Universitá del Caffè Brazil
Coffee Researches
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1. Café – Brasil
2. Agricultura e tecnologias relacionadas

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1. Preface

The Università del Caffè Brazil was born in March of 2000 as a result of a partnership between PENSA (Agribusiness Knowledge Center – FEA/USP and FIA) and illycaffè. The mission, since the beginning, has being the generation and dissemination of knowledge to the coffee system. To celebrate 18 years of activities we publish this collection of research conducted between 2013 and 2017.

During these years of activity the UdC Brazil team, in close harmony with Illycaffè, has conducted courses to coffee growers and technicians covering technical and managerial aspects. There were more than 9 thousand participations in seminars, short courses and five editions of Specialization Course in the Coffee Agribusiness. In tune with the needs of coffee growers and illycaffè, since 2014 the UdC Brazil courses are held at a distance through the portal universidadedocafe.com.

Aligned with its mission, the University of Caffè Brazil generates knowledge through the production of research. This book intends to support the dissemination of the knowledge to the community of the coffee agribusiness, adding value to all its participants. The seven studies are:

- Research on coffee production in Brazil: paving the way to the future
- Case studies about innovation in the Brazilian coffee production
- Strategic supply contracts for high quality coffee
- Drivers of change in the coffee production: past, present and future challenges
- Risk assessment for pesticide contamination of coffee
- The possibilities in the differentiation in the coffee production and the consumers' behavior

- Dryness of natural and natural-pulped coffee, with and without raking, and its effects on the espresso beverage

The original publishing was in Portuguese, but thinking about the international insertion of Illycaffè, we decided to publish this content also in this e-book in English, in order to extend the reach of the results.

We are proud to present this book dedicated to all those who work with coffee hoping that it can be a contribution to them.

Professor PhD Decio Zylbersztajn
Professor PhD Samuel Ribeiro Giordano
Professor PhD. Christiane Leles Rezende De Vita

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2. Research on coffee production in Brazil: Paving the way to the future – 2017

Decio Zylbersztajn • Samuel Ribeiro Giordano
Christiane Leles Rezende de Vita
Caroline Gonçalves • Pedro Braga Sotomaior Karam

2.1 Introduction: Research Networks – Global Warming – Coffee

The pressures that are hitting global agriculture demand coordinated efforts from companies, governments, and research systems. The challenge of food security calls for resources to supply food for an estimated population of 9 billion inhabitants by 2050. The need for increasing the productivity of production factors to meet the population growth demand, income increase, food security and environmental requirements all point towards a challenge whose complexity is ever more significant. The spectrum of global warming is an addition to the range of issues that arise for public and private decision-makers from the agricultural sector worldwide. The science model in the post-war period that resulted in the "green revolution" is not enough when it comes to facing current problems. The present paper aims at mapping the efforts of coffee research in Brazil towards meeting the scenario mentioned above. The study focuses on identifying significant research activities as well as verifying how research profile has changed over time. Furthermore, it seeks to discuss network-oriented research models that comprise the global warming issue.

Agriculture has been forced to supply the growing global population, within environmental standards, which assure the continuity of life on the planet, assist demanding consumers regarding information on technologies adopted in the supply chains, information about food sourcing and social aspects of production. Aside from that need, there have been problems for which companies, governments, and research entities should be aware. The issue of global warming signals the need for rethinking production standards, commercialization, and consumption of modern society. Global warming has the potential of caus-

ing direct impacts over agribusiness systems. Productive areas might become marginal or unfit for agriculture, whereas new regions can turn productive, as in the case of cold areas. Alterations to water regime might lead to the need for developing technologies that increase the resilience of varieties in use as a way to enhance tolerance to water stress and exposition to climatic accidents out of known standards.

Within a framework still under discussion regarding the global society's capacity to reduce CO2 emissions, new information about climate changes is perceived. Complex problems suggest complex solutions, multidisciplinary in general. Hence the question of how current research structures should prepare for facing such issues. Agricultural research has a characteristic of local specificity, that is to say, at least part of it should occur in the ecosystem where the innovation will happen. Knowledge exchange in the agricultural sector is limited and requires adaptation efforts in the regions receiving the technologies.

In this second decade of the millennium, Brazil is undergoing economic adjustments that curbs allocation of resources to research. Such reality is shown through the situation of the major universities in the country and of the research system represented by EMPRAPA, Federal and State Universities whose budget falls short of needs. Budget constraints placed before the growing demands leads us to reason over the efficiency of the country's current agricultural research model, where individual scientist work prevails or, at best, research group work. Few connections are observed among the country's research groups and even fewer with international groups of potential collaborators. We consider that the current model will not assure the generation of knowledge to face current and near-future problems. How to do it?

New research models: Studies on agriculture gained momentum with the view of Agribusiness Systems initiated by Ray Goldberg at Harvard and evolved with the debate over innovation networks[1]. Private strategies and public policies, including R&D policies, succeeded in the broadening of the scope in the field of the researchers invited to consider the chains and networks involved with agriculture. Some characteristics of network approach are noted in the literature and should be cited (Camps,T. et al. 2004).

1 O estudo e aplicações de redes de inovação foi adotado na Holanda em um modelo conhecido por KLICT: chains, networks, clusters & ICT. O resultado demonstrou impacto positivo no sistema de educação e de inovações na Holanda, colocando o país em posição de destaque na comunidade internacional.

The first one is interdisciplinarity, which is necessary for approaching the problems affecting agriculture. Issues such as global warming are complex enough to suggest the need for support and integration of different fields of knowledge. Research should not avoid communication with society, as a way to prevent from adverse reactions deriving from the public's lack of knowledge. The research must generate the capacity of solving real problems that affect the community and demonstrate flexibility to redesign traditional research systems which no longer respond to society's needs. It should create incentive mechanisms for the cooperation among research centers to push for interdisciplinary work, and, at last, rebuild competencies that allow for ex-ante assessment of the impact of innovations on society. New models have been tested worldwide, as the example from the KLICT experiment in Holland, which motivated efforts to create a cooperation network among universities from Holland, Denmark, Brazil, France, USA, and Canada. The model had an International Board, together with the government and the private sector. The initiative generated innovative projects, theoretical and applied, which sought to solve real problems.

One of the characteristics of the mentioned model is the decade-long resource input, research proposal design involving the private sector and knowledge centers, the implementation of an independent international committee to assess the proposals and oversee the execution of the projects. Despite Brazil having participated in the efforts as the cited country, the research model adopted in Brazil still features the structure based upon academic individualism and scarce incentives to the cooperation among centers of knowledge and few initiatives towards engagement from the companies.

This observation is not new, which leads us to think about the existing incentives in the country for the implementation of integrated research programs. Efforts from EMPRAPA and some one-off examples of coordinated action are exceptions, among which we have "Universidade do Café Brazil."

The solution for problems such as global warming demands the coordination of specialized knowledge centers as well as the strengthening of the relationships among different actors from the Agribusiness Systems. The new models suggest implementing a concept all of us agree to, but in fact, doesn't find incentives to be developed. We covered the models of cogeneration of knowledge that need new institutional designs that facilitate combined action between companies and research institutes.

The Global Warming: This study doesn't aim at generating new proposals for the interpretation of the causes for global warming but to map the existing efforts from the Brazilian research groups dedicated to climate, agriculture and, partic-

ularly, to coffee. The approach of Agribusiness Systems allows us to highlight motivating aspects for the accomplishment of the study.

- Changes that affect a sector within an Agribusiness System impact the other areas, demanding the adoption of joint strategies. In case climate changes are observed, which require the migration of coffee production activities, all the processing system, and product logistics will need a redesign.
- This work considers the hypothesis that the agribusiness system for coffee, especially the sectors dedicated to the production of specialty coffee (growers, processing companies, and consumers) may bear the impacts from global climate change.
- R&D organizations are pressed to respond with applicable solutions that guarantee the functioning of the coffee production system, which urges the need for discussing the current models.

The Structure of the Study: This study contains nine parts. Following this introduction, part 2.2 presents the central research objective, which emphasizes the mapping of researchers and the identification of potential research networks aimed for coffee production. In part 2.3 the reader will find a description of the model adopted for mapping research activity and, notably, the explanation of the tool utilized for mapping the existence and characteristics of research networks. Part 2.4 describes the state of the art of the research on climate changes and global warming in Brazil.

The adopted approach stems from general studies on climate change in agriculture depicting research lines in important centers and highlights coffee production. Part 2.5 presents a brief description of the visited research centers, which includes the source and history of the respective contributions. Part 2.6 presents net mapping findings, identifying the nodes and the intensity of cooperation among knowledge centers. Part 2.7 presents conclusions and suggestions for the strategic design of research networks in Brazil, highlighting a proposal that best uses the current structure as a way to boost innovation. Part 2.8 presents the appendix that includes the list of centers and researchers, as well as the adopted questionnaire model. Finally, part 2.9 presents an executive summary.

2.1.1 Bibliographical references:

Camps,T., Diederen,P., Hofstede,G.J., Vos,B. The Emerging World of Chains & Networks. Bridging Theory and Practice. Reed Business Information bv ´s-Gravenhage. The Netherlands. 2004.

2.2 Objectives

Agricultural research in Brazil does not have long-term planning. Due to lack of resources, it is understood that maintaining an up-to-date map of the activities accomplished in the different research centers dedicated to coffee may avoid duplicate efforts, facilitate information, result and partnership searches and, in a particular way, it may help format innovative R&D models.

This study aims at taking a first step toward rethinking the current model and does so using the mapping of the leading research activities dedicated to coffee production in Brazil. Particular attention is dedicated to the identification of approaches to the topic of climate change given the potential impact it may have on agriculture in general and, particularly, on coffee.

