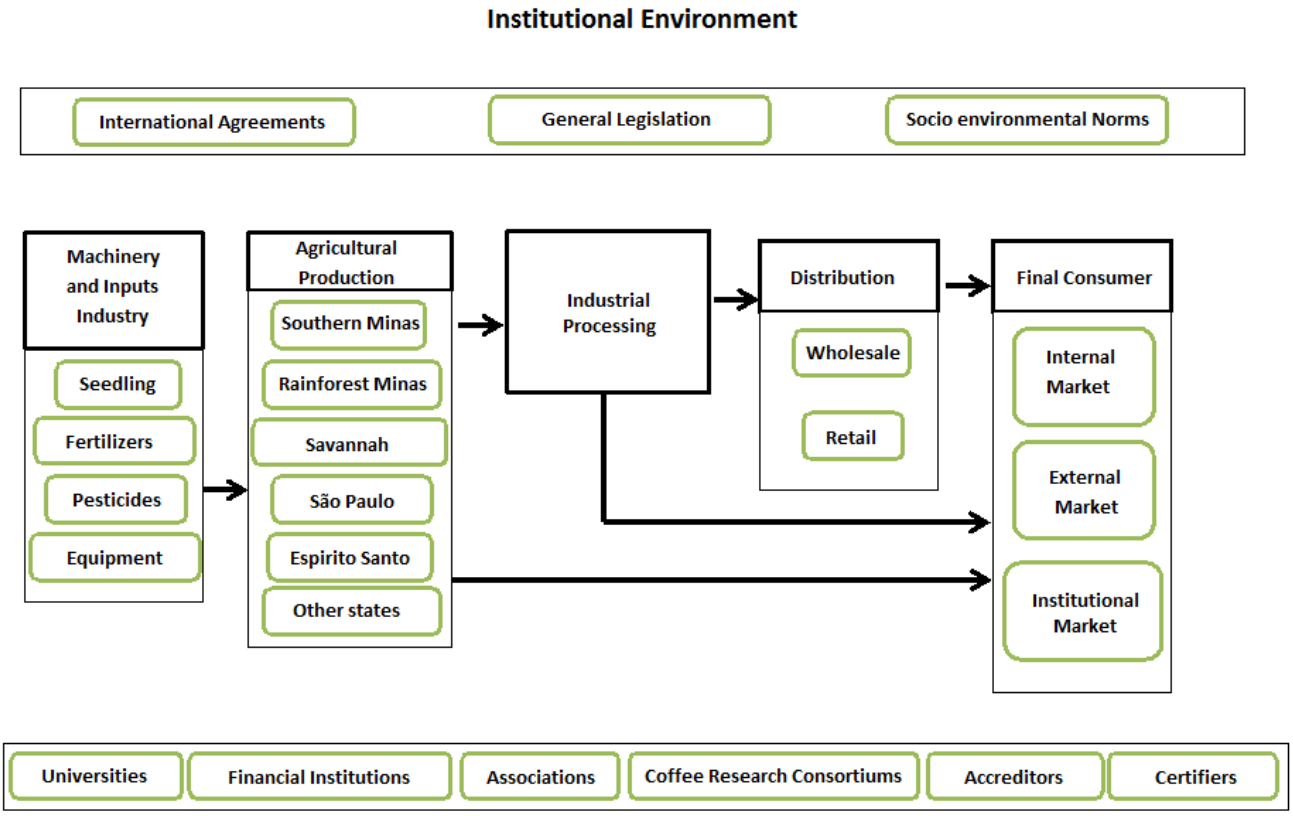
By using the assumptions of this mechanism for analysis, in order to have efficient investigative results we need to use some necessary procedures. First we will describe and characterize the institutional, organizational, technological and competitive environment. The later two environments are inherent and exclusive to each of the participating sector in the Coffee Agribusiness System (AS). Thus, we will observe the microanlytical character in the transaction between agents (coordination mechanism,

incentive and monitoring systems of property rights, definition of transactional attributes.)

Illy is immediately interested in the transaction between producers and the industry, which occurs in different manners that reflect the strategies of the companies in the sector.

Below is a chart of the Coffee Agribusiness System (AS), with its actors, organizational and institutional environments and position of each segment in the general flow.

Figure 1 – Coffee Agribusiness System (AS)



Source: Elaborated by the authors

This system is important to all who study coffee, including the industry, as it allows a privileged view of the stages coffee goes through, identifying the characteristics of each transaction. The Coffee Agribusiness System (AS) considers the relationship between consumers, industries and producers, besides the organizations (banks and research) that support it, and specially the institutional environment represented by laws and regulations.

The analysis of the Agribusiness System (AS) identifies the role of the industry as being na element that connects the producer and the consumer, making it roll relevant.

A concept that appears in the agribusiness systems literature is the subsystems. In the Coffee Agribusiness System (AS) you can observe the variations in the coordination mechanisms. These variations reflect the strategies of the companies. For example the subsystem strictly coordinated by Illy was used

as an example in an article published in the IV World International Congress of IAMA-[1] The example demonstrates the relevance that starting from a generic coordination other forms appear, each representing a different strategy.

4.3.2 The subsystem strictly coordinated – the iconic case of illycaffè

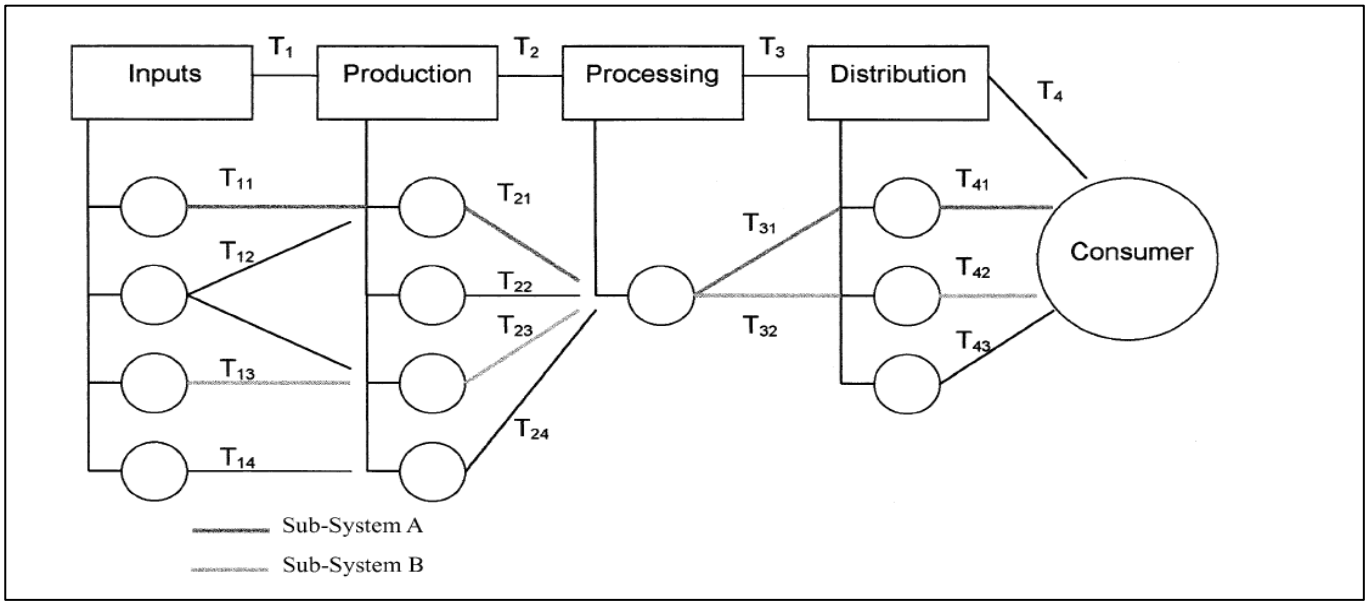
In the contractual relations between the industry and the producers the agribusiness products as coffee for example, also appear in the strictly coordinated subsystems model. The transactions are affected by new quality standards motivated by private structures of consumer organizations and also by the public state regulation policies, or simply reflecting the form of differentiating the relationships along the chain. Other examples that illustrate the growing levels of specificity are the changes in the consumers' preference habits, which have started to demand specific attributes, legislation to protect consumer's rights and have a concern with the environment and society.

In practice what occurs, is that the market per se is incapable of attending to these new levels of demand, which are not attended to automatically, but at the cost of close coordination of the supply systems and the contracts between suppliers and industries, with detailed clauses in relation to the requested attributes. Where these models apply, the capacity to compete with the normal coordinated systems resides in the ability of its agents. The most frequent examples of these subsystems are found in the industries that start working with specialties and very specific products like Illycaffé.

In this system, coffee does not follow the so called normal route of the commodities, but follows many different paths in function of the specific standards demanded by the industries, as the Illy case. Because there is a rigid demand in the various stages of the system for quality coffee, there is a fine tuning of controls and monitoring of the industry. That is why it is called strictly coordinated. The scheme below shows the model of the subsystem strictly vertically coordinated.

[1] Presented by ZYLBERSZTAJN, Decio . Case Study - Illycaffé: Coordination in Search for Quality. In: IV World Congress da IAMA - International Agribusiness Management Association, 1994. IAMA. Caracas, Venezuela.

Figure 2 – Business Model via strictly coordinated system



Source: Zylbersztajn e Farina, 1999

4.3.3 Competition in the Industrial Phase

There were 1.299 independent coffee roasting and grinding industries in Brazil in 2014, according to ABIC (Brazilian Association of Coffee Industry). 455 of these were associated to ABIC and were characterized by the use of physical transformation technology (basically roasting and grinding) and the physical controls of quality. At the end of 2013, ABIC found a reduction from 1.428 companies to 1.299 at the end of 2914, a 9,0% drop. The 10 biggest companies represent a 74,4% participation in volume, over the total amount produced by the associated industries, while the 50 biggest participate with 89.5% and the 100 biggest with 94,6%. It is very clear that more than 1.100 small-scale companies contribute only 5.4% of the processed volume. Illy does not worry with this competition because it Works with a differentiated product.

The competition pattern has been changing with the entry of other players that are convincing the consumer about the quality of their product. They make use of marketing campaigns with famous artists and other appeals that motivate consumers.

4.3.4 The Maintenance of Illy's Differentiation

The changes that occurred in the Brazilian Coffee Agribusiness System (AS) do café, show that until 1990 the differentiation of the quality coffees was inexistent. Today any company that wants to stock up with quality coffee will find in Minas Gerais supplies properly segregated and stored, ready for commercialization.

The question remains on how Illy can continuously differentiate itself maintaining its position in the market. For example, the continuity of excellent supply should be maintained but Illy should also be a leader in the process of adding value to the producer. This will be discussed in the Chapter on Innovation.

Illy was the pioneer in differentiating the product. This strategy motivated followers and today many competitors follow this trend. The extreme may happen when the coffees improve such that differentiation is very fragile amongst them or inexistent. The convergence of quality attributes of the drink can conduct Illy to identifying other forms of being a pioneer in the Coffee Agribusiness System (AS).

4.3.5 Conclusion

Illy was a pioneer in differentiation by buying its product directly form the producer, which was a winning strategy that generated imitation by its competitors. Even though it was a unique strategy, there were no mechanisms to protect the entry of other competitors.

4.4 RESULTS

The questionnaire briefly described in Chapter 2 of this report, is structured in three parts. The first describes those interviewed, the second prioritizes technical aspects in the production and the third is directed to the commercialization aspects, focusing on the relationship between the industry and the producer.

The present chapter aims at exploring the statistic results, which are presented in Appendix 2 of this report. It is important to mention that the data collection will continue in 2016, as part of Gustavo Magalhães de Oliveira's working plan for his master dissertation at the University of São Paulo. The aim is to generate enough information to have more robust statistics from the data collected. Following, we will comment on the results of the descriptive statistics.

4.4.1. Characteristic of the Producers

Knowing the profile of the producers allows Illy to design specific actions, either through Illy Coffee club, via UDC or Experimental Agricola.

Q1 – Those interviewed are predominantly from the state of Minas Gerais (91%), 6,1% from São Paulo, 1,5% from both Rio de Janeiro and Espirito Santo.

Q2 – The sample identified the elevated level of education, 86,6% with high school or university level. The education of the producers correlates with those who produce special coffees.

Q3/Q5/Q6 – The producers interviewed have an average of 20,86 years in coffee producing and cultivate an average of 91,15 ha, varying from 312 to 1 hectare, producing an average of 3.296 bags. We excluded data that could compromise the average evaluations due to their high degree of disparity compared to the central tendency of the variables of the analyzed sample. Three producers who were 53, 70, and 71 years old were not considered. Regarding the number of hectares, we excluded seven producers, two with 520 hectares, and the others with 400, 600, 1050, 1700 e 2700 hectares respectively. Regarding the average bags produced we excluded seven producers, two of which produced 20.000 bags, and the five others who produced 17.680, 22.000, 40.000, 50.000 e 100.000 bags respectively. Around 60% of those interviewed only work with coffee, and do not have any other agricultural activities or activities outside the area and 71.6% indicated that coffee is their principal source of family income.