The objectives are as follows:

- Map the primary programs and research institutes on coffee;
- Identify leading researchers and map potential research networks dedicated to coffee production in Brazil;
- Map ongoing research on coffee production so that they can be a reference for forthcoming work;
- Identify specific research on the effects of climate change on coffee.

This last objective meets Illycaffè's and all the industry's concern about coffee suppliers that need answers/orientations to produce coffee through changes to production conditions sustainably.

The results may guide research investments, the discussion of public policies for coffee research focusing on the quality and sustainability issue, as well as private organizations strategies for coffee supply.

2.3 Method

This chapter describes the adopted method in the study, to meet the proposed goals from the previous section.

The research proceeded from March to December 2017. To inform about the adopted procedures, this chapter is divided into three parts : bibliographic search; identification of research centers and researchers; questionnaire elaboration and application; organization of a panel of experts about global climate change and its effects on coffee production (to be accomplished in 2018 for val-

idation); tabulation and analysis of the results followed by the consolidation of the final document.

2.3.1 Bibliographic search

The research structure contains initial conceptual chapters that support the empirical part. Such chapters cover the following topics:

- History of the main institutions that work on the issue of coffee production in Brazil;
- Studies on climate change applied to agriculture, especially coffee production.

A bibliographic search was performed on the evolution of the topics from the Brazilian Coffee Research Symposium that took place from 2000 until 2015. This topic will be tackled in the Results chapter, 2.6.

2.3.2 Identification of research centers and researchers

The "coffee" theme has encouraged researchers from several fields of knowledge, encompassing agronomic research ranging from genetic improvement to biochemical studies and even genomic studies. The identification of potential structured research networks dedicated to coffee considered research centers and researchers as focal points. In other words from the specific academic production, we identified the researchers and the corresponding research centers where they work.

To carry out a search that covered all institutions and as many researchers as possible, the procedure of hiring researchers was adopted, identify the articles presented in technical meetings dedicated to coffee and the quotes of free access to the Lattes Platform.

The initial contact with traditional coffee research institutions generated the first list of researchers. Afterward, research was deepened using the Lattes Platform (http://lattes.cnpq.br/). Such platform integrates the curriculum database from CNPq[2] – National Board of Technological and Scientific Development, which became a standard in the registration of researchers' curricula and is adopted by most funding institutions, universities, and research institutions.

2 The National Board of Scientific and Technological Development is a department directly linked to the Science, Technology and Innovation Ministry to stimulate research in Brazil.

Employing the Lattes Platform researchers' area of work, publications and developed projects were identified. The five most recent publications from each identified researcher were linked, and from them, we identified the names of those researchers who work together in the papers. The collaborators' identification allowed us to extend the list of researchers. 634 researchers were identified, as well as 95 research centers.

The definition of the criterion for the effect of mapping was those researchers who had more than one publication related to coffee in the period between 2012 to 2017. With this distinction the sample was narrowed down to 471 researchers and 88 institutions. The full list with the names of the institutions is in Annex 2.2.

The initially mapped figure shows that there is a category of researchers that can be named "potential" and that, even if not focused on coffee, they can collaborate with research at any time on a variety of topics, provided they have the accordingly foster.

Specific questionnaires were applied to complement the database generated, and they are described in the item as follows.

2.3.3 Elaboration and application of questionnaire

Alongside with the Lattes Platform search, an interview questionnaire was elaborated for researchers, which can be viewed in Annex 2.2., structured in five central parts:

1. The identification of the Research Center.
2. The profile of the researchers from the center.
3. Existing Institutional partnership for research.
4. Description of the two main ongoing research projects.
5. Indications of connections with other researchers.

The interviews were carried out face-to-face or by phone, Skype or e-mail. In total 34 questionnaires were filled out, which yielded a non-random database to develop the analysis.

2.3.4. A panel of experts about global climate change and its effects on coffee production

Stemming from the identifications of the studies carried out in Brazil on climate change related to agriculture, especially coffee production, a panel of experts will take place on March 1st, 2018 for addressing the topic.

The schedule includes the discussion of the following topics:

a) Current research fields.
b) Consensus and controversies.
c) Organization of research in times of crisis.
d) Research needs.
d) Existing gaps.

After the accomplishment of the panel, a document will be produced, comprising the perception of the guest scientists about the current research areas, as well as research needs, the structure of the research institutions and the existing gaps. In the same way as for other research, the analysis was defined by taking into account the publications from the period between 2012 and 2017.

2.3.5 Tabulation and result analysis:

The resulting report was segmented into a) tabulation and descriptive study; b) result from analysis of coffee-related research mapping; c) identification and analysis of research networks.

a) Tabulation and questionnaire analysis. – The answers to the questionnaires were tabbed, and descriptive statistics of average and frequency analyzed their results through the creation of charts and tables. Part of the answers to the questionnaires fed the researcher databases.

b) Result analysis of coffee-related research mapping – The results obtained generated information on research institutions, researcher lines of work, as well as potential research lines based upon joint publications. The lines of research defined in the Symposium for Brazilian Coffee Research were used as redirection indicators for research interests over time. The results follow in the order:

– Lines of research, researchers, and institutions, segmented by regions.

– Lines of research from the Symposium for Brazilian Coffee Research over time (2000 to 2015).

– Network mapping, identifying the nodes, the intensity of cooperation among knowledge centers.

c) Identification of researcher networks – For research network mapping UCINET software, version 6[3] was used. This software can map potential networks, in our case as of the joint publications. Mapping means identifying the connections, the nodes, the links and the flows, which for the event of this research we will define as:

– Network: group of researchers that derive from each other for a specific purpose: development of research on coffee production in Brazil. Their relationship features the information flow. The network is composed of nodes, links and flows (Alejandro, Norman, 2005).

– Nodes: researchers and research institutes.

The relationship among researchers is what defines the nature of the observed link. In this study we define the publications as variables that identify such relationship. There will be a link whenever there is a joint publication involving two or more researchers. The links are represented as lines connecting the nodes.

– Flow: Indicates the link direction. It can be unidirectional or bidirectional.

When a researcher does not have a link with other researchers, he/she will be represented by a knot without connections, that is to say, one that does not feature a network.

From the network mapping the degree of centralization was calculated, which is one of the measures that characterize a given network. That measure discloses the number of people to which one of the researchers is directly related.

In order to facilitate result viewing, a new set of maps was generated taking into account all researchers, all research institutes, and another set of maps considering the most relevant researchers and institutions only.

2.3.6. Consolidation of the final document

From the analysis of interview and Lattes Platform results, a final report was generated with the main conclusions and schedule suggestions.

2.3.7 Bibliographical references

Alejandro, V. A. O., Norman, A. G. (2005). Manual introdutório à análise de redes sociais: medidas de centralidade. Mexico: Universidad Autonoma Del Estado de México.

Borgatti, Stephen; Everett, Martin; Freeman, Linton. (2002). UCINET for Windows: Software for social network analysis. https://sites.google.com/site/ucinetsoftware/

3 Manufacturer: Analytic Technologies, developed specifically for social network data analysis by Lin Freeman, Everett Martin and Steve Borgatti in the early 80's (Borgatti, Martin, Freeman, 2002).

2.4 The state of the art of the research on climate change and global warming in Brazil

This chapter describes the research lines on climate change and global warming in Brazil, with particular attention to those that focus on the effects on agriculture. The adopted approach includes Brazil's public policies with regards to climate change, part of the general studies on the topic, controversies that are likely to persist, the expected or observed effects on agriculture, as well as the description of ongoing research lines in major centers for coffee production.

The covered topics are:

- 2.4.1 Political Stance in Brazil on the Global Warming Issue
- 2.4.2 Brazilian Initiatives concerning climate change and public policies
- 2.4.3 Research lines funded by public resources
- 2.4.4 Description of studies on climate change in Brazil
- 2.4.5 Global Warming and scenarios for the Brazilian Agriculture
- 2.4.6.1 Climatic Modeling and Sectorial Vulnerabilities to climate change in Brazil
- 2.3.6.2 Climate change risks in Brazil and boundaries to adaptation
- 2.4.6.3 The approach of climate change in Research Centers and Specific Studies

Below, each subitem is presented.

2.4.1 Political Stance in Brazil on the Global Warming Issue

Brazil signed the Paris Agreement on climate change and, in 2015, presented an NDC (National Determined Contribution) to this accord. It came into effect in September 2016, when Brazil submitted the instrument of ratification. With this, which was Brazil's intention turned into a target.

That implied, on Brazil's part, in the commitment to developing policies by implementing actions and measures that support the compliance to the targets established in the NDC. The organization in charge of the implementation planning and the funding of these activities and rules is the Environment Ministry – MMA, through the National Strategy for the Implementation and Funding of NDC in Brazil, whose goal is meeting the goal of reducing the greenhouse gases emission – GEE, together with the Paris Accord.

The instruments for executing such actions, besides the National Policy on Climate Change – FNMC and the Communication from Brazil to IPCC.

The technical and scientific cooperation with entities related to the topic is promoted by the Environment Ministry – MMA so that the country reaches the voluntary commitments to greenhouse gas emission reduction. The fight against deforestation in the Amazon and other biomass is one MMA's target in this effort to achieve the goals. In partnership with other government agencies, MMA articulates agreements with the international community, supports and develops studies and projects related to environmental preservation.

Representatives from 195 countries convene annually in Conference of the Parties – COP from United Nations Framework Convention on Climate Change-UNFCCC-Convention. In such meetings, where measures related to global climate governance are discussed, Brazil committed to reducing greenhouse gas emissions by 37% until 2025 and presented the reduction indicative of 43% by 2030. Both are compared to the levels of 2005. Among other measures, the Paris Agreement aims at keeping global temperature increase average below 2°C about pre-industrial levels and at assuring efforts to limit temperature increase to 1.5°C. These numbers represent the official Brazilian position in the Agreement. Some studies were made, and others will be produced within the scope of PNMC.

2.4.2 Brazilian Initiatives concerning Climate Change and Public Policies

Brazil adopted a position with the ratification of the Paris Accord on climate change and, as a result of its decision, set goals for the reduction of greenhouse gas emissions – GEE, determined by the federal government, a National Policy for Climate Change – PNMC. Even with the USA withdrawal during Trump administration, Brazil signals to keep up with the agreed targets.

In parallel to the politically-charged actions that place Brazil in the international scenario, internally the stance resulted in actions along with civil society using the Brazilian Panel on Climate Change – PBMC[4]. Through the Panel, there was the creation of several studies and reports gathered in the Adaptation Plan to Climate Change. They show the scientific basis behind the changes, impacts, vulnerabilities and adaptation needs from several country's economy sectors, such as Industry, Energy, Agriculture, Residues, Changes in land use among

4 PBMC – The Brazilian Panel of Climate Changes (PBMC) is a scientific group created by the Brazilian government to study the global warming from the Brazilian perspective. Its structure is inspired by the Intergovernmental Panel on Climate Change-IPCC, UN group founded by the World Meteorological Organization and the UN Program for the Environment.

others, as well as proposals for the mitigation of climate change effects. Several institutions took part in the Working Group on Adaptation to Climate Change[5].

In a particular way and preceding the climate agreement, there was evidence that coffee-related research centers had been looking into the effects deriving from climatic alterations in several areas of knowledge such as genetic improvement, mineral nutrition of plants, plant physiology, water management, irrigation, Phytopathology, entomology and other. These studies were central or cross-curricular areas applied to agriculture in general and coffee production in particular. The research lines tackle the topic from different strands and, many times, have a common focus on climate change, although the main axis might not aim at that. In better words, the Brazilian agricultural research, as it will be demonstrated in this study, incorporated in its agenda, directly or indirectly, the climate change issue. The national policies about climate change, the general studies and research lines under way will be indicated in this chapter.

The National Policy on Climate Change – PNMC is the main Brazilian public policy on climate, set up by specific legislation[6], from which the Environment Industry sets strategies and proposes policies related to the monitoring and implementation of sectoral plans for mitigation and adaptation.

PNMC officializes Brazil's voluntary commitment to the UNFCCC for climatic alterations, to the reduction of greenhouse gas emissions between 36.1% to 38.9% of the emissions expected until 2020. It is aimed to ensure, through the cited legislation, that the economic and social development may contribute to the protection of the global climate system.

The base line for GEE emissions until 2020, according to the PNMC regulation[7], was estimated at 3,236 million tons of equivalent CO2, this figure being the total number of emissions from a variety of activities[8]. Thus, the absolute reduction of corresponding emissions was set at a 1,168 Gt CO2-eq and 1,259 Gt CO2-eq interval, representing an emission reduction percentage of 36.1% and 38.9%, respectively. That is Brazil's commitment to reduction.

The law established the development of sectoral plans for emission mitigation and adaptation on three levels: local, regional and national. Such plans aim to support goal achievement, poverty, and social inequality relief, as well as economic growth and environmental preservation. The decree sets guidelines to meet these goals as:

The encouragement of good governance that reduces greenhouse gas emissions and the support to the adoption of activities and technologies of low emissions of such gases, besides sustainable standards for production and consumption. The Executive Power, in compliance with the PNMC guidelines, establishes the sectoral plans for mitigation and adaptation to climate change for the consolidation of an economy of low carbon consumption, which aim to meet gradual goals for the reduction of quantifiable and verifiable anthropic emissions, considering sectors as: generation and distribution of electric power, public urban transportation, industry, health, and farming, considering the specificities of each sector, by means of Clean Development Mechanism (CDM) and the Nationally Appropriated Mitigation Actions (NAMA). The instruments for the execution of such actions, besides PNMC, are the National Fund for Climate Change (FNMC) and the Communication from Brazil to IPCC.

Another advance in public policies for the monitoring, control, and recovery of degraded vegetation on the level of rural properties was the implementation of the Environmental Rural Register, known as CAR. That was the main novelty from the New Forestry Code as well as the Program of Environmental Regularization, known as PRA. The CAR is the registration that all rural proprietors need to set up to regularise their properties. It's the first step to comply their lands environmentally with the law. The CAR is just like the property's ID, which gathers registration and environmental information about the rural real estate. After the CAR registration, in case the rural real estate does not have as much forest area as the one required by the Forestry Code in Permanent Preservation Areas and Legal Reserve, it will have to recompose it through PRA or activate compensatory mechanisms[9].

5 Institutions that participate in the GT on Climate Change: Agência Nacional de Águas, Centro Nacional de Monitoramento de Desastres Naturais, Empresa Brasileira de Pesquisa Agropecuária Fórum Brasileiro de Mudanças Climáticas , Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis Instituto Chico Mendes de Conservação da Biodiversidade, Instituto Nacional de Pesquisas Espaciais, Ministério da Agricultura, Pecuária e Abastecimento, Ministério da Ciência, Tecnologia e Inovação, Ministério de Minas e Energia, Ministério do Desenvolvimento, Indústria e Comércio Exterior, Ministério do Meio Ambiente, Ministério do Planejamento Orçamento e Gestão, Ministério da Saúde, Serviço Geológico do Brasil – CPRM, among other entities.

6 Law nº. 12.187/09

7 Decree Law no. 7.390/10

8 The projection of the national emissions of greenhouse gases for the year of 2020 stated under the unique paragraph of art. 12 of Law No. 12,187 of 2009, defines the amount quoted as detailed in the Annex to this Decree Law, which includes projections for the following sectors: I – Land Use Change: 1,404 million tonCO_2eq II – Energy: 868 million tonCO_2eq ; III – Agriculture: 730 million tonCO_2eq; and IV – Industrial Processes and Waste Treatment: 234 million tonCO_2eq.

9 There are several compensatory forms to regularize the legal reserve such as: Compensation of the Legal Reserve in another rural property of the same ownership. Registration in the CAR, equivalent areas in extension in the same Biome and, if it is in another State, in priority areas for conservation. It will not be allowed to convert new areas to another alternative land use; Acquisition and other rural property and other equivalent area and exceeding the Legal Reserve, in property of the same ownership or acquired in

Membership to PRA is not mandatory, but it offers countless benefits to the rural proprietors. When signing up for the program, access to rural credit is assured, once PRA will be required by financial institutions in their credit application contracts. Membership will give way to the continuation of economic activities such as ecotourism, rural tourism, and agroforestry, within the Permanent Preservation Areas, thus having only to preserve or restore a minimal strip close to natural water set by law. Furthermore, as long as the measures suggested by the landowner are underway, any administrative sanctions caused by the proposed measure will be suspended, which means that the real estate owner will not be penalized for actions leading up to that situation.

This way, when the obligations presented in the PRA are observed, fines referring to the regularization of APP areas, Legal Reserve, and restricted use will be converted into services for environmental preservation and recovery, regularizing the use of consolidated rural areas. Taking part in the program is leverage for everyone, even in cases when there is no APP or legal reserve deficits in the property, the landowner will be benefited. However, to apply for membership, it is necessary to await regulations from each state.

2.4.3 Lines of research funded by public resources

The Research Support Foundation of the State of São Paulo (FAPESP) has been taking action as research fomenter since Brazil committed to the GEE emission reductions along the lines of the Paris Accords initiated in December 2015 in the Conference of Parts (COP) 21. This governmental agency from the state of São Paulo funds research on global climate change. Meetings were accomplished to discuss research findings, as the one that took place in June 2017. Researched lines are diversified and focus on climate, atmospheric and hydrographic studies, carbon stock and its emissions, two studies concerning agriculture (beans and sugarcane) and two studies about beef cattle. No specific projects for coffee production were identified.

third-party property, with established native vegetation, in regeneration or recomposition, since located in the same biome. Forest lease: is the use of part of the property of a third party to meet some interest of a higher order, such as in the case of compensation of legal reserve of a property, which has no native vegetation.

2.4.4 Studies on climate change in Brazil

Many doubts persist after the presentation of results from the IPCC reports (UN's International Panel on Climatic Change). Such doubts involve questions like:

Does the observed warming represent climate change resulting from anthropization or are natural climate variations? That issue is debated by IPCC critics, who claim that CO2 concentration increase in the earth atmosphere cannot be held solely accountable for the increase in the average temperatures and support their hypotheses with historical facts of the Earth's temperature variability by showing that temperature increase has not been linear and rising since 1850, as it is highlighted by other scientists, according to Molion (2012).

Still according to Molion (2012), between 1850 and 1920 there was inter-annual variability. Between 1920 and 1946 there was a 0.6oC temperature increase. However, between 1946 and 1976, there was a 0.2oC widespread cooling not explained by IPCC and, from 1976 onwards, global average temperature increased by about 0.4oC. Even IPCC agrees that the first period of warming, between 1920 and 1946, might have been due to natural causes, perhaps the increase in solar energy production and the reduction of planetary albedo. Before the end of WWII, emissions pertaining to anthropic actions were lower than 10% of the current ones and, therefore, it is difficult to argue that temperature increases, that time around, have been caused by the intensification of greenhouse gases through anthropic carbon emissions, as stated by Molion (2012), critic of IPCC.