Q4 – The predominant topography demonstrates that 25% of the producers plant coffee in the mountains, 18% in plain areas

and 44,8% in mixed areas; 12% of those interviewed did not respond.

Q7/Q9 – Around 20% of the producers do not control their production costs and 89% are members of a cooperative.

Q8 –21% of the producers came from other activities and 22% of the producers come from families that have been in coffee production for more than three generations. This information interests Illy, because they can strengthen partnerships with new producers, possibly open to changes and adoption of technologies. With the older producers they can prepare and participate in the family succession inside these properties, renewing bonds they have made and maintaining the inherent quality in the knowledge they have acquired.

Q10 – 76% of the producers are active in technical meetings.

4.4.2. Technological Aspects in Production

The technical profile can suggest actions that aggregate value to the producers, strengthening ties in cooperation.

Q11 – The manual operation was reported by 38,8% of the producers interviewed, while 6% reported doing 100% of the operations mechanically. Only 6% mentioned that they shared equipment and 27% use family labor to harvest, In other words, the practice of hiring temporary labor is predominant.

Q12/Q13 – Around 34% answered that they predominantly use mechanized technology, based on tractors and harvesters. The use of small size equipment was reported by 21%. Around 6% develop their own equipment on the property, suggesting an innovative profile.

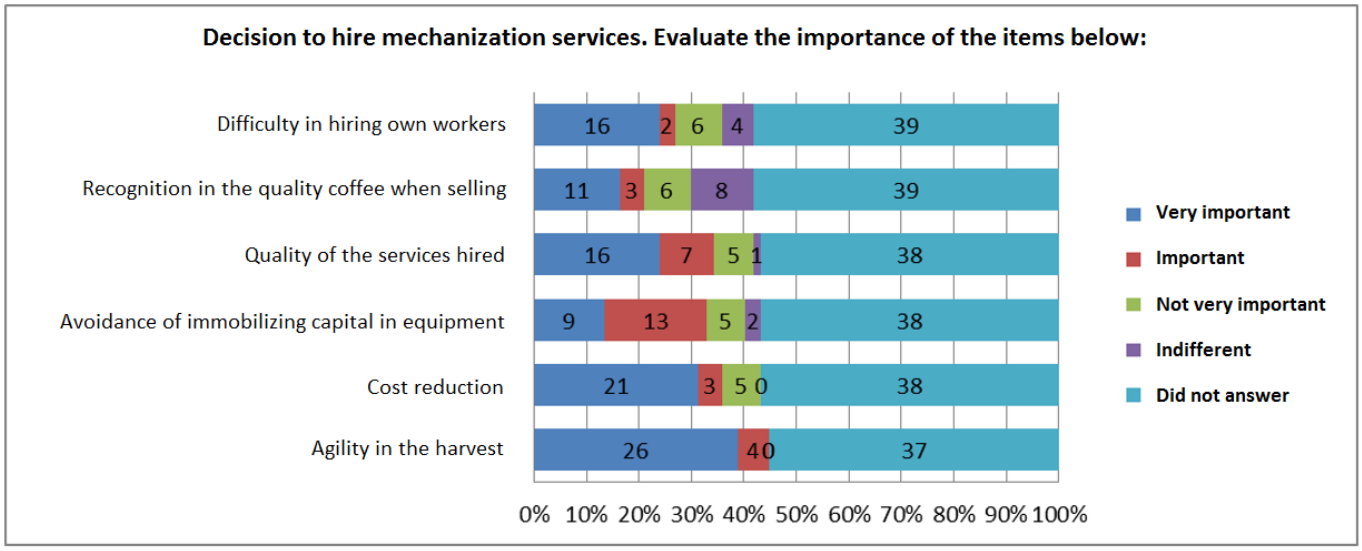
Q14/Q15 – Around 67% of the producers only use their own equipment, 7,5% use equipment of the hired labor and 6,0% affirm they contract service providers. Around 50% said that they have more than R$ 400 thousand reais invested in fixed assets (equipment) we believe this information is useful to Illy, in search for adding value to their suppliers. If the practice of renting or sharing equipment evolves, the rural entrepreneurs will fix less capital with a lower financial cost.

Q16/Q17 – The post harvest activities represent an important demand for external services, predominately for processing (45%), pulping (21%), drying (20%), and preparing (9%). The activities of external storage were reported by 39% of those interviewed and 6% mentioned doing toll processing in roasting.

Q18/Q19/Q20/Q21 – Around 49% of the producers hire some type of external mechanization service. Approximately 32, 8% adopt formal contracts per harvest with service providers. Some Exchange services or lend equipment. The payment for these services is predominantly in cash (31,3%), in product (9%), and 4,5% pay via exchange in services, and 12% contract services from friends.

Q22 – Chart 1 – To justify hiring mechanization, around 86,7% mentioned that it sped up the harvesting, 72,4% mentioned it as a reduction in cost factor, and 55.2% considered the quality of hired service and 57,1% considered the difficulty in hiring manual labor. Only 31% mentioned it as a very important factor in reducing the value of fixed capital. This last point can be debated with the producers in the Illy club activities and other meetings and field days.

Chart 1 - Decision to hire mechanized services



Source: Elaborated by the authors

Q23 – Only 4,5% mentioned eventual legal problems in hiring services.

Q24 – The average employees on the properties is 8, varying from 50 to none. Around 70% answered that they used permanent and eventual employees, 9% only have permanent employees, and 7,5% use Family labor associated with hired labor. The average temporary labor is 28,2%. This answer suggests introducing the theme of hired service management in the Illy training programs.

Q25 – It is common practice to hire the same working teams year after year. 62,7% of those interviewed report this practice.

Q26 – The origin of the temporary workers in Minas Gerais was 67%, not identified 18%, and 4,5% in the states of São Paulo and Bahia.

Q27 – The benefits reported for permanent employees was: 61% offer housing for the employees and their families, 24% offer school help for the children of employees, and 18% offer housing for the employee but not for the Family, and 16% offer a basic food basket.

Q28/Q29: These benefit are extended to temporary employees in 32,8% of the cases. The main forms of contact for hiring this temporary labor are: 64% previous experience, 43% recommended by employers, and 40% recommended by other producers.

Q30: The total cost of salaries plus average social costs suggest a maximum value of R$ 3.000,00 per permanent employee, R$ 4.800,00 per temporary employee, R$ 3.500,00 per permanent employee with family and R$ 3000,00 per temporary employee with family. The average expenditure with these categories ranges from R$ 1.930,73, R$ 1.213,13 to R$ 658,74 respectively. This scenario denotes an elevated expenditure with the family participating in permanent labor, since the worker only aggregates his work. Whilst with the temporary workers it is noticeable the use of familiar work, where all members also participate in the work involving coffee in the farm. In this way the expenses with the temporary workers with family

decrease due to the relation with kind of work that is done.

Q31: Still referring to the cost of labor, it represents an elevated cost in the total coffee production cost . The maximum index of the sample showed a percentage of 55% for cultivating activities, 45% for the post harvest activities, 15% for maintenance and depreciation of the producers' machinery and 10% for hired machinery. The average of these values decreases due to the variability in the size and production scale of the producers that were interviewed.

Q32: Around 33% of the producers have had labor problems associated to termination of contract, lack of contract, control of workin g hours. Around 80% of those interviewed preferred not to mention the causes. Apparently the theme of working relations could be treated in future courses promoted by Illy.

4.4.3 Commercialization Aspects

These answers refer to the transactions between producers and their commercialization channels, ranging form industries, cooperatives to brokers. Just part of those who answered supply Illy, which allows us to compare the two groups of producers.

Q33 – The exclusive production of natural dried coffees was reported by 35,8%, while 27% produce between 50% and 60% natural coffees. 13.4% produce pulped coffees and 27% produce between 40% and 50% pulped coffees.

Q34 – Above 80% produce UTZ certified, Organic, Rainforest, Fair trade, e Gourmet.

The sample is clearly biased for the producers with high technology who direct themselves to the market with quality products,

Q35 – 19% sold directly to the industries, 36% sold to the domestic market through brokers, 51% sold to export through brokers and 63% use the cooperatives. These answers indicate that the cooperatives are important to the producers, principally for those that are not aiming at the special quality markets. In the interviews some of the producers reported that the cooperative is interesting for the commercialization of their lower quality product and for the acquisition of inputs. In other words, the cooperatives do not compete directly with Illy. To the contrary, they can be seen as partners in that they support the producers selling inputs at competitive prices.

Q36 – The answers indicate that 71% of the producers commercialize at least part of the coffee via spot market. 27% sold 100% of their production this way. 34% commercialized their coffee through formal contracts per harvest and 27% used formal long term contracts. 40% used barter operations.

Q37: With regards to the motivation to establish contract the most relevant reasons mentioned were: price locking, risk reduction and relationship with the distribution channels. Other reasons were guarantee in the flow of production, financing the production and less relevant, technical assistance.

Questions 36 and 37 confirm that price and risk are the most valued factors by the producer. Around 30% of the producers mentioned financing. There are two relevant reasons: the first is related to the lowest financial availability, in other words, in the harvest season when most producers go to banks in search of working capital; the second is the drastic reduction in the offer of agricultural credit which happened in the 2015-2016 harvest, which might possibly repeat itself in the next harvests. In other words, Brazil is going through a crisis in the offer of agricultural credit.

Q38: Around 34% of the producers report that they do not negotiate their product beforehand, 66% anticipate the commercialization of their product

Q39: Around 50% affirm that that they set the price when they sell, in advance, demonstrating the intention of protection against eventual price fluctuation

Q40: Among the producers who make contracts, around 39% affirm having faced price fluctuations which made it difficult to maintain the original contract. In such cases 9% renegotiated the terms of the contract, 30% maintained the original intention and 1,5% broke the contract.

Q41: Around 28,4% reported some sort of anticipated payment, and 58% reported not having resorted to this practice. We would like to call the attention to the fact that there are no PENSA research projects that have identified conflicts in contracts that have been taken to court.

Q42: The quality prize was reported by 65,7%, suggesting that it is well known in the special coffees market.

Q43/45: Around 58% reported that the commercialization channel has some type of event to recognize the producers and 67% of the buyers have some sort of event to reinforce their relationship with the producers

Q44: The motivation to choose a specific industry to commercialize the coffee is related to:

a) price, b) the company's reputation, c) guarantee of payment, d) long term relationship.

The respondents consider anticipated payment the less relevant of all.

Q46/48: Around 56,7% affirm that the commercialization channel incentivizes innovation through talks and field days. Around 60% affirm they receive visits from the commercialization channels during the harvest, specially in the high quality coffee segment.

Q47: Around 38,8% of the producers hire private technical assistance and 32,8% do this via cooperatives. The role of the suppliers of inputs was mentioned by 9%. Around 3% do not receive technical assistance.

Q49: Around 34% have a low or medium confidence in their commercialization channel, while 55,2% have a high degree of confidence.

4.4.4 General Comments

To conclude this chapter, some relevant points need to be mentioned:

- The importance of the cooperatives as strategic partners.
- The presence of first generation coffee producers who are open to change.
- The importance of exploring
  a) the topic of producers subcontracting equipment in the courses at the University and day fields of the Club Illy.
  b) the theme of producer's micro-innovations, such as those who design and build their own equipment.
  c) The theme of human resource management, because of the temporary labor in the sector.
  d) The theme of innovation in the production phase which will be treated in chapter 6.

- The degree of confidence in the buyer is an important factor. 82,1% answered

medium and high. More actions could be done to maintain and increase this confidence, such as quicker payments, quicker sample analysis).

- Regarding anticipation of payment for coffee, 58,2% answered that this did not happen to them, while 28,4% said it did. Increasing the number of those who receive anticipatedly generates confidence and furnishes capital in a period where they most need it.

- As 67,2% have their own machinery, they could offer consulting in how to rationalize machinery and equipment. The average fixed capital in machinery is more than R$ 400.000,00 for 50,7 % of those who answered the questionnaire.

- The theme of contracts with the producers will be treated in a specific chapter. However, it is important to mention 2 things:

a) The importance of setting prices.

b) The possibilities of partnerships in the specialized financial sector (Bank of Brazil, Rabobank) for joint operations amongst Illy, banks and producers.

4.5 AGRIBUSINESS CONTRACTS AND ILLY'S RELATIONSHIP IN BRAZIL

4.5.1 Agribusiness Contracts

From the time of the coffee barons to the present moment, there have been changes in the coffee Agro-industrial system, from the input industry to the final consumer. The organizations involved, the technology available, and the complexity of management have changed over time.