On the basis of aspects still being discussed on climate change, speculations are made by many social segments presenting varied results, many of them coming close to catastrophism. In the general run, we can propose 4 positioning types:

– Irrecoverable catastrophism:

It consists of a group that tackles the issue of climate change from a radical viewpoint by not foreseeing a line on the horizon for improvement and mitigation of the problems caused by climate change. It is embraced by radical politicians, extremist groups fighting for the environment, as well as the ill-informed population.

– Recoverable catastrophism:

This category comprehends scientists who are committed to applied research on effect studies, adaptation to changes and effect mitigation of climate change. They participate in the International Panels of Climate Change on behalf of their institutions or governments. Also, part of responsible, not sensationalist media

can be fitted into this category, as well as NGOs and Civil Society Representation Associations, Defense Associations for industrial and agribusiness interests, along with other non-radical ones, and part of the well-informed population.

– Weighted skepticism

This category is made up of few scientists who still are not in line with climate change issues, ascribing alterations to natural, non-anthropic phenomena. They are undertaken to disseminate their viewpoints by concepts and studies that might demonstrate contradiction to climate change. They participate in International Forums. Part of responsible, not sensationalist media can be fitted into this category, as well as NGOs and associations defending economic, industrial and agribusiness interests and others not in line with anthropic changes, besides part of the ill-informed population.

– "Laissez-faire":

This is a category that shows no interest in doing anything or discussing the subject because they feel that their political and economic interests are threatened by the mere discussion about the topic. In this category are non-clean energy sectors like coal, oil, nuclear energy, energy-dependable steel industry, as well as very conservative farming sectors.

We all agree that climate might suffer anomalies, variations, and standard changes and that there are anthropic effects accelerating those processes over the last 150 years, according to IPCC[10] (2013):

– Variability is defined as the variation in the average within a given period.

– The anomaly is explained as meteorological events with deviations way above customarily observed variability standards.

– Change is defined as global alterations of climatic conditions.

Climate presents variations year after year. The El Niño and La Niña phenomena are accountable for part of climate variability. Factors like the temperature in the Atlantic Ocean affects climate, prompting drought periods, followed by intense heat (25-35 degrees centigrade), strong sunstroke and low relative humidity during rain season or winter, and also high rainfall rates.

10 Climate Change The physical Science Basis. Chapter 10 Detection and Attribution of Climate Change: from Global to Regional (2013).

From now on the main studies conducted in Brazil between 2007 and 2017 on climate changes will be examined.

2.4.5 Global warming and Future Scenarios of the Brazilian Agriculture

In Brazil, the most elaborate studies on the impacts of climate change on agriculture started in 1989 with Assad and Luchiari Jr.[11], who assessed the possible yield alterations for soybeans and corn production due to scenarios of temperature increase and reduction. Afterward, Siqueira et al. (1994 e 2000)[12] presented, for some locations in Brazil, the effects of global changes on wheat, corn and soybean productions.

Pinto, Assad and staff accomplished in 2001[13], the first work focusing on coffee, which also pioneered the identification of climate change on regional production. The authors simulated the effects of temperature and rainfall elevations in the coffee zoning for the states of São Paulo and Goiás. As a result, we would have the extinction of coffee in those regions.

The IPCC report (2001)[14] indicated that the forecast for global temperature increase, in the next 100 years, is of 1.4 and 5.8°C, taking the 1990 average as a reference. According to Pinto et al. (2002)[15],, these numbers were highly objected, although Webster et al. (2001)[16], based on a probabilistic assessment of the model sensibility, drew the conclusion that at level 95% of the confidence interval, these levels would be 0.9°C and 5.3%°C. Similar analyses carried out by Wingley and

11 Assad, E.D. e Luchiari Jr., 1989. A future scenario and agricultural strategies against climatic changes: the case of tropical savannas. In: Mudanças Climáticas e Estratégias Futuras. USP. Outubro de 1989. São Paulo. SP

12 SIQUEIRA, O.J.F.; FARIAS, J.R.B. and SANS, L.M. A. 1994. Potential effects of global climate change for brazilian agriculture and adaptative strategies for wheat, maize and soybean. Revista Brasileira de Agroclimatologia. Santa Maria. V.2, pp: 115-129. e Siqueira, O.J.W., Steinmetz, S., Ferreira, M.F., Costa, A.C., Wozniak, M.A. 2000. Mudanças climáticas projetadas através dos modelos GISS e reflexos na produção agrícola brasileira. Revista Brasileira de Agrometeorologia, Santa Maria, v.8, n.2, p.311-320, 2000.

13 Pinto, H.S., Assad, E.D., Zullo JR., J., Brunini, O., Evangelista, B.A. Impacto do Aumento da Temperatura no Zoneamento Climático do Café nos Estados de São Paulo e Goiás. Avaliação dos cenários do IPCC. XII Congresso Brasileiro de Agrometeorologia; pp: 605-606. Fortaleza, 2001.

14 IPCC. Intergovernmental Panel on Climate Change. 2001. Climate Change 2001: Impacts, Adaptation and Vulnerability. Working Group II. TAR: Summary for Policymakers. http://www.meto.gov.uk/sec5/CR_div/ipcc/wg1/WG1-SPM.pdf

15 Pinto, H.S., Assad, E.D., Zullo JR., J., Brunini, O. O aquecimento global e a agricultura. COMCIENCIA – SBPC. v.35, p. 1 a 6. 2002

16 Webster, M. D.; Forest,C. E.; Reilly, J. M.; Sokolov, A. P.; Stone, P. H.; Jacoby, H. D. and Prinn, R. G. 2001. Uncertainty Analysis of Global Climate Change Projections. Joint Program on the Science and Policy of Global Change. MIT. Cambridge, MA, USA. http://web.mit.edu/globalchange/www/rtp73.html. 3 pp.

Raper (2001)[17] show that, in the absence of a policy for limiting anthropic effects to minimize global warming, the increase in global temperature between 1990 and 2100, with 90% accuracy, would be between 1,7°C and 4.9°C.

Considering that this scenario of temperature increase, in the most significant part of Minas Gerais state, major Brazilian producing area, would be unsuitable for coffee production. This crop would migrate to colder regions, from the southeast to the south of the country.

Research from Assad, Pinto, and staff continued with scenarios for the Brazilian agriculture (2006 and 2008)[18]. In these studies, evaluations, and quantifications of the impact of climate change on the zoning of climatic risks in Brazil were made. The economic and financial impacts of temperature increase on the Brazilian agriculture were assessed, taking the zoning of climatic risks as a reference. Adaptation and mitigation actions aiming at minimizing the effects of climate change over 50 years following the study were proposed. The outline conditions for the adopted model were: assessment of temperature peaks, water deficiency and evapotranspiration for 2020, 2050 and 2070. The indications were made per administrative unit, or cities. The possible impact on eight crops was assessed: corn, sugarcane, sunflower, rice, soy beans, coffee, beans, cotton.

Criticism from specialized climate scientists who analyzed this study was based upon the fact that it worked primarily on temperature and its outcomes, disregarding other important variables like altitude, CO2 concentration, the capacity of plants to physiologically respond to these peaks. According to Molion (2012) the natural climate variability does not allow us to affirm that the 0.6°C is the result of greenhouse intensification caused by human activity. It also challenges the likelihood for warming to last for the upcoming decades, as suggested by the IPCC reports. Molion (2012) points out inconsistencies between the apparent consistency of historical facts and the model forecasts, stating that this consistency would not necessarily showcase that warming was occurring. The scientists remarks that these historical facts conflict with the hypothesis of intensified greenhouse, because the planet would have heated more rapidly between 1925 and 1946, when the amount of CO2 released in the atmosphere was lower than the current one by 6% and would have been cooled between 1947 and 1976, as it occurred as an effect of economic growth after WWII. Data from meteorological satellites, as stated by Molion, differ from the series of temperature measures from the surface of the Earth and would not endorse significant warming after 1979. Finally, he argues that, in the IPCC summary, published in February 2007, it is stated that CO2 concentration has risen 35% in the last 150 years. He suggests that might have been due to internal variations to the earth-ocean-atmosphere system, given that CO2 solubility in the oceans depends on its temperature with an inverse relation. Thus, with the increase in the ocean temperature due to the reduction of the planetary albedo[19] and to more intense solar activity between 1925-1946, CO2 absorption (emission) by the oceans might have been reduced (increased) and more CO2 might have been stored in the atmosphere, so it can't be stated that CO2 level increase was the one that led to temperature rises. It might have been the other way around, that is to say, that CO2 levels increased as a response to the ocean water and adjacent air temperature increases.

According to meteorologists from Viçosa Federal University, study findings dating back to 2008 that showed the likelihood of geographical dislocation of several crops to regions featuring more temperate climate are insufficient in their analyses.