Changes in consumer habits and production technologies have required producers and industries to develop a range of strategies to produce and secure quality attributes throughout the production systems. Part of these strategies is the creation of long-term links between industry and producers of high quality coffees. In this universe of transactions, those made in the spot market, without product specifications, meet the requirements of the less specialized market for ordinary coffees. Fine coffees, however, require other mechanisms that we may call contractual mechanisms.

4.5.1.1 Concept of contractual vision in agribusiness

Contracts can be formal or informal, and both have legal protection. In general, in contracts the identity of the actors is known, safeguards are defined and, in cases of continuous relations, the role of reputation creates incentives to fulfill contractual terms. Traditionally, in Brazil, when talking about a coffee contract it means the contracts in the stock exchange for future delivery, used less to guarantee the supply and more to manage risks of fluctuation in prices. This way, the producer can sell in the forward market by means of a contract, fixing the prices. The industry can buy a term contract and guarantee the price. In general, the physical delivery of the product is not performed.

Other types of contract between an industry and a specific group of farmers is justified if there are requirements. In general, the requirements of specific quality standards, are associated to delivery under special conditions in handling the product, t meeting deadlines, to adopt certain sustainable production technologies or technological requirements that involve the control of the inputs used in the post-harvest processes. Coffee in the commodity market cannot meet these requirements. Although produced within the desired standards, the information is lost and the commodity coffee market cannot meet the process which suggests the need of the relationship between industry and producer.

This relationship occurs through contracts, whether formal or via relational elements.

For a long time in Brazil the coffee contracts stipulated only for the standard type, quantity and price. However, these transactions have become increasingly complex since in many cases their function involves, in addition to defining specific quality attributes, the allocation of risk between the parties, the provision of credit, and the need to prevent conflicts.

Illycaffè's purchase of specialty coffees is an example of a transaction that involves asset specificity. In this case, this transaction is part of what we call a strictly coordinated subsystem, assembled when Dr. Ernesto Illy realized that the quality of the final product depended on a series of coordinated actions along the coffee chain.

Strictly coordinated subsystems are formed when one or more economic agents in the Agroindustrial System (AS) adopt stricter coordination mechanisms in order to generate value, as well as to protect it. In this context, the role of contracts is fundamental.

4.5.1.2 The importance of contracts

There is evidence and empirical studies that attest the relevance of contracts in agriculture. According to Zylbersztajn (2005) the first agricultural contracts arose in the 19th century in the United States. Recently, its use is widespread. FAO has encouraged the adoption of contracts seeking regional development (FAO, 2013-2015) by providing practical guides to facilitate its adoption. The contract can have many functions: to allocate responsibilities, to reduce risk, to guarantee credit, to add value, among other specificities to each transaction. Examples abound:

- Exchange contracts (inputs - producer)

- Poultry and pork production contracts (Producer - industry)

- Marketing contracts for fruit, tomatoes, among others with food industry (Producer - industry);

- Anticipated sales contracts (Producer - trading/industry);

- Lease contracts (Producer - Producer or Producer - industry);

- Forest development contracts (Producer - pulp and paper industry);

- Contracts for the production of Biodiesel (Producer - industry).

Although common sense indicates a higher frequency of contracts between larger scale producers interested in risk reduction and transaction cost savings, FAO considers contracts as a way of including small producers and has therefore created a contract research center: "Contract Farming Resource Center". The purpose of this Center is to provide free and quality information to producers and industries, as they believe that this is a way of linking small producers to the market.

FAO makes the point that there are costs and benefits in contractual relations. According to SILVA (2005), for the contractual relationship to be sustainable and lasting, it is essential that some conditions exist, namely:

- Benefit for both parties,
- Mutual trust,
- Reciprocal dependency.

The next item will deal with the incompleteness of contracts, as well as dispute prevention and resolution mechanisms.

4.5.1.3 Contracts do not solve all problems

When the possibilities for unilateral gains from the breach of contract increase, logically, there is a real possibility of post-contractual opportunistic behavior (Klein, Crawford and Anchian, 1978). In addition, contracts by

nature are incomplete, i.e. parties can not anticipate all future contingencies.

The practice of contracts suggests that there may be problems of breakdowns. The motives vary and in some cases, are justified and supported by the law. The role of contracts is not to eliminate but reduce risks by creating incentives for investments made by the stakeholders. The value of the contract lies in the fact of enforcing its clauses, especially in a time of conflict between the parties. From this rationale, it is possible to differentiate contracts from agreements.

Caleman (2015) points out that the contracts are supported by the possibility of applying sanctions in the formal judicial mechanism. However, it is important to mention that a transaction always has multiple dimensions. Part of these dimensions is represented in contracts and part in agreements. Contracts are secured by legal property right, in this case, Judiciary, and Agreements are secured by economic property right (Barzel, 1997).

As economic property rights are, for example, informal mechanisms, such as agents' reputations. Reputation is very important in cases of repeated negotiations, such as annual farm operations. There are costs and benefits as a result in the breach of a contract. Each agent will evaluate whether the gains will be greater than the cost of legal and / or economic sanctions. Legal sanctions are stipulated in contracts in the form of fines and will be valuable if they are liable to judicial coercion. Economic sanctions are not written in the contract, but they are important, especially in the next relationships, as is the case with the reputational effect (Klein, 1992). That is, the party that wishes to break the contract, if acting rationally, will consider the present gain less penalties and losses in future negotiations.

4.5.1.4 Advantages and disadvantages of contracts

There are advantages and disadvantages in the use of contracts. From the perspective of the analysis of the agro industrial system, some of the advantages are:

- Efficiency gains with coordination
- Higher transaction value
- Reduced uncertainty over price
- Allocation of risk between the parties
- Induction of specific and long-term investments.

As disadvantages, one has:

- Risk of contractual breach with disturbances in the Agroindustrial System
- Cost of operating the markets

4.5.1.5 Collective contracts treated as a trading platform

An example of representative agribusiness entities dealing with industry representatives is CONSECANA.

CONSECANA-SP (Council of Sugarcane, Sugar and Alcohol Producers of the State of São Paulo) is an association made up of representatives of the sugar and alcohol industries and sugarcane planters, who is responsible for the relationship between both parties.

One contribution of the association was the definition of a payment system for the supply of sugarcane with sucrose content. The value of sugarcane is based on Total Recoverable Sugar (ATR) = amount of sugar available in the raw material, subtracted from losses in the industrial process, and sugar and ethanol prices sold by the mills in domestic and foreign markets. The system can be adopted voluntarily. Beyond the details in the contracts, CONSECANA instituted a continuous negotiating platform between the parties, making the contracts only the consolidation of agreements that evolve together, although some friction remains among the agents.

4.5.1.6 Contracts for the purchase and sale of coffee

a. Typology

In the agro-industrial system of direct future coffee contracts between coffee growers and industry are incipient, being more common between the producers and the cooperative or with the warehouse, as well as between the industry and the cooperative / warehouse.

In other agroindustrial systems, such as soybeans, direct contracts of anticipated purchase between the producers and the trading companies with anticipation of financial resources (or inputs) began to spread in the 1990's, guaranteeing the supply of commodities to trading companies and helping to compose the supply of rural credit to the agricultural producers. Subsequently, the modality was intensified without the anticipation of resources, with the objective of establishing the sale price, in order to reduce the impacts of the price oscillation at the time of the harvest. Therefore, the parties (producer and industry), in carrying out contracts may have different objectives: Financing, guarantee of supply-origination / commercialization and / or allocation of the risk in price oscillation.

Contracts for the anticipated sale of coffee with advancement of resources have space to grow, because when selling the product in advance, the producer is able to obtain credit at competitive costs, providing part of the resources that he needs to pay for the harvest. Another factor that may motivate the adoption of this modality of contracts is the perspective of reducing resources for rural credit in Brazil in 2016-2017. For the industry, an advantage of the transfer of anticipated resources is the understanding of the transfer of the right of ownership, that is, of the purchase of the good. The research by Rezende (2011) showed an analysis of judicial decisions in disputes over soybean sales contracts. In cases in which the industry advanced the probability that the decision of the judge to favor the maintenance of the contracts was 81%, against 46% in cases where there was no advance. The industry should weigh the financial cost involved, to make selective contracts, with producers of greater interest.

4.5.1.7 Analysis of the Illy Future Contract

Illy maintains with a select group of suppliers the future purchase contract for coffee. The current contract is not registered, nor does it provide for penalization for a possible breach. The contract is considered relational, since it is supported mainly by economic mechanisms such as reputation and interest in re-contracting in the future. In this item we will treat the characteristics of this contractual relationship, as well as the possibilities for improvement.

In this case, both parties express interest in effecting the transaction. The incentives for the coffee grower are:

- Price premium for the differentiated quality of coffee;

- Recognition as a producer of quality coffee, which facilitates / values the marketing of its coffee with other companies (Positive externality);

- Being part of the Illy Coffee Club;

- Receiving the visit of technicians and orientations in relation to the production of quality coffee with social and environmental sustainability.

In turn Illy has as an incentive:

- The supply of a relevant part of the coffee, with the required quality.

- Loyalty of the coffee grower who feels more protected by having a contract with Illy.

Description of the current agreement between Illy and the coffee grower

Illy now buys coffee in two ways: Purchase spot and future contract. In this harvest, the two

modalities represented almost 50%. The future contract is only made with Illy coffee club producers, who have good history (regularity and quality standards) and an excellent relationships. The amount to be defined in the future contract is directly related to the trading history with Illy. The contract for future delivery practiced is formalized, but not registered, has clauses of price, quantity, quality, deadline, as well as declaration of good production practices and compliance with environmental and labor legislation. As it is not formalized, the contract resembles a document of intention.

The contractual relationship maintained with coffee farmers has a great advantage from the economic point of view that leads to stability in the relationship: the fact that it is small for the other party. That is, each producer contributes individually with a small amount to the total purchased by Illy. On the other hand, Illy purchases from each producer, most of the time, a small part of his total production. This is a great safeguard for Illy, which can be visualized in two hypothetical situations:

- Climate change compromised part of the harvest (Quality and / or quantity)

If the producer has committed the whole crop for future sale he will not be able to fulfill the contract with all parties, and will have to choose with whom the contract will be maintained. As Illy's share is small, he has economic and reputational incentives to keep this contract.

- Relevant price change at the time of product delivery

If the amount is small, it will not have as much impact on the total revenue. Considering the value received minus the future loss, the producer also has incentives to keep the contract. In other words, being a small amount of coffee, even if the producer fails to earn an extra price if he breaks the contract at any given time, it would be offset by future gains from his long-term relationship with Illycaffè.

In both cases, due to the fact that Illy buys only a small part of the production of each coffee grower, the reputational effect on future relations has a greater impact than the economic one.

For Illy, it is important to maintain the strategy of increasing the number of purchases of small lots, while maintaining incentives for the stability of contracts. Increasing the scale of buying from a single producer, on the one hand reduces marketing costs, but on the other hand creates dependence that can be avoided.

Possibilities for improvement of the contractual instrument

Despite the good relationship with its suppliers, the contractual relationship presents some weaknesses, such as the difficulty in identifying the bad-faith of the producer if the sample sent is of inferior quality in a moment of disparity between the price agreed in the contract and the price in the spot market. Depending on weather conditions, the supplier can effectively have difficulty achieving the required quality standard. On the other hand, a producer who does not intend to comply with the contract can send a sample that he knows will not be approved. In these cases, when the sample is rejected, Illy requests the sending of another sample. There is no limit to sending samples, nor the obligation of the coffee grower to do so. If the producer wants to fulfill the contract, he can send samples until they are accepted. If he does not want to abide the contract he can say that he could not prepare the lot with the required qualities.

In 2014, there were climatic problems that influenced the quality of the beans, but also, at the time of contract settlement, there was price variation in relation to the contractor. According to information from Experimental Agrícola do Brasil the total number of contracts canceled was 16%. This year (2015) there was no significant change in prices and so far, the number of contracts canceled was less than 5%. When thinking about this and other cases where Illy might eventually become vulnerable

at a time of conflict with the coffee grower, said Prof. Dr. Rachel Sztajn, Professor of Commercial Law at the Faculty of Law of the University of São Paulo. The document prepared by the teacher was based on the model of future contract currently used, and is fully shown in Annex 3 of this report.

Some points that could be improved in the contract:

- The title of the contract must include: Contracts for the purchase and sale of raw coffee through sampling.

- The requirements regarding the characteristics of the beans, the accepted MRLs (Minumum Requirement Levels) of agrochemicals, compliance with environmental and labor laws, among others that are important could be allocated in an appendix of general conditions, which will facilitate any modifications due to the addition of certification requirements. This appendix could also mention:

- That all inputs (chemical or non-chemical) are purchased in legal and reputable establishments;

- Wastes are treated in a way that does not pollute the environment.