2.4.5.1 Climatic Modeling and Sectoral Vulnerabilities to Climate Change in Brazil

In studies following Assad et al. about coffee (2007)[20], from the latest IPCC report simulations were made and the impact caused by an increase of the average temperature of 1o C, 3o C and 5,8o C in the states of Goiás, Minas Gerais, São Paulo and Paraná. Results showed that, in the event of a temperature increase at 5.8oC, the reduction of crop-fitting areas would be superior to 95% in Goiás, Minas Gerais, and São Paulo, and 75% in Paraná. The authors emphasize that the results are valid if current genetic and physiological characteristics of Arabica coffee crops are maintained, which have annual average temperatures between 18°C and 23°C as tolerance limit. In a more recent study conducted by Assad et

17 Wigley, T. M. L. and Raper, S. C. B. 2001. Interpretation of High Projections for Global-Mean Warming. Science Magazine. 10.1126/science.1061604. http://www.sciencemag.org/cgi/content/full/293/5529/451. 10 pp

18 Assad,E. ; Pinto,H.S. "Aquecimento Global e Cenários Futuros da agricultura Brasileira",2008 produzida a partir do estudo "Aquecimento Global e Cenários Futuros da Agricultura Brasileira", coordenado pelos pesquisadores Eduardo Assad (Embrapa Agropecuária) e Hilton Silveira Pinto (Cepagri/Unicamp). São Paulo – 2008. ZULLO JUNIOR, J.; PINTO, H. S.; ASSAD, E. D. Impact assessment study of climate change on agricultural zoning. Journal Applied Meteorology, v. 13, p. 69-80, 2006.

19 Albedo is the reflectivity of a surface. A surface that has a high albedo reflects a lot of solar radiation from the sun back into the atmosphere, whilst a surface that has a low albedo reflects little solar radiation, absorbing it instead.

20 Pinto,H.; Zullo, J.;Assad, E.;Evangelista, B. O AQUECIMENTO GLOBAL E A CAFEICULTURA BRASILEIRA. Boletim SBMET abril 2007

al. (2016)[21], modeling related to random events of climate change and its impacts was made. In spite of not including coffee crop in part referring to impacts and vulnerabilities in the Brazilian agriculture and only covering rice, beans (2 crops), corn (2 crops), soy beans and wheat productions, findings might be relevant for coffee production.

The authors show that it is likely that there will be an increase in the number of days with temperatures higher than 34oC in the upcoming years. As an outcome of those extreme events, coffee and beans flower abortion will occur. Authors state that one of the solutions to the reduction of effects on plant production is the search for crops resistant to high temperatures and, consequently, to water deficit. As stated by the authors of this study, in case management and adaptation solutions are not sought, impacts on plant production may reduce 2nd harvest of corn and soybean productions by over 90%. This way the authors state that several adaptation paths and the quest for new crop systems are being tested to reduce the estimated impacts in the studied scenarios. Thereby the referred study is concerned about the observed fact of climatic alterations, focusing its impact less on the causes for the phenomenon.

2.4.5.2 Risks for Climate Change in Brazil and Limits to Adaptation

According to Nobre et al. (2011)[22], temperature increase scenarios were traced, which is one of the indicators for climate change in Brazil, which would represent a risk factor of death for about 9 million people. Corn and soy crops would be jeopardized, and some regions of Brazil would be prone to endemic outbreaks spawned by an increase in vector populations. There would be interference with an electric power supply and the risks for endangered species would rise to 25%. The dramatic impacts highlighted by the authors in case temperature increases 4oC on average above the Earth temperature before the Industrial Revolution are covered in several impacted areas in this study. According to Carlos Nobre, president of Coordination for the Improvement of Higher Education Personnel (CAPES), climatologist and coordinator of the study, the likelihood for this outcome to happen is insignificant, despite being low. According to the coordinator, considering current global emissions, there is at least a 30% risk for the country's average temperature to rise above 4oC by 2100. Authors conclude that the solutions are the reduction of emissions and adaptation to the new reality.

2.4.5.3 The approach of climate change in Research Centers and Specific Studies

When it comes to research on the impact of climate change on agribusiness there are studies and modeling available for the public, showing possible scenarios and potential outcomes of temperature increase for the outlook of 2050 and 2100. Assad et all (2008) and Nobre et al. (2011) authors conclude that the probability of impacts on agriculture and cattle raising productions are minor, although they can't be disregarded.

Specific lines for climate change studies applied to coffee, either directly as the central theme or indirect as a cross-cutting theme, have been developed by coffee research centers.

This study identified consolidated research lines that focus on the problem, using the interviews carried out in coffee research centers. Viçosa Federal University (UFV), Lavras Federal University (UFLA), Agriculture Research Company of Minas Gerais (EPAMIG), Brazilian Agricultural Research Agency (EMBRAPA), Capixaba Research Institute, Technical Assistance and Rural Extension (INCAPER) and the Agronomic Institute of Campinas (IAC) were contacted.

Amongst existing studies and those that are being developed by several coffee research centers, we list some examples of lines of research as follows:

- Influence of climate change on irrigation demand.
- Effect of climate change on the behavior of pests, diseases, and nematodes.
- The influence of temperature increase on coffee crop physiology (flowering and photosynthetic metabolism).
- Genetic improvement of coffee crops focusing on the mitigation of impacts caused by climate change.
- Nutrient absorption and enzymatic activity of the coffee crop under water stress conditions.
- Effect of environmental impacts on the coffee life cycle.

This chapter shows, in its part 2.6, the full list of research lines and researchers obtained in several centers, according to the proposed methodology.

The issue of climate change is a concern for the research community. One can observe, however, that the mapping of the research that will be shown, sampling

21 Ministério das Ciências, Tecnologia e Inovação. Modelagem Climática e Vulnerabilidades Setoriais à Mudança do Clima no Brasil Capitulo quatro "Impactos e vulnerabilidades da agricultura brasileira às mudanças climáticas" Eduardo Delgado Assad; Aryeverton Fortes de Oliveira;Alan Massaru Nakai; Eduardo Pavão ; Giampaolo Pellegrino ; José Eduardo Monteiro, Brasília, P 184, 2016

22 Nobre, C.A.; Marengo, J.A.; Soares,W.R. ; Assad, E., Schaeffer, R, ; Scarano, F.R. ; Hacon, S.S. "Riscos de Mudanças Climáticas no Brasil e Limites à Adaptação" Projeto colaborativo realizado pelo Centro de Ciência do Sistema Terrestre (CCST) do Instituto Nacional de Pesquisas Espaciais (INPE) do Brasil e o Meteorology Office Hadley Centre (MOHC) do Reino Unido, 2011

473 researchers, presents a small group of studies carried out or underway, representing 2% of the total observed. Nevertheless, when analyzing the work from researchers, it is possible to note that the issue of climate change is cross-cutting in several areas, for instance, genetic improvement, nutrition, and water use. That means the researcher may not identify with climate change in coffee whereas he/she shows competence to generate knowledge relevant to coffee production whenever necessary.

More details will follow in the next chapters.

2.4.6 Bibliographical references

Assad, E. ; Pinto,H.S. "Aquecimento Global e Cenários Futuros da agricultura Brasileira",2008 produced from the study "Aquecimento Global e Cenários Futuros da Agricultura Brasileira", coordinated by researchers Eduardo Assad (Embrapa Agropecuária) and Hilton Silveira Pinto (Cepagri/Unicamp). São Paulo – 2008.

Science, Technology and Innovation Ministry Climate modeling and Sectoral Vulnerabilities to Climate Change in Brazil Chapter Four "Impactos e vulnerabilidades da agricultura brasileira às mudanças climáticas Eduardo Delgado Assad; Aryeverton Fortes de Oliveira ;Alan Massaru Nakai ;Eduardo Pavão ; Giampaolo Pellegrino ; José Eduardo Monteiro, Brasília,2016

Environment and Science, Technology and Innovation Ministries. Scientific Basis of Climate Change – Vol. 1 uptaded 11/2016, available at http://www.pbmc.coppe.ufrj.br/pt/publicacoes/relatorios-pbmc/item/base-cientifica-das-mudancas-climaticas-volume-1-completo?category_id=18 acessado em 30/08/16

Environment and Science, Technology and Innovation Ministries. Impacts, Vulnerabilities and Adaptation – Vol. 2 uptaded 11/2016 available at http://www.pbmc.coppe.ufrj.br/pt/publicacoes/relatorios-pbmc/item/impactos-vulnerabilidades-e-adaptacao-volume-2-completo?category_id=18 accessed on 08/30/16

Environment and Science, Technology and Innovation Ministries. Mitigation of Climate Change – Vol. 3 updated 11/2016 available at http://www.pbmc.coppe.ufrj.br/pt/publicacoes/relatorios-pbmc/item/mitigacao-das-mudancas-climaticas-volume-completo?category_id=18 accessed on 08/30/16

Molion, L.C.B. Aquecimento global: Fatos e Mitos. In: E.N. Fernandes et al (Org.). Desafios para a sustentabilidade ambiental, social e econômica da cadeia produtiva do leite. 1ed.Juiz de Fora: EMBRAPA, 2012, v. 1, pp 77-100.

Nobre, C.A. ; Marengo, J.A. ; Soares,W.R. ; Assad, E., Schaeffer, R, ; Scarano, F.R. ; Hacon, S.S. "Riscos de Mudanças Climáticas no Brasil e Limites à Adaptação" Collaborative project accomplished by the Earth System Science Center (CCST) and by National Institute of Space Research (INPE) and by Met. Office Hadley Centre (MOHC) from the United Kingdom, 2011.

2.5 Main Research Centers

2.5.1 The History of coffee research in Brazil

The history of research institutes in Brazil associates in one way or the other, with the crises that brought concerns and problems to Brazil. Human endemic outbreaks such as yellow fever and also coffee-related pests and diseases, primary economic activity in Brazil accounting for 60% of exports, explain the origin of Research Institutes, which arise amidst those crises.

It is the case of the Agronomic Institute of Campinas in 1897, with the mission of protecting the sanity and vitality of the most significant revenue source for Brazil at that time: coffee. Also, another organization was created to face the issue of coffee berry borer in 1924, called Board of Study and Debelation of coffee pests that would give way to the foundation, in 1927, of the Biological Institute.