- Clause of contractual penalty if the producer does not send the sample within a certain period.

- Maximum time for delivery of the consignment to the warehouse after approval of the sample.

-Conditions for rejection of the consignment delivered to the warehouse. It is necessary to specify the obligation of the producer to withdraw the product delivered to the warehouse within a certain period, as well as the payment of the costs related to the storage of the lot.

- Illy may reserve the right to inspect the property whenever it is necessary, provided that it is notified 24 hours in advance. This measure may restrain the opportunism of a producer who deliberately sends inadequate samples (of inferior quality) for the purpose of not fulfilling the contract. On the other hand, it also guarantees the entry of the Experimental Agrícola do Brasil technician who will verify the property conditions necessary for the certification that Illy has with DNV (Det Norske Veritas).

- Include a contractual penalty clause for breach of contract.

- The payment amount must always be fixed in national currency. In the case of multi-year contracts, it is possible to mention the correction for the exchange variation, but it is necessary to clearly define how the exchange parity is calculated (for example - closing on the BMF @ Bovespa the previous day).

- If there is an intermediary responsible for preparing, storing and / or sending the sample or batch, this must be mentioned in the contract, for the purposes of determining responsibility, if applicable.

- Include a clause with the law of regency of the contract – part of the Brazilian law, and if appropriate, arbitration clause, that is, recourse to arbitration and / or mediation In this case choose the Chamber of arbitration or mediation.

Sub-item: Contracts with advancement of financial resources:

- The possibility of advancing a small part of the payment for those producers with whom the company has a long history of relationship is a strategy that deserves to be observed by Illy.

A complaint from those answering the questionnaire was relative to the length in time from the sample selection to the payment. There are many studies that prove that the harvest time concentrates the highest cost of production, that is, this is a moment that the coffee *grower* in general has committed cash flow. The advancement of part of the financial resources would be an innovation that would add value especially to those critical periods and, in case of legal disputes, would give Illy

strength, since it facilitates the judge's understanding of the sale.

There is always a risk for Illy if the producer cannot produce the quantity and / or quality set, however, as discussed earlier, the fact that Illy purchases only a small part from each producer facilitates compliance.

In the case of granting advancement in financial resources in relation to the value of the contract, it is suggested that this should be requested by the producer, in writing and duly justified, being Illy's discretion to accept the request in full, refuse or partially accept. This care protects Illy if any other producer claims for the same right.

Brazilian laws do not allow the collection of interest on this type of loan. If it did it would characterize an operation that can be performed only by banking institutions. If it is necessary to correct the values, these can be corrected by the exchange variation counting the day it is delivered to the bank account of the producer until the payment of the balance of the purchase and sale. Consideration should be given to involving a specialized bank, such as Rabobank or Bank of Brazil, reducing the financial cost to Illy and the producer.

The contract must provide for the possibility of the producer failing to deliver the contracted beans. In this case, the date and conditions for return of the values must be fixed (for example, the return can be split with the correction of the exchange variation).

4.5.1.8 Final Discussion

The results of the interviews conducted in this research are in line with what the theory says and what the recent FAO texts say. According to them, the main reasons for making a contract, in order of importance, are:

- Price fixing
- Reduction of risk
- Relationship with the commercialization channel

Among the interviewees, 34.33% stated that they sell coffee through formal contracts per crop, and 26.9% stated that they make formal long-term contracts. Another relevant fact was that 28% said they already receive a part of the value of the advance contract, which shows that it is an already existing practice, although it is not widespread.

Those interviewed that make future contracts were asked if if they had already experienced situations with price disparities at the time of contract settlement. 38,8% answered that had and only 1 producer stated that on this occasion he did not fulfill the contract. It should be noted that this producer does not belong to Illy cafè's supplier group.

The results reinforce that the producers have looked for financial instruments with the purpose of reducing the risk of the activity. In the more in-depth interviews, the respondents highlighted two points that could be worked out in relation to Illy:

- Reduction of the payment deadline after the delivery of the lot. In the market, it is usually three business days after the delivery to the warehouse, but with Illycaffè this term can reach ten working days.

- Advancement of part of the financial resources in relation to the contract. The advancement of up to 30% would deepen the bond with the producer who needs extra resources during the harvest period.

4.5.1.9 References

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4.5.2 Illy Relationship

4.5.2.1 The agriculture-industry relationship: an important link

The concept of contractual vision within the agribusiness is important to Illy as was seen in the previous item for the various segments of the agro industrial system. The final quality product is the result of the efforts in the agricultural production phase, in the industrial phase in finishing and preparing the product and in the distribution and commercialization segment of the final product.

The relationship enters this point, as a factor of coordination and incentive for producers. This relationship was an important managerial innovation introduced by Illy in Brazil.

Illy is a pioneer in the relationship with the coffee grower. Introduced relational practices in Brazil by establishing the Brazil Quality Award for Espresso Coffee, the Illy Club and the University of Coffee Brazil .

Until then, (1990) Brazil was known as producer of high volumes of coffee called commodity. It was a product that gave volume to the blends.

In 2016, the Award will complete 25 years showing the vigor and interest of the producers in the dispute.

In 1991, Dr. Ernesto Illy instituted the Award as a way to encourage the producer to produce coffee with the Illy standards of quality. It was also a way to obtain a critical mass of quality coffees, which at that time were not readily available on the market. Through the innovative process of direct purchase, Illy advanced in a process of relationship with the producers, over the years, attracting a large range of suppliers that satisfied the needs of the Illy standard of excellence of raw material. And, most importantly, they all had personal relationships with the Illy team.

4.5.2.2 Illy-Producer Relationship Patterns

The relationship with coffee growers occurs in several ways:

- in the sending of samples, both for the Award and for normal commercial sale,

-the constant visits made by Illy's team to producers with the potential to produce quality,

- visits to the farms made annually by Illy's staff,

- at the awards ceremony

-with the Illy Club and the University of Coffee Brazil.

An acknowledgment of the value Illy has given to producers is the testimony of a producer from Minas Gerais, Mr. Gerson Naimeg, when he declared at the 1992 award ceremony :

"I've been a coffee producer for 15 years and the Brazilian government has never rewarded me. A foreign company had to come to Brazil to recognize my work. "

And also, the statement of Mr. José Garcia: "The Illycaffè Award was a milestone for regional coffee. It made us open our eyes to a market we did not know existed. "

These are two examples of relationships with producers shown in the 1995 Illycaffè -PENSA case study.

But the breakthroughs and depth of the relationship with producers occurred in 2000, when the University of Coffee Brazil was created, aiming at bringing knowledge to the coffee community to strengthen the supply of quality coffee in the market.

In 2015, courses for producers and the general public were formatted for distance application, facilitating their implementation. A strategic research process was initiated, carried out by PENSA, supporting Illy's strategic management, adding value to its actions and marking its presence with the Coffee farmers. From 2013 on, Experimental Agrícola took over the realization of the local lectures making them technical, directed and specific, meeting the focal needs determined by Illy. In this capacity, more than 8,000 participants have carried out activities since 2000.

The Illy coffee club started its activities in 2000, contributing to the closer relationship with the producers, creating the loyalty and supply program for Illy. This program was divided into red (1st sale) silver (sale for three consecutive harvests), gold (supply for more than three consecutive harvests) and platinum (sale for more than ten consecutive harvests). The holders of these cards have advantages such as attending courses at reduced or free prices, receive, informational communications and bulletins from Illy, receive written technical information and lectures, field days, contests to travel to Italy, participate in exclusive promotions of Illy products (coffee cups, coffee, "Espresso" machines, etc.) and preferences in the company's internal programs.

Illy created the green card intended to strengthen the relationship with the classifiers. The classifier receives the green card for having classified a sample for Illy in the previous crop year. It can be seen that over the years Illy has expanded and sophisticated its relationship with the classifiers, key elements in the agro-industrial coffee system.

4.5.2.3 The Illy Strategy seen by our eyes.

The relationship between the industry and the production is of fundamental importance in the coordination of the agro-industrial coffee system. Not only in coffee, but in all agro-industrial systems. As a result of this relationship, the Illy industry acted in Brazil as a driver of changes in the supply of quality coffees. Coffee can be divided in Brazil into two distinct periods: BI (before Illy) and AI (after Illy). In the BI period the producers followed the tone of the market and offered commodity coffees without differentiation, with little distinction between lots, and prices did not represent incentives for differentiation. With the beginning of Illy operations in Brazil, there have been several changes in the producer's

behavior. Enlightened and informed about Illy quality standards, knowing exactly what kind of raw material Illy needed to maintain its mission and vision of offering the market the best espresso in the world, the producer envisioned a positive business opportunity by selling differentiated coffee to Illy. Illy would pay premium prices for the coffee sold to them if the producer had followed the instructions for harvesting and preparing the coffee. According to Illy technicians, the cherry coffee is more or less the same, and of good quality, when it is on the tree. Problems begin immediately after harvesting or stripping of the beans. That was where the performance of Illy took place with the producers. Proving that they could earn more with a higher quality product, Illy, through its direct relationship with the producers, initiated an irreversible process in the coordination of the agro industrial coffee system in Brazil.

4.5.2.4 The Illy Strategy Cost

For any industry, establishing a formal coffee supply contract has low transactional costs, either with a large supplier or with a cooperative that meets its specifications.

But the strategy set up by Illy has its transactional costs, they are not few, and they have a weight in their budget to maintain its structures of:

Purchase,

Technical assistance,

Monitoring the crop,

Visits,

Lectures,

Field days,

Illy Coffee Club,

University of coffee,

Courses,

Research,

Quality Award for Expresso,

Vehicle and channels of communication with the producer,

Ombudsman's Office,

Analysis of coffee samples and feed-back to producers.

The strategy set up by Illy, successful worldwide, is not free. However, it is not only the costs that count and this must be looked at when analyzing the strategy. There is a mutual generation of benefits.

4.5.2.5 The Benefits of the Strategy (Illy and producers)

When Illy puts its strategy into action, it obtains the selection of producers, in which it saves transactional costs. There are club members who have been providing coffee with the Illy standards for more than 20 years in a row and do not need monitoring because the concepts, attitudes and actions between the two of them are so entrenched. There is the guarantee of Illy standard. And this is worth a lot because it is an asset that very few companies have. For producers, in Brazil, there are several benefits obtained in the relationship with Illy. The first, and most evident, is the financial factor, the income obtained with the price bonus. But it is known that this is not the Leitmotif that maintains the relation of the producer with Illy, even though, for many producers, the volumes traded with Illy do not often represent a high percentage of their total coffee income. In other words, it is not just that factor that motivates the producer. There are other factors not quantifiable financially in the contracts between the producers and Illy. There is the reputational factor, evidenced by research done by the UDC Brazil conducted by Prof. Maria Sylvia Saes and published in the Illy University books (No. 1, 2003). This is where the positive externalities of providing coffee for Illy come about. This externality arises when a transaction reflects in gains for one of the agents because it has previously had a transaction with another agent of good reputation in the market, according to Saes

(2003). In the results of this research, the author concludes that the important relational elements are:

-The Illycaffè supplier is recognized in the market as a producer of quality coffee (high reputation), which facilitates the marketing - through the reduction of transaction costs - and adds value to the rest of the coffee produced by him.

-The reputational effect. Illy supplier quality coffee gets, on average, top prices in the market. When the producer is identified as Illy supplier his reputation has a specific weight.

4.5.2.6 The Free Riders

These actions of Illy, through its strategy of performance was successful. It benefited them, the producers and a range of competing companies as well. Today the strictly coordinated sub- system of high quality coffee is a reality and has grown in scale. Any roaster can buy special coffees in the producing regions, which was not possible when Illy arrived in Brazil.

Since Illy is not a big buyer they have advantages and disadvantages. Because Illy purchases limited quantities of coffee from each supplier, it dilutes its risk of shortages. Suppliers have every interest in marketing part of their coffee with Illy, albeit in small batches, much more for reputational aspects, than for financial ones (although these are also important). It will not be because of a slightly higher price offer that the Illy supplier will cease to provide coffee to them.

In field visits to the supplier's properties one observes a constant desire of the producers to increase their sales volumes to Illy. This personal desire, perhaps differentiates them from their peer producers. Knowing the ego of the producers and the suppliers, this wish would sound like, "Illy is buying more coffee from my farm this year."

For Illy it is good that their individual purchases from each supplier are limited to the scale of each other, rather than large lots. The dependence in volume of some suppliers is not advantageous for Illy in commercial relational terms. Multiple relationships with multiple suppliers, not buying large lots, will continue to ensure the success of Illy's coffee purchasing seasons.

4.5.2.7 Conclusion

The question to be answered is: "How can Illy, being a pioneer and innovative company, advance its relationship with its suppliers in a creative, modern and exclusive way, making use of the specific assets it has created with its suppliers since its arrival in Brazil ? "

This discussion about the relationship between Illy and its suppliers, a theme closely linked to contracts, leads us to suggest a series of themes that Illy can explore in the form of relationship actions, in the pioneering way Illy has always worked.

-To act on the issue of working capital for the producer.

-To coordinate international technical trips for producers.

- To coordinate national technical field trips.

-To install and demonstrate pilots for technical visits to the field in agreement with the producers.

-To up-grade their feed-back to suppliers in cases of non-acceptance of samples.

-To create of a green number for the special supplier (hot line)

-To up-grade the contracts

-To diffuse micro-innovations amongst the producers.

4.5.2.8 REFERENCES

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4.6 INNOVATION

4.6.1 Introduction

The Illy strategy in Brazil relied on two aspects . First, the addition and sharing of values with the coffee producers. The second was the establishment of a direct relationship with the producers creating a flux of information channels with common interests to Illy and to them. As a result of consistent actions, even in periods when the market was more sensitive to prices, Illy created a reputational capital that was valued by the producers. Everyone wanted to be a Illy supplier, even if a small part of their total production was sold to Illy.

Within the expanded concept of contracts, there are the formal contracts and relational contracts. The first has the objective to guarantee prices and volumes with Illy standards of quality. The second is about the differential competence constructed by Illy, which is the relationship they have with the producers. Illy constructed a differential competence hard to be replicated by the competitors and it can be well explored by them: the generation of innovation for the producers.

This chapter is structured in three parts. Following this introduction, the second part deals with the concept of innovation in agriculture, developed by the World Bank. In the third part, strategic suggestions are presented for Illy, in order to maintain its competitiveness in the special coffees Market.

4.6.2 Innovation in Agriculture

The investments made in the creation of knowledge in agriculture occur in research centers and in private corporations. In general, the technologies generated are easily replicated, which limits the incentives of the private corporations to make investments. However, this context has changed radically, which can be shown by the action of agricultural genetics and biotechnology corporations.

The World Bank points to six changes that are happening in the agricultural innovation generation systems which are:

a) The role the markets and the final consumer superimpose on the agricultural productivism i.e. – Concern with the environment and with food safety.

b) Consumption, commercialization and production of agricultural products have been suffering rapid and unpredicted changes. I.e. – creation of producer, processing and distributing networks that act coordinately to reach markets.

c) Increase in the importance of the private sector in the generation of technology, information and knowledge. i.e. Change in the role of seed company and vegetable health products, research and technical assistance to the producers.

d) Exponential growth in the use of information technology, allowing generation of knowledge from existing data, which is not always used. i.e. Use of “data mining” and “big data analysis” tools.

e) Rapid change in the structure of generating knowledge for agriculture which occurs in many countries. i.e. Development of International research networks.

f) Globalization in the agricultural development process. i.e. A role played by multinational companies, including trading companies in the transformation of agricultural regions in Asia, Latin America and Africa.

How did these changes affect the production of knowledge and innovation in agriculture?

The change pointed out by the World Bank was the evolution of model 1, to model 2 to model 3. Model 1 was the national generation of knowledge centers, whose focus was on the generation of research. Model 2 was the information and knowledge systems that recognize that knowledge is generated out of the university. Model 3 were innovated systems that advocated the demand and recognized that the simple generation of knowledge can not be enough to change agriculture.

The concept of "Innovation Systems" can be defined as part of a network of organizations, companies and individuals focused on bringing new products, processes and new forms of organization for society to use. According to World Bank:

"The innovation systems concept embraces not only the Science suppliers but also the totality and interaction of actors involved in innovation" (pg XIV).

The study of World Bank present relevant conclusions for the Illy strategies with regards to generating value, strengthening partnerships with innovative producers.

Problems in the innovation systems are connected to:

a) Absence of connection between relevant actors in the innovation systems.

b) Attitudes and practices are the biggest obstacle for innovation.

c) the lack of interaction produces: limited access to new knowledge; little articulation between training and the need for research; little technological learning; weak or absent learning relations that involve rural producers and companies; little relevance give to social and environmental aspects and weak connections with sources of resource to finance innovation.

d) Changes and challenges occur continuously

e) The characteristics observed in the study amongst countries were:

- The biggest problem is not in the generation of knowledge. Innovation resides in the application of existing knowledge.

- Technologic innovation walks side by side with organizational innovation.

- Innovation establishes itself on a great number of little advances and not in big ruptures.

- There is great potential to add value to non traditional agricultural systems.

The aspects here reported called PENSA's team's attention to the alignment between the needs pointed out by the World Bank and Illy' s existing strategies, which can be adjusted or adapted at low cost. Some will be explored in the next item, which concludes this chapter.

4.6.3 Innovation in the Illy System

Reading the World Bank report, it is clear that Illy adopts several of the concepts pointed out. For example, the company is worried with the tendencies of the consumers, knows the research structure existent in Brazil, created a communication system between producers and the company, has an eye focused on the producers' practices and works towards bettering them.

Some of the practices consolidated themselves in forms of routines like the annual prize, the interactions in the coffee buying, the domain of the relevant information of the final product markets. Based on the existing routines, we suggest a construction of a system of innovations, which will be hard for the competitors to copy due to the routines and exclusive competences Illy has, We understand that Illy has the unique conditions to make this advancement.

Appendix 1 Questionnaire used for the coffee producers

You are invited to participate in a research that aims at studying Brazilian coffee producing. Filling out this questionnaire is a contribution to a PENSA research project (Centre of Knowledge in Agribusiness of the University of São Paulo). The information will not be disclosed. We hope to count on your collaboration to provide the information requested.
If you have any doubts you can contact: gustavomoliv@gmail.com

Thank you for participation.

The research team

The answers are confidential. UNDER NO CIRCUMSTANCE WILL YOU OR YOUR COMPANY BE IDENTIFIED. Thanks you for your collaboration. Your experience will be very important to help us understand the real problems.

Start time: ___hr ___min

Identification (name of the producer or rural property):

A) PROFILE OF THE PRODUCER

1. Location (municipality/state): _____
2. Education: () None () Primary () High School () University
3. Time in the business: _____ years
4. How would you classify the topography of your property?
   Plain: _____ %
   Mountainous: _____ %

5. Characteristics of your Property	Number of Hectares	Number of bags produced	Percentage in rural income (%)
Coffee			

6. Is coffee the main source of family income? () Yes () No.
   What percentage in the family income? _____%
7. Do you control the administrative costs of your property? ( ) Yes ( ) No.
8. Tradition in the activity:
   ( ) 1st generation ( ) 2nd generation ( ) 3rd generation ( ) > 3rd generation
9. Are you a member of a cooperative or association? () Yes () No.
10. If you are: what's the name of the cooperative or association? _____
    How long have you been a member? _____years.
11. Do you participate in coffee producer seminars? ( ) Yes ( ) No.
12. If you do: Which? _____
    For how many years? _____ years.

B) CHARACTERISTICS OF THE PRODUCTION

13. In Cultivation and harvest labor is: (percentage of each modality):
% ( ) Own Mechanization
% ( ) Outsourced Mechanization
% ( ) Shared Mechanization
% ( ) Family Manual labor
% ( ) Hired Manual labor

14. Classify the PREDOMINANT type of labor used in cultivation and harvest on your property:
( ) Mechanized
( ) Semi mechanized
() Manual

15. Indicate which kinds of equipment and machinery are used in cultivation and harvest:
( ) large machinery (harvesters, tractors)
( ) Small manual equipment bought at factories
( ) Small manual equipment improvised on the property
( ) Just manual labor

16. Who does the MACHINERY on your property belong to: (just tick what is predominant):
( ) Own
( ) Of the hired labor
( ) Of the service provider company
( ) Cooperative
( ) Association
( ) Neighbors
( ) I do not have machinery

17. How much approximately do you have in immobilized capital in your own machinery?
( ) Up to R$ 50.000,00
( ) From R$ 50.000,01 to R$ 100.000,00
( ) From R$ 100.000,01 to R$ 200.000,00
( ) From R$ 200.000,01 to R$ 300.000,00
( ) From R$ 300.000,01 to R$ 400.000,00
( ) More than R$ 400.000,00
( ) I do not have machinery

18. Do you hire any post harvest service from a company? ( ) Yes ( ) No.

19. If you hire services, what are the post harvest activities involved?
( ) Processing
( ) Pulping
( ) Preparation
( ) Drying
( ) Storing
( ) Roasting
( ) Other, which: _____
( ) I do not hire these services

20. Do you hire mechanization services from a company? ( ) Yes ( ) No.

21. If you do, what kind of contract do you have?
( ) Formal contract per harvest
( ) Exchange of services
( ) Other: _____
( ) I do not hire these services

22. How do you pay the services above?
( ) Product

( ) Cash
( ) Other ways (exchanges)
( ) I do not hire these services

23. If you hire mechanization services from a company, what are the characteristics of the company?
City/State:_____/____
Years of relationship:_____
Recommended by :_____

24. If you hire mechanization services, evaluate the importance of the item below for this decision (answer all the alternatives)
4 – Very important; 3 – Important; 2 –Not very Important; 1 – Indifferent
( )Speed in the harvesting
( ) Cost reduction
( ) Avoids immobilization of capital in equipment
( ) Quality of the hired service
( ) Recognition in the quality of the coffee sold
( ) Difficulty in hiring own labor
( ) Other, Which: _____
( ) I do not hire this kind of service

25. Have you already had any legal problems hiring mechanized services in your region?
() Yes () No.
If so, what was the reason? _____

26. How many workers do you have on your property?
Hired _____
Temporary (hired at peak seasons) _____

27. Do you contract temporary professional you have already hired previously?
() Yes () No.
If so, what is the number of times you re-hired someone? _____

28. Where do these temporary workers come from? (What state) _____

29. List the benefits you offer to the hired workers on your property:
( ) Housing just for the worker
( ) Housing just for the worker and family
( ) Meals just for the worker
( ) Meals just for the worker and family
( ) Financial help for schooling for the worker's children
( ) Basic food basket
( ) Other: _____
() I do not offer any benefits

30. Are the above benefits extended to the temporary workers?
() Yes ( ) No ( ) I do not have temporary workers

31. How do you contract temporary labor?
( ) Re-hiring
( ) Relatives recommend
( ) Present workers recommend
( ) Farmer friends recommend
( ) Through associations
( ) Through cooperatives
( ) Through a specialized agency
( ) Other: _____
( ) I do not have temporary workers

32. What is the average/monthly total cost (salary and social contributions) of a worker in case you hire them:
Hired worker: R$ _____

Temporary worker: R$ _____
Hired worker with family: R$ _____
Temporary worker with family: R$ _____

33. What is the percentage in the labor cost in relation to the total cost of the property:
Specialized labor for cultivation (hired and temporary) _____ %
Specialized labor for post harvest (hired and temporary): _____ %
Mechanization (own machinery): _____ %
Mechanization (hired machinery): _____ %

34. Have you had any legal problems in hiring?
( ) Yes ( ) No.
If so, what was the reason? _____

C) COMMERCIAL ASPECTS

35. What product do you commercialize? (% in the total production of the coffee farm):
% ( ) Dried natural coffee
% ( ) Pulped
% ( ) Other, which: _____

36. What type of coffee do you commercialize? (% in the total production of the coffee farm):
% ( ) Traditional Coffee
% ( ) Gourmet Coffee
% ( ) Fair trade Coffee
% ( ) Rainforest Coffee
% ( ) Organic Coffee
% ( ) UTZ Coffee
% ( ) Other, which: _____

37. What % of your total production is commercialized with each of the commercialization channels?
% ( ) Exporter broker
% ( ) Industry
% ( ) Cooperative
% ( ) Internal market broker
% ( ) Others, which: _____,

38. How do you sell coffee?
% ( ) Spot sale
% ( ) Formal contract per harvest
% ( ) Formal long term contract
% ( ) Intention sale term
% ( ) Barter
% ( ) Others

39. What would motivate you to make a contract: (answer all the alternatives as an intention even if you do not make a contract)
4 – Very important; 3 – Important; 2 – Not very Important; 1 – Indifferent
( ) Setting the price
( ) Reducing risk
( ) Guarantee of commercialization
( ) Financing the production (anticipation)
( ) Scientific–technical assistance
( ) Relationship with the commercialization channel
( ) Reputation on the market as an outcome from the relationship with a company
( ) I have no interest in making contracts.