2.5.2 Research Institute timeline

This timeline shows the creation of the central research institutes that played (and still play) a significant role in coffee production in Brazil. It is worth noting that the history of the institutes has always been linked to some problem that affected the Brazilian coffee economy. Not only that, the creation of these institutes happened in the late 19th century and the early 20th century. It has a lot to do with the fact that the Brazilian economy, until the 1950's, was based upon coffee production and exports. That scenario began to change as of 1950 with the implementation of the steel, oil and power industries, giving rise to a transformation in the Brazilian condition, which turns from a rural into an industrial society.

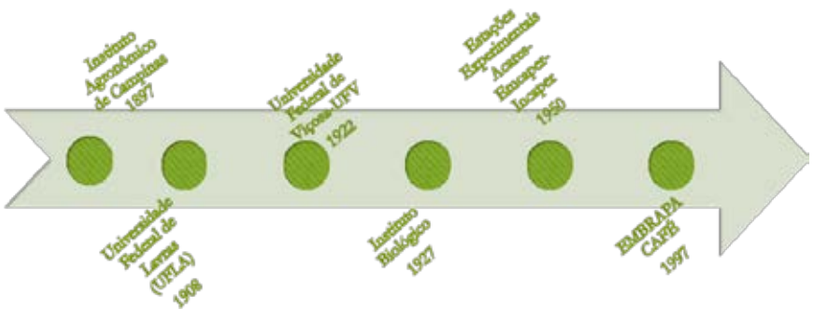


Figure 2.5.1. Timeline of the main coffee research centers

Source: Authors

2.5.3 The Agronomic Institute of Campinas

The Imperial Agronomic Station of Campinas, later renamed The Agronomic Institute of Campinas, was created in 1887 by emperor D. Pedro II in response to the plea from the State growers. Its first director was Austrian scientist F.W. Dafert, who pioneered agronomic research in Brazil and managed it until 1897 (Romero, J.P. 1997 e O Agronômico, 2007). According to Meloni (2004), the choice of the city of Campinas, distant from Rio de Janeiro, the then capital of the country, can be explained by the fact that São Paulo was the agricultural capital and its location was amidst a coffee region. There was also the need for developing the crop as a whole in a dynamic, expanding, potentially growing region. With a German director, the model adopted in Campinas ensued, according to Sanches Jr. (2015), the one from European agronomic stations, notably German.

In 1892, at a time when Brazil was already a Republic, the institute was owned by the Government of the State of São Paulo. In the following years, Dr. Dafert published the book "Agricultural Issues" in 1893, addressing the reform of coffee plantations established in exhausted lands. According to Romero (1997), this scientist anticipates in the 1970's the reality in nearly a century with coffee production conducted in poor soils. A handful of studies on coffee technology were performed, such as the use of chemical fertilizers, manure, organic matter, limestone, pruning, and shading.

In 1897 Brazil faced a crisis with the first signs of coffee overproduction. Coffee elites did not perceive IAC as a problem-solver. In that year, the Institute's activities went from a scientific perspective to a path more related to coffee management problems (SANCHES JR., 2015).

During its 130 years of existence, completed in 2017, IAC brought essential contributions to the Brazilian agriculture. Almost 800 new species varieties were developed, tolerant or resistant to disease, more productive and of better quality. Currently, this figure is even more significant. It is hard to limit IAC's importance to some examples from the time of its creation. Although some actions can be noted, namely:

In the 1930's coffee crisis, IAC was capable of offering alternatives to growers in the cotton production technology, thanks to the studies conducted by researcher Cruz Martins. At that time, IAC was responsible for the production of hybrid corn seeds in São Paulo, world's leading region that uses it, second only to the USA. In the 1940's, the São Paulo's citrus production, affected by the citrus "tristeza" virus, was saved thanks to studies on rootstocks carried out by researcher Sylvio Moreira. In the 1970's, the outbreak of coffee rust did not catch IAC off guard, once researcher Alcides Carvalho had been studying varieties resisting to that disease, and he foresaw its coming at any time.

Alcides Carvalho's research collection, as well as his forecast, were formed by the activities had been carried out since 1935 at IAC, until completing five decades of research activity. He stood out, particularly in the genetic, evolution and coffee plantation improvement areas. His extensive scientific production reacher nearly 250 published works in specialized magazines. He also participated as co-author of several books, besides the elaboration of didactic material on graduation and post-graduation levels.

Black rice production can be noted as of 1994, which is more nutritious; in 1991 the "gomo-de-mel" pineapple (i.e. "honey bud"), which stands out for dispensing peeling; as of 2002 the linalool oil, extracted from basil, used for manufacturing perfumes; the decaffeinated coffee rehashed in 2004 from Ethiopian seeds; the "carioca" beans with several crops conducted for decades, among other themes.

A technology generated by IAC is Infoseca, which is a system for capturing/transferring information on dryness, and it allows to anticipate the risks of hydric stress for agriculture.

2.5.4 Lavras Federal University

The history of UFLA (Federal University of Lavras) began in 1908 at the Agricultural School of Lavras. It was later renamed to Superior Agricultural School of Lavras (ESAL) in 1938. The history of coffee in this institution began with the first experiment from Professor Paulo de Souza at ESAL in the 1950's. In 1994 ESAL became Lavras Federal University (UFLA).

Due to its location in one of the significant coffee-producing areas, South of Minas Gerais, the institution has always been intimately involved with this product, which encouraged researchers from several fields of knowledge to develop projects linked to coffee.

The arrival of the Presbyterian mission to the Minas Gerais' city of Lavras intimately connected to the creation of UFLA. The transfer of the International Presbyterian School from Campinas to Lavras occurred due to the yellow fever outbreak in 1893. Their managers, when faced with the hazard of losing their lives, as well as the lives of their family and staff members, proposed a location change for the Institute, and Lavras from Minas Gerais was the chosen city. After the establishment of the High School and the Gymnasium, the Agricultural School of Lavras was founded in 1908 by a visionary American Presbyterian and his colleagues, Dr. Samuel Rhea Gammon (later Grammon Institute was named after him) and Dr. Benjamin Harris Hunnicutt, who was also the first director of the School of Lavras.

The school was built on a hill located on the west side of the Gymnasium of the Evangelical Institute, presently named Gammon Presbyterian Institute, in the location which was named Ceres Farm. In 1938 the Agricultural High School became Superior Agricultural School of Lavras (ESAL). The Federalization of The Superior Agricultural School of Lavras (ESAL) occurred in 1963 when some changes were required in the structure of the school. Until December 1965, ESAL had been through a hard period, and its director was Professor Alysson Paulinelli, who later became the Agriculture Minister, and is the one who worked on the new structure. In 1966, the Agriculture Department (DAG) was created and initially set up in ESAL's Noble Hall, prompting agronomic research.

Changes occurred with the implementation of post-graduation courses at ESAL in 1975, headed by Professor Fábio Cartaxo. In 1994, ESAL was transformed into Lavras Federal University. The earliest experiment accomplished at ESAL aimed at comparing coffee plantation in terraces with the alternative of planting in pits, conducted by Professor Paulo de Souza (in memoriam), Coordinator of Lavras' Experimental Substation, institution associated with the National Department of Farming and Cattle Raising Research from the Agriculture Ministry (MENDES AND GUIMARÃES, 2015).

According to Carvalho et al. (2015), the embryo from the coffee plantation research at ESAL was in this Experimental Substation in Lavras, later incorporated as UFLA's asset. The first coffee crops in the ESAL campus used "Mundo Novo" varieties, featuring different spacings. The ESAL researchers pioneered the identification of rust focuses in the south of Minas Gerais and, in this area, they assessed a fungicidal application for disease control in 1970.

After the destruction of coffee crops in Paraná in the 1970's due to frost, coffee migrated to new areas, and the coffee setting in Brazil changed. Minas Gerais was the state that best welcomed the product and became the central coffee-producing state. With coffee thriving in Minas, research funding emerged. In 1990, the coffee production sector from the Agriculture Department from ESAL was created and, later in 1994, the Center of Studies on Coffee Production (NECAF) was established, which began to centralize coffee research in that institution.

NECAF organizes multidisciplinary work that enables the accomplishment of research in some departments: Business Administration and Economics, Agriculture, Biology, Computer Science, Food Science, Soil Science, Exact Sciences, Forestry Sciences and Physical Education. In total 128 professionals among professors and researchers that work with coffee (Carvalho et al., 2015).

A UFLA organization dedicated to coffee is InovaCafé, Coffee Innovation Agency, tied with the Research Pro-Rectory (PRP) of the university. It is financially supported by the Study and Project Funding (Finep) and the Foundation for Supporting Research in the State of Minas Gerais (Fapemig) for the conduction of studies and research that present solutions to problems on demand in organizations and public or private institutions connected with coffee agribusiness. This agency features a breakthrough operation, as its name, and integrates initiatives from the Coffee Production Sector from UFLA.

As part of the agency, there is the institutional coordination from the Pesquisa Café Consortium, the Coffee Roasting Unity, the administrative secretariat of Coffee Science Magazine, the Unit of Virtual Diffusion of Technologies – Coffee Web TV, the Center of Storage and Control of Agricultural Pesticides, and the Coffee Anatomy and Physiology and Molecular Genetics laboratories. Besides, research centers from the university began to be based in these locations, namely: Center of Coffee Production Studies (Necaf), Center of Studies on Quality, Industrialization and Coffee Consumption (QI Café), Study Group on Herbicides, Weed and Allopathy (GHPD), Center of Studies on Improvement and Cloning (NEMEC), that was created with headquarters in the Agency. Other centers such as Center for Studies on Coffee Post-Harvest (Pós-Café) and the Research Center on Agricultural Machines and Portables (Nempaport) also have ties with the agency.