40. What percentage of your coffee is commercialized before the harvest? _____ %

41. In your sales contract is price set?
( ) Yes ( ) No. ( ) I do not have a contract

42. Have you faced a disparity in prices where it was difficult to maintain the contract?
( ) Yes ( ) No.

43. If this happened, what did you do?
( ) Maintained the contract
( ) Renegotiated the contract
( ) Broke the contract

44. Is there any form of anticipated payment? ( ) Yes ( ) No.

45. Do you receive premium price for quality? ( ) Yes ( ) No.

46. Does your commercialization channel promote any event to recognize it suppliers that have top quality? ( )Yes ( )No.

47. What is the importance in the reasons below for choosing a certain industry to commercialize with (answer all the alternatives):
Write 4 to 1- (4) highest reason and (1) lowest reason
( ) Price paid for coffee
( ) Anticipated payment
( ) Guarantee of payment
( ) Long term relationship
( ) Reputation of the company

48. Does your channel of commercialization promote seminars and exhibits to exchange experiences among coffee producers ? ( ) Yes ( ) No.

49. Does your channel of commercialization incentivize innovation in your production?
( ) Yes ( ) No.
If so, how is this done? _____

50. What is your main source of technical assistance?
( ) Own hiring
( ) Services offered by the commercialization channels
( ) Coffee producer Associations
( ) Cooperatives
( ) I do not have technical assistance

51. Do you receive any sort of contact form the channels in the harvest time? ( ) Yes ( ) No.

52. What is the trust you have in your main channel of commercialization?
( ) High
( ) Medium
( ) Low

Thanks for your answers.
Stop time: ___hr ___min

Appendix 2 Descriptive Statistics of the result of the interviews

A. Profile of the producer

Question 1		
Where property is located (city)		
City	Number	%
Alto do Jetiquiba	1	1,5%
Araponga	1	1,5%
Areado	1	1,5%
Boa Esperança	1	1,5%
Bom Jardim	1	1,5%
Cabo Verde	1	1,5%
Campestre	1	1,5%
Campo do Meio	1	1,5%
Canaa	1	1,5%
Candeias	1	1,5%
Caparaó	5	7,5%
Capetinga	1	1,5%
Carmo da Cachoeira	2	3,0%
Carmo de Minas	3	4,5%
Carmo do Paranaíba	1	1,5%
Cristais Paulista	1	1,5%
Diamantina	1	1,5%
Eloi Mendes	1	1,5%
Espera Feliz	2	3,0%
Franca	1	1,5%
Guaxupé	1	1,5%
Ibiraci	1	1,5%
Itamogi	1	1,5%
Itirapuã	1	1,5%
Jacutinga	1	1,5%
Lajinha	1	1,5%
Machado	1	1,5%
Manhuaçu	2	3,0%
Manhumirim	1	1,5%
Monte Belo	2	3,0%
Monte Carmelo	4	6,0%
Monte Santo de Minas	1	1,5%
Não respondeu	1	1,5%
Passos	1	1,5%
Patos de Minas	1	1,5%
Patrocínio	7	10,4%
Perdizes	1	1,5%
Piumhi	1	1,5%
Reduto	1	1,5%
Romaria	4	6,0%
São Domingo das Dores	1	1,5%
São Gotardo	1	1,5%
São Sebastião da Grama	1	1,5%
Sao Sebastiao do Paraiso	1	1,5%
Serra do Saripe	1	1,5%
Total	67	100,00%

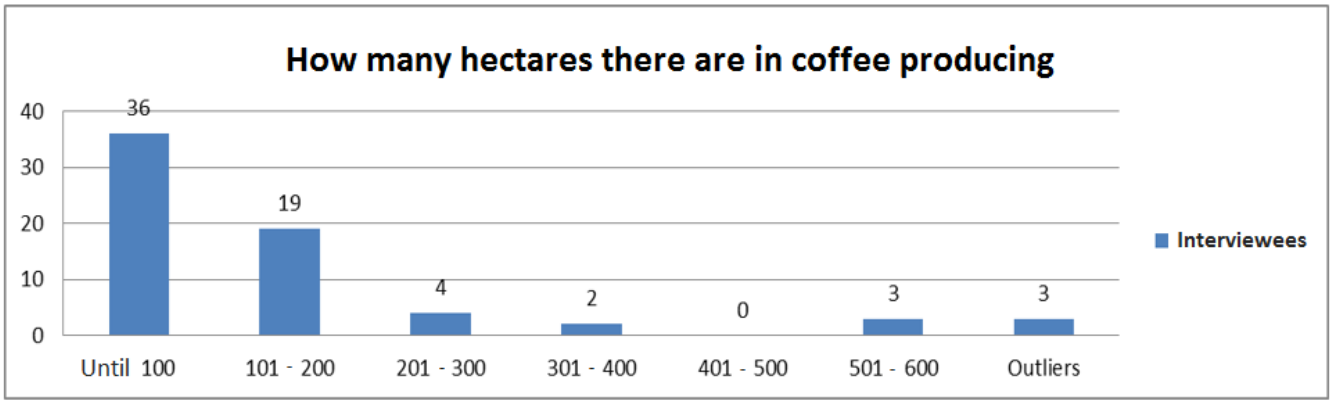
Question 1.1		
Where property is located (state)		
UF	Quantity	%
ES	1	1,5%
Região das Matas (MG)	16	24%
Cerrado Mineiro (MG)	24	36%
Sul de Minas (MG)	21	31%
RJ	1	1%
SP	4	6,0%
Total	67	100,00%

Question 2		
Education		
Level of Education	Quantity	%
None	2	3,0%
Primary	7	10,4%
High-School	12	17,9%
University	46	68,7%
Total	67	00,00%

Question 3	
Number of years working with coffee production	
Years	
Maximum	71
Minimum	3
Average	25,46

Question 4		
Predominant Topography		
Type of Topography	Quantity	%
100% Plain	12	17,9%
100% Mountainous	17	25,4%
Predominately Plain (>50% of the property)	14	20,9%
Predominately Mountainous (>50% of the property)	12	17,9%
Half Plain and Half Mountainous (50% of both topographies on the property)	4	6,0%
Did not answer	8	11,9%
Total	67	100,00%

Question 5	
How many hectares do you have for coffee?	
Hectares	
Maximum	2.700
Minimum	1
Average	195,51



Question 5.1	
Number of bags produced	
Bags	
Maximum	100.000
Minimum	24
Average	7112,06

Question 5.2		
What is the contribution of coffee in the rural income?		
Percentage	**Quantity**	**%**
10%	1	1,5%
20%	1	1,5%
30%	2	3,0%
50%	3	4,5%
60%	2	3,0%
70%	1	1,5%
80%	5	7,5%
82%	1	1,5%
90%	9	13,4%
95%	2	3,0%
100%	40	59,7%
Total	**67**	**100,00%**

Question 6		
Is Coffee the main source of Family income?		
	Quantity	%
No	19	28,4%
Yes	48	71,6%
Total	67	100,0%

Question 9		
Are you a member of a cooperative or association?		
	Quantity	%
No	7	10,4%
Yes	60	89,6%
Total	67	100,0%

Question 6.1		
What percentage is coffee in family income?		
Percentual	Quantity	%
5%	1	1,5%
10%	3	4,5%
15%	1	1,5%
20%	1	1,5%
30%	2	3,0%
40%	5	7,5%
50%	7	10,4%
60%	4	6,0%
70%	5	7,5%
80%	8	11,9%
85%	1	1,5%
90%	6	9,0%
95%	2	3,0%
100%	20	29,9%
Did not answer	1	1,5%
Total	67	100,00%

Question 9.1		
If so, which one?		
Did not answer	10	14,9%
AGRIFOC	1	1,5%
AMOCA	1	1,5%
COCACER	1	1,5%
COCAPEC	5	7,5%
COCARIVE	3	4,5%
COOCAFE	3	4,5%
COOPADAO	1	1,5%
COOPAMA	1	1,5%
COOPARAISO	1	1,5%
COOPARAO	5	7,5%
COOPERATIVA DE MACHADO	1	1,5%
COOPERCAM	1	1,5%
COOPERCITRUS	1	1,5%
COORPOL	1	1,5%
COOXUPE	17	25,4%
COPA	1	1,5%
EXPOCACCER	1	1,5%
EXPOCAFE	2	3,0%
MINASSUL	3	4,5%
MONTECER	2	3,0%
SCAMG	4	6,0%
SICOOB CREDICAF	1	1,5%
Total	67	100,0%

Question 7		
Do you control administrative costs of the property?		
	Quantity	%
No	14	20,9%
Yes	53	79,1%
Total	67	100,0%

Question 8		
Tradition in the activity		
Generation	Quantity	%
1st generation	14	20,9%
2nd generation	14	20,9%
3rd generation	24	35,8%
> 3rd generation	15	22,4%
Total	67	100,00%

Question 9.2		
If so, for how long?		
Years		
Maximum	53	53
Minimum	1	1
Average	16	16

Question 9.3		
	Do you belong to a cooperative?	
Are you an Illy supplier?	No	Yes
No	4 (6%)	39 (58%)
Yes	3 (4%)	21 (32%)
Total	7 (10%)	60 (90%)

Question 10		
Do you participate in coffee producers meeting?		
	Quantity	%
No	8	11,9%
Yes	51	76,1%
Did not answer	8	11,9%
Total	67	100,0%

Question 10.1		
If so, which?		
Did not answer	18	26,9%
ASCARJ	1	1,5%
VALE DA GRAMA Coffee Producer's Association	1	1,5%
CENECAFE	1	1,5%
Southern Minas Coffee Producing Circuit	1	1,5%
COCAMIG	1	1,5%
Several conferences	4	6,0%
Brazilian Coffee Conference	1	1,5%
Coffee Conference	1	1,5%
National Coffee producing Conference	1	1,5%
PROCAFE Conference	1	1,5%
COOXUPÉ	1	1,5%
Field Day	1	1,5%
EDUCAMPO	2	3,0%
CARMO DO PARANAIBA Coffee Producers' Meeting	1	1,5%
ILLY Meeting	1	1,5%
EQUIPE GUY CARVALHO	1	1,5%
EXPOCAFE	1	1,5%
Cooparaó Agricultural Product Exhibit	1	1,5%
PROCAFE	1	1,5%
FAEMG Meeting	1	1,5%
International Coffee Week	2	3,0%
Manhuaçu Producer Week	1	1,5%
Amoca Seminar	1	1,5%
CERRADO MINEIRO Seminar	5	7,5%
Coffee Seminar	1	1,5%
PATROCÍNIO Coffee Seminar	1	1,5%
SIMCAFE	2	3,0%
SIMPOSIO	2	3,0%
Matas de Minas Coffee Symposium	3	4,5%
Manhançu Coffee Symposium	5	7,5%
MANHUAÇU Symposium	1	1,5%
University of Coffee	1	1,5%
Total	67	100,0%

Question 10.2	
If so, for how long?	
	Anos
Maximum	40
Minimum	2
Average	11,43589744

B. Characteristics of the production

Question 11	
Cultivation and harvest	
	% (Média)
Own mechanization	38,80%
Just own mechanization	6%
Shared mechanization	6%
Family manual labor	26,87%

Question 12		
Classify the PREDOMINANT kind of labor		
Type of labor	Quantity	%
Mechanized	23	34,3%
Semi mechanized*	25	37,3%
Manual	19	28,4%
Total	67	100,00%

* Semi mechanized means using mechanized and manual labor jointly. This includes small Manual equipment. Mechanized considers the need of driver.