UFLA hosts the National Institute of Coffee Science and Technology – INCT/Café, in partnership with other institutions from Coffee Research Consortium, relying on the support from CNPq, Fapemig, Capes, and Finep. 62 researchers participate in it, besides undergraduate, Master, doctorate and post-doctorate scholarship holders, representative from several consortium institutions besides UFLA, like Viçosa Federal University (UFV), Company of Farming Research of Minas Gerais (Epamig), Agronomic Institute of Paraná (Iapar), Embrapa Genetic Resources and Biotechnology, Embrapa Café, Capixaba Research Institute, Technical Assistance and Rural Extension (Incaper) and Agronomic Institute of Campinas (IAC).

The university holds the Center for Teaching, Research, and Extension of Coffee Agribusiness – Cepecafé, responsible for a research program with over 100 professors and researchers from different departments, operating in several areas of knowledge. Part of the research developed will be tied to the Coffee Research Consortium program. Cepecafé supports training of graduated professionals, specialists, masters, doctors and post-doctors in coffee production, using support grants that result into the generation of knowledge and technologies.

The university hosts two crucial poles for coffee-growing. One of them is the Coffee Excellence Pole, which contributes for sustainable, competitive development of coffee agribusiness through the integration of institutional competences, human resources qualification, stimulus to innovation capacity and the genera-

tion of high added-value business. The Excellence Pole is an initiative from the Government of Minas Gerais – Science, Technology and College Education Secretariat (SECTES) and partnership with the State Secretariat of Agriculture and Supply (Seapa).

The second one is the Center of Technology in Coffee Quality, which brings innovation to the coffee-growing sector through teaching, research and extension applied to quality, recognized as one of the reference centers in coffee quality in Brazil and overseas. UFLA develops technologies that have played an essential role in the development of coffee production in Brazil. Among these, techniques for seedling cultivation through cloning, automated system for physical analysis of coffee, resistance inducers to wide-range diseases and low environmental impact, technologies (GPS, remote sensing, geographic information systems, among others) developed in partnership with Epamig and Embrapa Café, that have supported in the coffee-growing planning and in the obtention of Geographical Indications aiming for competitivity and sustainability of Brazilian coffee.

UFLA publishes the Coffee Science magazine, the only Brazilian scientific magazine specialized in coffee production. Created by the Coffee Research Consortium and edited three times a year by UFLA, it is supported by Fapemig and the Pole of Coffee Excellence. Still, there are Biofábricas, a UFLA initiative through Research Pro-Rectory and SECTES (Innovation Incentive Program) which aims at transforming innovative technologies into products to be made available on the market.

2.5.5 Viçosa Federal University

The Viçosa Federal University (UFV) was founded in 1926 under the name of Superior School of Agriculture and Veterinary Medicine of Viçosa (ESAV), based upon models called "land-grant colleges", as in the USA, through which universities were established in public lands, supported by the teaching, research and extension tripod (Enes, 2006). By that time coffee stood out as the leading export agricultural coffee in the country. In São Paulo, the main competitor in coffee with Minas Gerais, an agriculture school had already been created along the same lines in 1901, the Luis de Queiroz Agricultural School. Through strong influence from then-President Arthur Bernardes, the location chosen for this new Superior School of Agriculture was Viçosa, where it was originated.

Still, according to Enes (2006), the intention of creating an agricultural school in the countryside of Minas Gerais responded to some kind of "historical mission" which governs its administration. The traditional rural oligarchies supported the assumption that the country was supposed to take over its exporting role of agricultural products, which had been expressed since "the Portuguese colonization period," and the most feasible way to farm the land and push the envelope on agronomic sciences was the creation of a modern teaching institution. Even before the beginning of educational activities in 1926, there had already been experiments on citrus, eucalyptus, cotton, and wheat. The presidential decree for the creation of the school dated back to 1922 and, as long as its buildings were under way some experiments were already implemented. There was a strong influence from Iowa University, and the first director was Mr. Peter Henry Rolfs, who came from that university and supported by engineer João Carlos Bello Lisboa. From the very beginning, in 1926, several course modalities were already offered: short, elementary, intermediary, superior and specialized ones. The latter pioneered post-graduation characteristics. In 1961, supported by the Purdue University, the Master Course was implemented, and the first Magister Scientieae thesis was defended, evidencing the university's knack towards research. 1929 saw the creation of a long-standing activity that has been running still today, named Farmer's Week, and on this day the school opens doors for the growers' community and hosts them so technological advances can be shown.

UFV pioneered Biology and coffee plantation leaf rust control studies. One of the goals to be met included the obtention of cultivars bearing genetic resistance to Hemileia vastatrix Berk et Br, the causative agent of leaf rust. As a pursuit of this goal, the UFV's Phytopathology Department, under the impetus of Prof. Geraldo Martins Chaves, introduced the Center of Research of Coffee Leaf Rust (CIFC) in 1970/1971, located in Oeiras, Portugal, a vast and valuable coffee germplasm, originated from Hibrido de Timor, bearing resistance factors against H. vastatrix, and differentiating clones from physiological breeds of H. vastatrix. This way, the UFV-CIFC and the Program for Genetic Improvement of Leaf Rust Resistant Coffee cooperation began, featuring Hybrids Timor was the sourcing material. In 1974, the UFV program was associated with Epamig and, as a result, by utilizing the Hibrido de Timor was resistance source, the resistance variety 'Oeiras- MG 6851' was launched, named after the city of Oeiras in Portugal. Subsequently, UFV and EPAMIG launched resisting cultivars 'Paraíso MG H 419-1', Araponga MG 1, Sacramento MG1, Pau-Brasil MG1, Catinguá MG1 and Catinguá MG 2.

In the 1980's, the Viçosa Syrup was developed by Prof. João da Cruz Filho from DFP/UFV, composed of a mixture of nutrients and copper, and is aimed at providing chemical control of coffee leaf rust and guarantee the supply of micronutrients boron and zinc, both paramount to coffee-growing. Still today the Viçosa Suroup is administered for leaf rust control in Brazil, primarily by small growers. Aside from the micronutrient supply, the Viçosa Syrup is efficient, economical and non-polluting.

In 2005, UFV kicked off a project called Integrated Coffee Production, which aimed at setting norms to be incorporated to the coffee certification and traceability program, coordinated by the Ministry of Agriculture, Cattle-Raising, and Supply (MAPA, 2008). Through a wide range of arrangements signed up later with Embrapa and Coffee Consortium, UFV played an important role in scientific knowledge input in several fields like Genetics, Phytopathology, Vegetal Physiology, Irrigation, Soils and Mineral Nutrition, Pyrotechny, Entomology, and others.

2.5.6 The Biological Institute of São Paulo

The Biological Institute (IB) is a science center tied with the Secretariat of Agriculture and Supply from the State of São Paulo. It is aimed at the production, dissemination, and exchange of scientific knowledge and technology in the agribusiness bio-security and associated areas. Created in 1927, it is one of the state's main training centers for scientists, working in the post-graduation area. The creation of IB took place in May 1924 when a strong pest devastated São Paulo's coffee plantations. The long-held ambition of creating an organization responsible for dealing with one of the leading state's assets – coffee – was finally sealed. Bearing in mind the vast loss represented by the pest and the intense pressure coming from growers, the Agriculture Secretariat created a committee dedicated to pest study and control – popularly known as coffee berry borer (Hypothenemus hampei). The committee chaired by Dr. Arthur Neiva and Ângelo da Costa Lima and Edmundo Navarro was equipped with two laboratories aimed at pest control. The inspection, monitoring and promotion campaign reached over 1330 farms (about 50 million feet).

Instituto Biologico is a benchmark in national agricultural research and runs a set of laboratories all over the state of São Paulo. Their headquarters, in São Paulo, hosts the Centers of Research and Development of Animal and Plant Health and Environmental Protection, besides the Museum, the Memory Center and a library with over 100 thousand books.

It hosts the Advanced Center of Technology of Poultry Industry Agribusiness, the Research and Development Unity in Bastos, and the Center of Central Experimental in Campinas. The institute is responsible for some publications and scientific bulletins and keeps under its guard a vital archive of Helminthology, Bacteriology, Fungi, herbarium, Entomology and entomopathogenic microorganisms.

We have identified, at the Biological Institute, 6 researchers who work in coffee research, of which 5 work in diseases and nematodes and one researcher focuses his work on pests, especially coffee.

2.5.7 Capixaba Institute of Rural Research and Extension – INCAPER

Agricultural research in the state of Espírito Santo dates back to the decade of 1926 when the experimental cocoa farm Goytacazes was created in Linhares by the Ministry of Agriculture. Although there had not been an official research institution in the state, several scientific publications were made in the 1930's, featuring research conducted by researchers from Minas Gerais, Rio de Janeiro, and São Paulo. The state's first agricultural school dates back to 1941 and the agrotechnical school of Colatina dates back to 1944. In 1948 the Biological Institute of Espírito Santo (IBES) was created, currently run by Institution of Forestry and Agricultural Defense in Espírito Santo (IDAF). In 1949, the Museum of Biology Prof. Mello Leitão (MBML) was created in Santa Tereza.