Question 13						
What machinery and equipment was used	No		Yes		Did not answer	
	Quantity	%	Quantity	%	Quantity	%
Large Machinery (harvesters, tractors)	4	6,0%	19	28,4 %	44	65,7 %
Small manual equipment bought at factories	9	13,4 %	14	20,9 %	44	65,7 %
Small manual equipment improvised on the property		28,4 %	4	6,0%	44	65,7 %
Just labor	16	23,9 %	7	10,4 %	44	65,7 %

Question 14		
The machinery I use belongs to:		
	Quantity	%
Did not answer	1	1,5%
I do not have machinery	10	14,9%
Mine	45	67,2%
Of hired labor	5	7,5%
Service provider company	4	6,0%
Cooperative	0	0,0%
Association	0	0,0%
Neighbors	2	3,0%
Total	67	100,00%

Question 15		
How much approximately do you have in immobilized capital in your own machinery?		
	Quantity	%
Did not answer	1	1,5%
I do not own machinery	16	23,9%
Up to R$ 50.000,00	1	1,5%
From R$ 50.000,01 to R$ 100.000,00	5	7,5%
From R$ 100.000,01 to R$ 200.000,00	4	6,0%
From R$ 200.000,01 to R$ 300.000,00	3	4,5%
From R$ 300.000,01 to R$ 400.000,00	3	4,5%
More than R$ 400.000,00	34	50,7%
Total	67	100,00 %

Question 16		
Do you hire post-harvest services from any company?		
	Quantity	%
No	27	40,3%
Yes	40	59,7%
Total	67	100,00%

Question 17						
Do you hire any company for post harvesting	No		Yes		Did not answer	
	Quantity	%	Quantity	%	Quantity	%
Processing	37	55,2 %	30	44,8 %	0	0,0%
Pulping	52	77,6 %	14	20,9 %	1	1,5%
Preparing	57	85%	9	13,4 %	1	1,5%
Drying	53	79,1 %	13	19,4 %	1	1,5%
Storage	41	7,5%	26	38,8 %	0	0,0%
Roasting	62	92,5 %	4	6,0%	1	1,5%

Question 18		
Do you hire mechanization services from any company?		
	Quantity	%
No	37	55,2%
Yes	30	44,8%
Total	67	100,00%

Question 19		
If you HIRE mechanization services, what kind of contract do you use?		
	Quantity	%
I do not hire this kind of service	37	55,2%
Formal contract per harvest	22	32,8%
Exchange of services	2	3,0%
Other	5	7,5%
Did not answer	1	1,5%
Total	67	100,00%

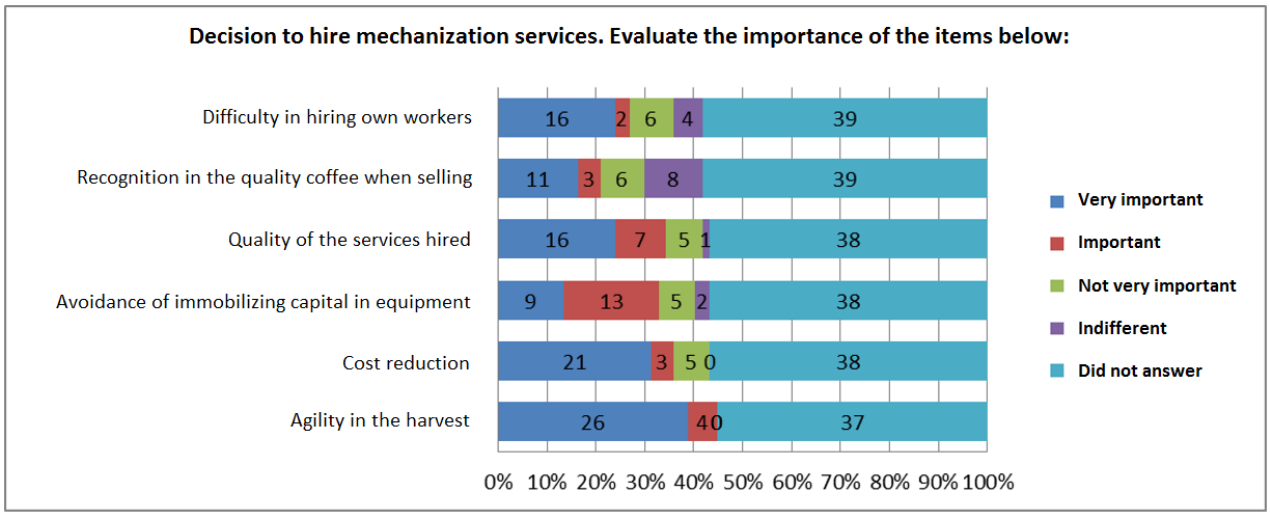
Question 20		
How do you pay the services above?		
	Quantity	%
I do not hire this kind of service	36	53,7%
Product	6	9,0%
Cash	21	31,3%
Exchanges	3	4,5%
Other	1	1,5%
Did not answer	0	0,0%
Total	67	100,00%

Question 21.1		
If you HIRE mechanization, what are the characteristics of the company?		
State	Quantity	%
I do not hire this kind of service	37	55,2%
Did not answer	17	25,4%
ES (Espirito Santo)	1	1,5%
MG (Minas Gerais)	10	14,9%
SP (São Paulo)	2	3,0%
Total	67	100,00%

Question 21.2	
If you HIRE mechanization, what are the characteristics of the company?	
	Years
Maximum	16
Minimum	2
Average	8,230769231

Question 21.3		
If you HIRE mechanization, what are the characteristics of the company?		
Recommendation	Quantity	%
I don't hire	37	55,2%
Did not answer	16	23,9%
Friend	8	11,9%
Cooperative	2	3,0%
Neighbor	4	6,0%
Total	67	100,00%

Question 22



Question 23

Have you had any legal problems hiring mechanization services in your region?

	Quantity	%
No	32	47,8%
Yes	3	4,5%
I do not hire these services	28	41,8%
Did not answer	4	6,0%
Total	67	100,00%

Question 24

How many workers do you have on your property?

	Quantity	%
Only hired labor	6	9,0%
Just family labor	1	1,5%
Just temporary labor	4	6,0%
Hired and Family labor	1	1,5%
Hired and temporary labor	47	70,1%
Family and temporary labor	5	7,5%
Did not answer	3	4,5%
Total	67	100,00%

Question 24.1

How many workers do you have on your property?

Number of hired workers	
Maximum	50
Minimum	0
Average	8

Question 24.2

How many workers do you have on your property?

Number of family workers	
Maximum	50
Minimum	0
Average	6,333

Question 24.2

How many workers do you have on your property?

Number of temporary workers	
Maximum	100
Minimum	0
Average	28,2

Question 25		
Do you hire temporary workers again that were hired previously?		
	Quantity	%
No	15	22,4%
Yes	42	62,7%
I do not use temporary workers	1	1,5%
Did not answer	9	13,4%
Total	67	100,00%

Question 26		
Where were the hired workers from (state)?		
State	Quantity	%
-	12	17,9%
BA (Bahia)	3	4,5%
ES (Espírito Santo)	1	1,5%
MG (Minas Gerais)	45	67,2%
MG/RJ (Minas Gerais/ Rio de Janeiro)	1	1,5%
MG/SP (Minas Gerais/ São Paulo)	3	4,5%
SP (São Paulo)	2	3,0%
Total	67	100,00%

Question 25.1	
Do you hire temporary workers again that were hired previously?	
Number of time they were re-hired	
Maximum	80
Minimum	0
Average	8,742857143

Question 27						
List the benefit offered to the hired workers on your property.						
	No	(%)	Yes	(%)	Did not answer	(%)
Housing for the worker	47	70,1	12	17,9	8	11,9
Housing for the worker and family	18	26,9	41	61,2	8	11,9
Meals for the worker	50	74,6	9	13,4	8	11,9
Meals for the worker and family	52	77,6	7	10,4	8	11,9
Financial help for schooling for the workers children	43	64,2	16	23,9	8	11,9
Basic food basket	48	71,6	11	16,4	8	11,9
Total	67	100,00%				

Question 28		
Are the benefits extended to temporary workers?		
	Quantity	%
No	32	47,8%
Yes	22	32,8%
I do not use temporary work	5	7,5%
Did not answer	8	11,9%
Total	67	100,00%

Question 29						
How do you hire temporary labor?						
	No	(%)	Yes	(%)	Did not answer	(%)
Had already been hired previously	15	22,4	43	64,2	9	13,4
Relatives indicated	45	67,2	13	19,4	9	13,4
Present workers indicated	29	43,3	29	43,3	9	13,4
Indication of other farmers	31	46,3	27	40,3	9	13,4
Hiring via associations	57	85,1	1	1,5	9	13,4
Hiring via cooperatives	58	86,6	0	0,0	9	13,4
Hiring via specialized agency	56	83,6%	2	3,0	9	13,4
I do not use temporary labor	56	83,6%	2	3,0%	9	13,4%
Total		67			100,00%	

Question 30			
What is the average/monthly total cost (salary and social contributions) of a worker in case you hire them:	Maximum	Minimum	Average
Hired worker: R$ _____	3000,00	0,00	1930,73
Temporary worker: R$ _____	4800,00	0,00	1930,73
Hired worker with family: R$ _____	3500,00	0,00	1213,13
Temporary worker with family: R$ _____	3000,00	0,00	658,74

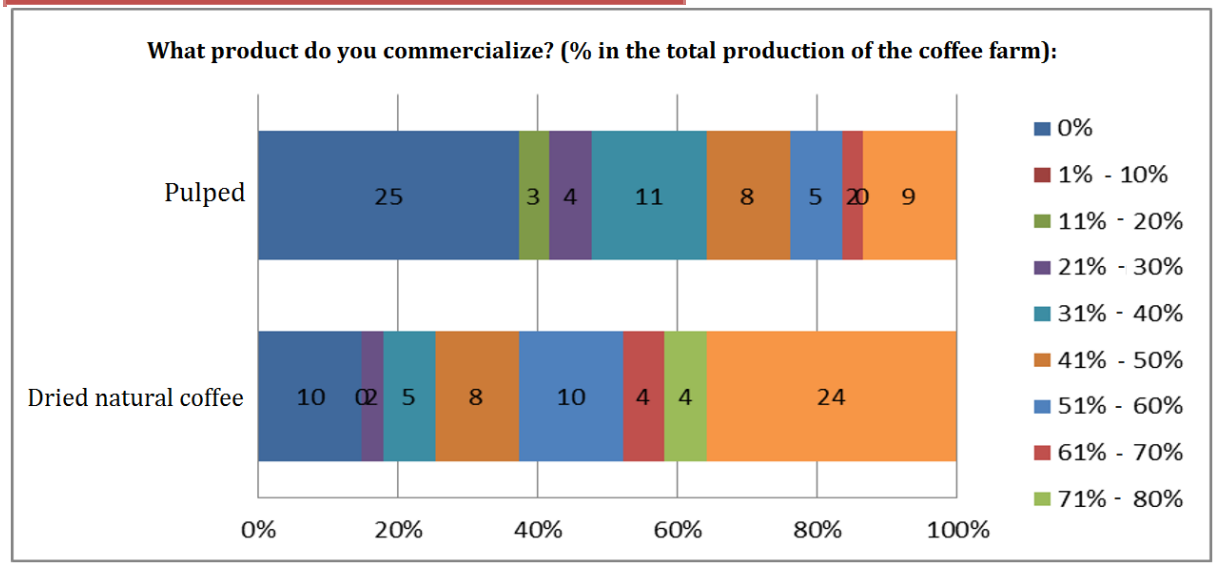
Question 31			
What is the percentage in the labor cost in relation to the total cost of the property	Maximum	Minimum	Average
Specialized labor for cultivation (hired and temporary)	55,0%	5,0%	26,3%
Specialized labor for post harvest (hired and temporary)	45,0%	2,0%	17,3%
Mechanization (own machinery)	15,0%	10,0%	11,8%
Mechanization (hired machinery)	10,0%	5,0%	8,3%

Question 32		
Have you had any legal problem?		
	Quantity	%
No	37	55,2%
Yes	22	32,8%
Did not answer	8	11,9%
Total	67	100,00%

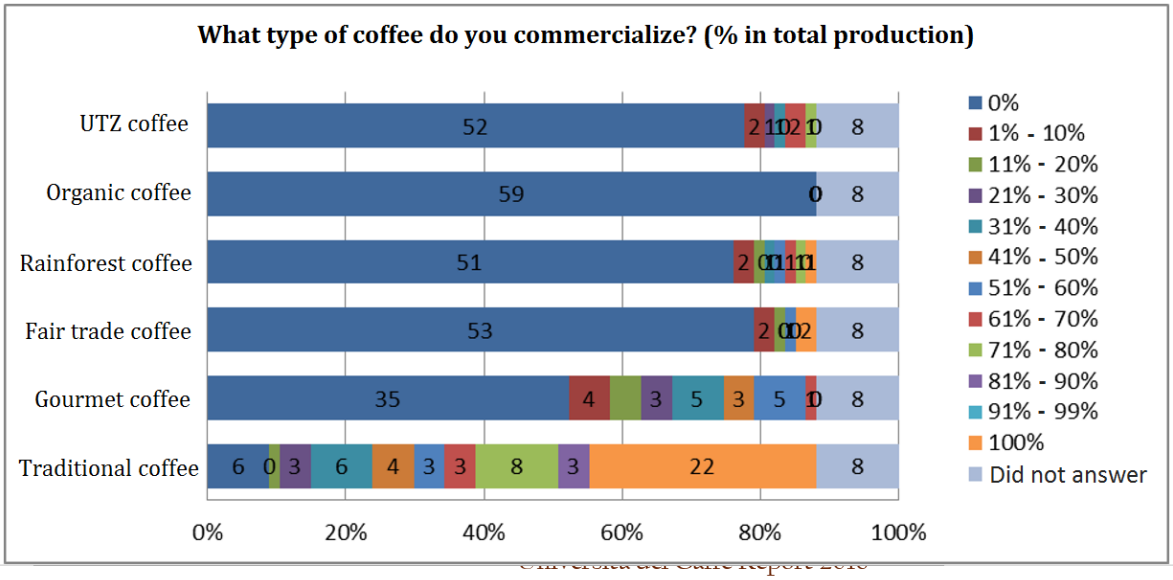
Question 32.1		
If you have, what was the reason?		
	Quantity	%
Did not answer	53	78,8%
Mistake in the termination of the contract	3	4,5%
Not registering legally	3	4,5%
Number of hours worked	4	6,1%
Bad working conditions	1	1,5%
Health problems	3	4,5%
Total	67	100%

3. Commercial Aspects

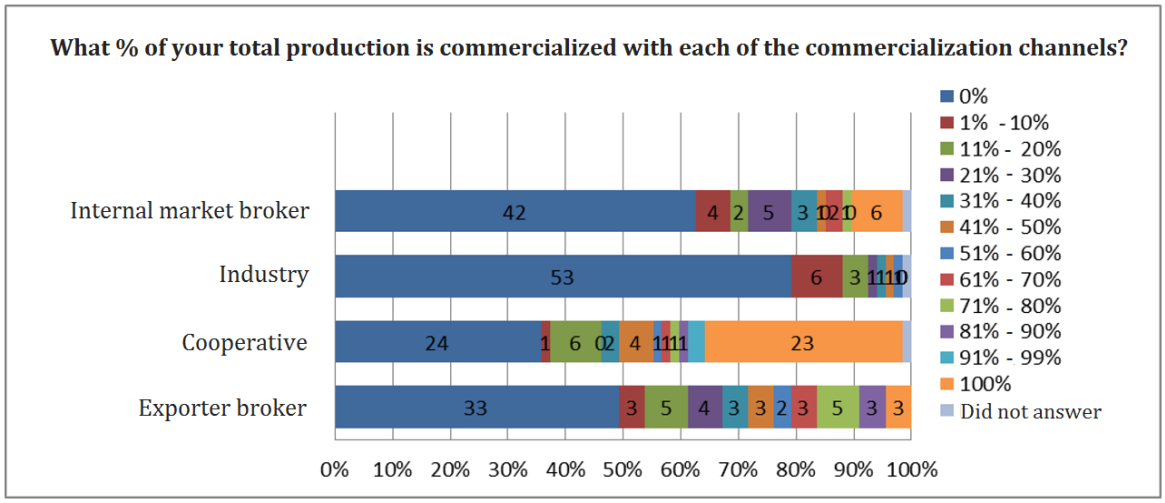
Question 33



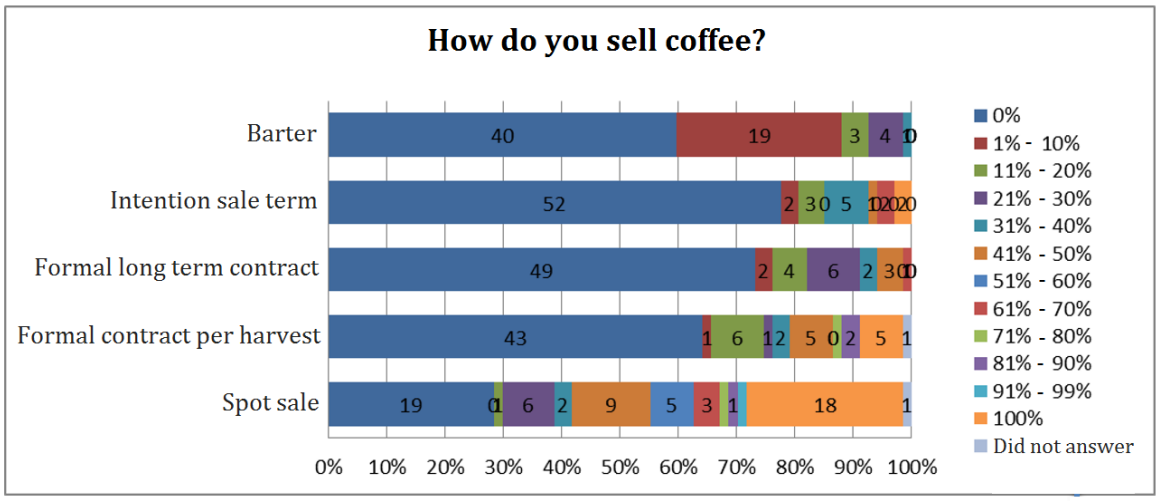
Question 34



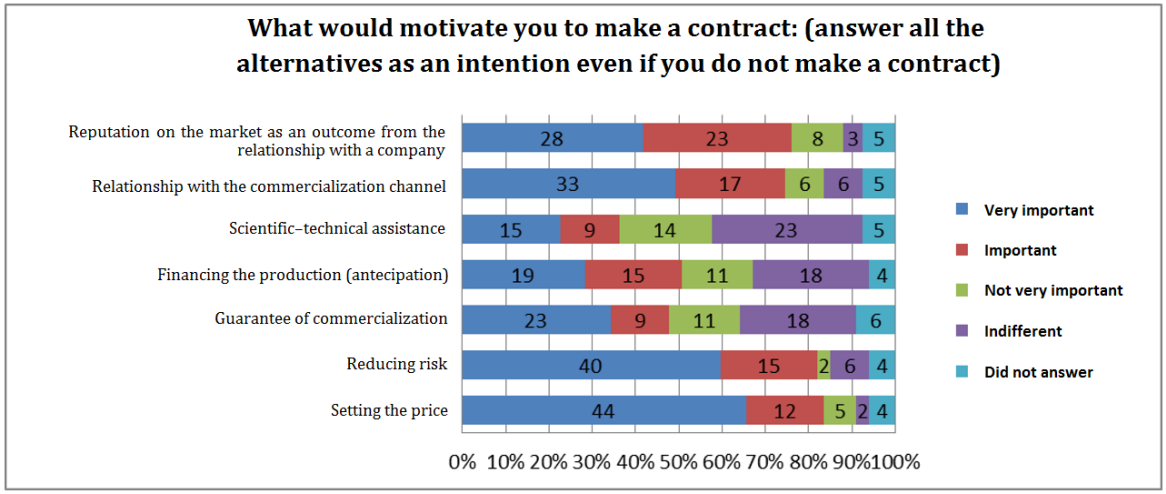
Question 35



Question 36



Question 37



Question 38		
What is the percentage of coffee commercialized before the harvest?		
Percentual	**Quantity**	**%**
0%	23	34,3%
10%	6	9,0%
20%	4	6,0%
30%	9	13,4%
35%	1	1,5%
40%	8	11,9%
50%	4	6,0%
55%	1	1,5%
60%	4	6,0%
70%	7	10,4%
Total	**67**	**100%**

Question 39		
In the sales contract is the price set?		
	Quantity	**%**
No	11	16,4%
Yes	34	50,7%
I do not have a contract	16	23,9%
Did not answer	6	9,0%
Total	**67**	**100,00%**

Question 40		
Have you faced a variation in prices in which it was hard to maintain the contract?		
	Quantity	**%**
No	32	47,8%
Yes	26	38,8%
Did not answer	9	13,4%
Total	**67**	**100%**

Question 40.1		
If you did, what did you do?		
	Quantity	**%**
Maintained the contract	20	29,9%
Renegotiated the contract	6	9,0%
Broke the contract	1	1,5%
Did not answer	40	59,7%
Total	**67**	**100,00%**

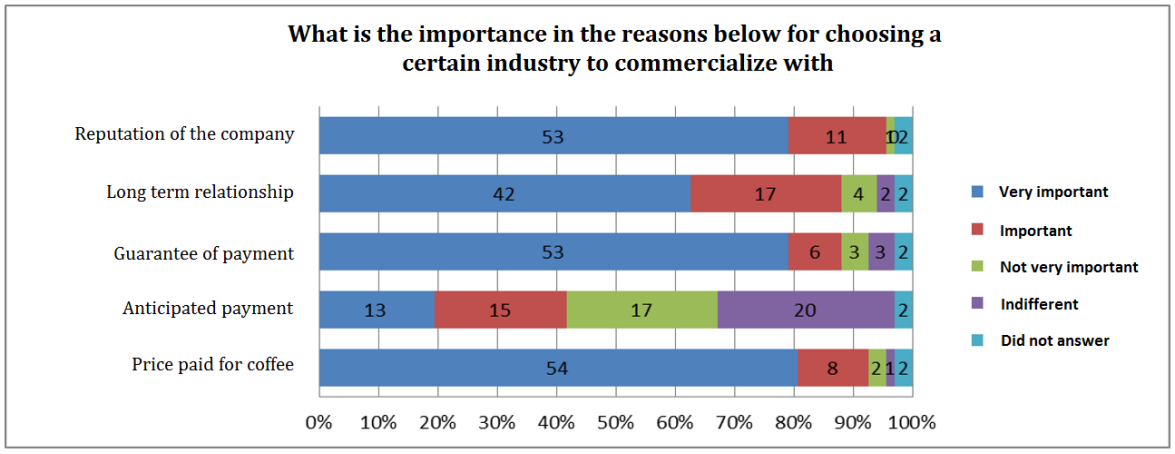
Question 41

Is there any form of anticipated payment?		
	Quantity	**%**
No	39	58,2%
Yes	19	28,4%
Did not answer	9	13,4%
Total	**67**	**100,00%**

Question 42		
Do you get premium price for quality?		
	Quantity	**%**
No	22	32,8%
Yes	44	65,7%
Did not answer	1	1,5%
Total	**67**	**100,00%**

Question 43		
Does your commercialization channel have any special event to recognize their best quality coffee suppliers?		
	Quantity	**%**
No	20	29,9%
Yes	39	58,2%
Did not answer	8	11,9%
Total	**67**	**100,00%**

Question 44



Question 45

Does your commercialization channel have seminars and exhibits to exchange experience amongst coffee producers?

	Quantity	%
No	14	20,9%
Yes	45	67,2%
Did not answer	8	11,9%
Total	**67**	**100,00%**

Question 46

Does your commercialization channel incentivize the creation of innovation in your production?

	Quantity	%
No	21	31,3%
Yes	38	56,7%
Did not answer	8	11,9%
Total	**67**	**100,00%**

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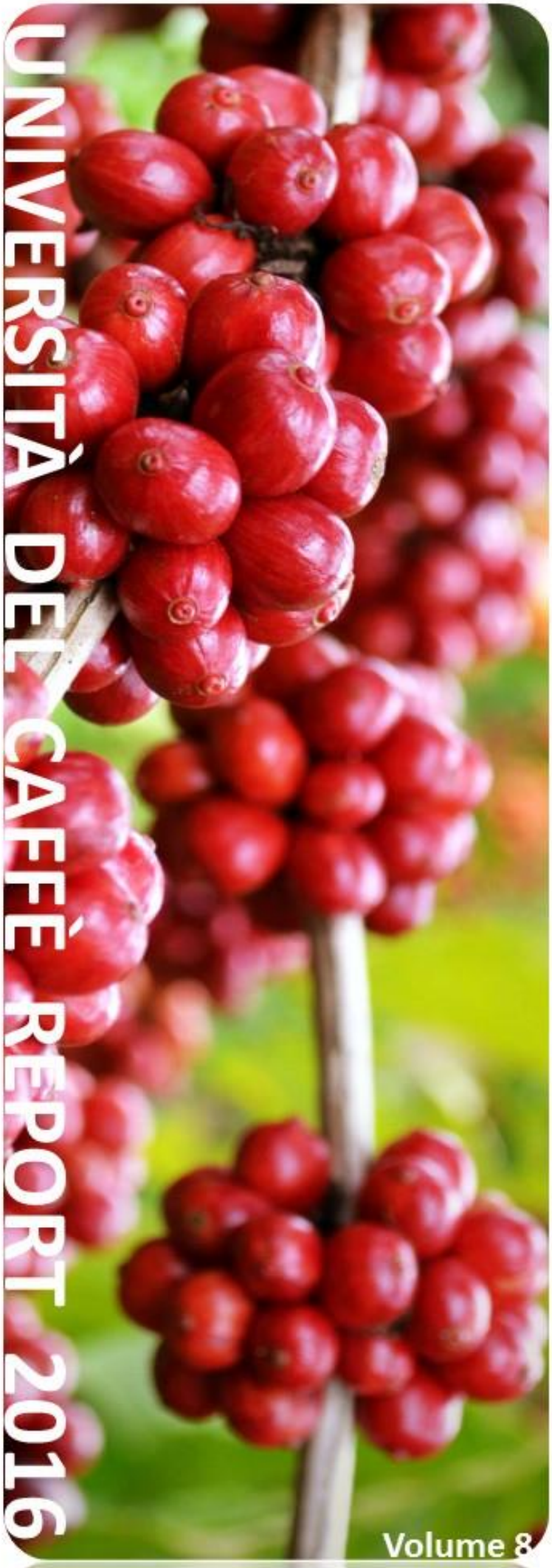

Volume 8

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