Along with the creation of experimental farms in the 1950's and the Association of Credit and Rural Assistance in Espírito Santo in 1956, the state steps, in 1960, towards the creation of the Division of Experimentation and Research (DEP) from the Agriculture Secretariat and institutes tied with the Federal Government such as IAA, Sugar and Alcohol Institute, IBC, Brazilian Coffee Institute and IPEACS, Institute of Agriculture and Cattle Raising Experimentation of the Center-South. In 1973, EMCAPA, Capixaba Company of Agricultural and Cattle-Raising Research was created and, in 1975, EMATER-ES, Company of Technical Assistance and Rural Extension of Espírito Santo, replacing and reuniting the other similar entities.

The research internalization began in 1984, and in 1999 the EMCAPA and EMATER-ES merger occurs, consolidated at EMCAPER, which later becomes an autarchy in 2000 and becomes the current INCAPER, Capixaba Institute of Research, Technical Assistance and Rural Extension, united through the Integration Forum that took place in 2014.

INCAPER, in 2017, counts on the Center of Research Serrano (laboratories of plant tissues and soil chemistry, Phytopathology, Entomology, Tissue Culture and Molecular Biology; The South Research Center and The North Research Center (laboratories of soil chemistry, Soil Physics, Post-Harvest Physiology, Phytopathology, Nematology, Entomology, Biological Control, Nutritional Science and Seeds.

Incaper has, in 2017, 153 ongoing research projects, of which 36 of those are on coffee, as well as a team of over 20 coffee-related researchers. The continuing research and development projects undertaken by the Institute add up to R$ 31 million. Sources are Fapes – Research Support Foundation of Espírito Santo, Funcafé – Coffee National Fund, FINEP – Study and Project Funder, CNPQ – National Council of Scientific and Technological Development, PAC-Emprapa – Brazilian

Agricultural Research Agency and other sources. The INCAPER staff is composed of 63 researchers, 153 extensionists, 101 farming technicians and 307 supporting employees, totaling 624 people. The technical personnel has 39 doctors, 61 masters, 57 specialists and 11 graduates. Besides connecting research to the rural extension, Incaper has brought an essential contribution to coffee production in Espírito Santo, especially connilon coffee for the mountain plantation of arabica coffee in Brazil. Its research has been critical in several traditional areas of agronomic knowledge and has it has been adapted to the new climatic reality having launched, in November 2017, in the city of Marilândia-ES, the new conillon coffee clonal cultivar tolerant to drought (Marilandia ES4186). All information about INCAPER was obtained in a visit made by the research team in October 2017, in a meeting with the head of coffee research and the General Head of Research from the Institute, besides five attending researchers.

2.5.8 EMBRAPA-CAFÉ and the Brazilian Research Coffee Development Consortium

The Deliberative Council of Coffee Politics (CDPC), tied with the Agriculture, Cattle-Raising and Supply Ministry – Mapa, was created in 1996 with the purpose of formulating public policies related to production, commercialization, exports and marketing, as well as of setting an agronomic and marketing research program to provide technical and commercial support for the development of the coffee agribusiness.

Under the CDPC management and Embrapa coordination, 1996 saw the creation of the National Program of Research and Development of Coffee, known as "Coffee research program," in partnership with institutions belonging to the National System of Agricultural Research (SNPA), institutes, Brazilian universities and the private sector relating to coffee agribusiness. It was established that the Research on Coffee Program should contemplate, in all supply chain, the development of scientific and technological research and the socioeconomic studies, technology and information dissemination and the monitoring of the Brazilian and global coffee economy.

Next year, in 1997, the Brazilian Consortium of Coffee Research and Development was created, to plan and carry out research in the scope of the Coffee Research Program. The Constitution Term of the consortium was concluded by Embrapa; Baiana Company of Agricultural Development – EBDA; Agricultural Research of Minas Gerais – EPAMIG; Agronomic Institute of Campinas – IAC; Agronomic Institute of Paraná – IAPAR; Capixaba Institute of Research, Technical Assistance and Rural Extension – INCAPER; Ministry of Agriculture, Farming and Supply – MAPA; Company of Agriculture of the State of Rio de Janeiro – PESAGRO-RIO; Lavras Federal University – UFLA; and Viçosa Federal University – UFV. The consortium blueprint the normal researcher operation in the form of the integrated research network.

Embrapa Café was created on August 30th, 1999 to coordinate the Consortium. Its goal is to accomplish, promote and support coffee research and development activities in the scope of the company and institutions that integrate the Consortium.

In its activity report from 2016, the Coffee Research Consortium informs that there were 92 research projects on five thematic focuses on 496 research action plans and over one thousand researchers and technicians. Aside from the ten founding institutions, it has 52 agreement-based institutions in twelve states. The current thematic focuses, as well as their corresponding percentage of action plans, are listed below:

- Sustainability of highland coffee production (19%);
- Quality and marketing for profitability (23%);
- Scarce and high-cost labor (2%);
- Biotic and Abiotic Stresses (42%);
- Deficiency in technology transfer processes (14%).

The Steering Committee approves the lines of research after the workshop attended by coffee agribusiness members (Growers, Cooperatives, Consultants, Researchers) to survey knowledge gaps.

All projects must be multi-institutional, that is to say, composed of action plans from several institutions. Each one has an institutional coordinator, who is an EMBRAPA spokesperson at the institutions.

There are several results and examples of technologies stemming from the creation of the consortium. For example:

- Launching of 131 Coffee arabica cultivars
- Identification of over 33.000 expression genes from the coffee genome
- Technology for rational water use using controlled hydric stress, among other examples.

The Symposium of Research of Coffee from Brazil was created in 2000 by the Consortium to foster researcher discussion from associated areas.

The history of agronomic research on coffee in Brazil comprehends over 100 years, covering periods during which crises triggered by diseases and pests prompted the creation of specialized research centers. They generated, and still do a worldwide research archive nowadays. Many researchers from all over the world come to Brazil to take their post-graduation programs and network with

Brazilian researchers. It is important to point out that the coffee park from many countries, especially Latin and Central America, has a considerable amount of its genetic material originating from Brazilian research.

The interest of this work is focused on the connection and coordination of activities among research institutes. The narrative of this chapter begs the question of whether there is some research coordination or direction and of institute integration. The existence of the consortium spearheaded by EMPRAPA says so, but there is some other relevant information that is under discussion in the forthcoming chapters, which raises questions about the efficient coordination of national coffee-based research activities.

2.5.9 Bibliographical References

CARVALHO, Milton Moreira. GUIMARÃES, Rubéns José; MENDES, Antônio Nazareno Guimarães; GUIMARÃES, Elisa Rei. A cafeicultura na história da Universidade Federal de Lavras. In: GUIMARÃES, Rubéns José; MENDES, Antônio Nazareno Guimarães; GUIMARÃES, Elisa Rei. Café na UFLA: Resgate histórico. Lavras: Editora UFLA 2015, 216 p.

ENES, T. Arquivo Histórico da Universidade Federal de Viçosa: subsídios e perspectivas para a história da educação superior no Brasil do século XX. In: VI Congresso Luso-Brasileiro de História da Educação: 'percursos e desafios da pesquisa e do ensino de história da educação', 2006, Uberlândia/MG. Anais do VI Congresso Luso Brasileiro de História da Educação. Uberlândia: Editora da UFU, 2006.

EMBRAPA- Embrapa café-História disponível em https://www.embrapa.br/cafe/historia acessado em 12/8/2017

EMBRAPA CAFÉ – Consórcio Pesquisa Café. Relatório de atividades 2016.

GUIMARÃES, R. s J.; MENDES, A. N. G.; GUIMARÃES, E. R. Café na UFLA: Resgate histórico. Lavras: Editora UFLA 2015, 216 p.

Incaper em Revista-Jan 2013 a Dez 2014, Vols 4 e 5.

MENDES, Antônio Nazareno Guimarães; GUIMARÃES, Rubéns José. Linha do tempo com datas e fatos importantes relacionados ao café na UFLA. In: GUIMARÃES, Rubéns José; MENDES, Antônio Nazareno Guimarães; GUIMARÃES, Elisa Rei. Café na UFLA: Resgate histórico. Lavras: Editora UFLA 2015, 216 p.

Ministério da Agricultura, Pecuária e Abastecimento. Produção integrada no Brasil: agropecuária sustentável e alimentos seguros / Ministério da Agricultura, Pecuária e Abastecimento. Coordenação- Geral de Sistemas de Produção Integrada. – Brasília : Mapa/ACS, 2008.

O Agronômico. Agronegócio Café: Principais contribuições de pesquisas realizadas no IAC., Série Técnica Apta, Campinas, 59(1), 2007.

Romero, J.P. Cafeicultura Prática: cronologia das publicações e fatos relevantes. São Paulo: Editora Agronômica Ceres,1997. 400 p.

Sanches, Jr. J.L. A encyclopedia viva da moderna cultura cafeeira no Brasil. São Bernardo do Campo, SP: Editora da Universidade Federal do ABC,2015.

2.6 Research Results

This part presents the results from the mapping of the studies covering coffee growing, especially researchers and their research lines, institutions and research centers, as well as the mapping of potential research networks.

For this purpose, this part is divided in the following way:

- 2.6.1 Lines of research from the mapped researchers
- 2.6.2 The researchers by Federation Unity
- 2.6.3 Institutions, research centers and research lines
- 2.6.4 Results of in-depth interviews with a questionnaire
- 2.6.5 Evolution of the themes from the Research Symposium of Coffees from Brazil during the period of 2000 and 2015
- 2.6.6 Mapping and analysis of existing networks.

As described in Chapter 2.3, Method, the mapping of researchers and research centers has been the fruit of specific academic production on coffee. In better words, the analysis unity of this study is the researcher who studies coffee, identified from the scientific publications. In this way, database accounted all those who, over the last 5 years, published two scientific articles on the topic at least.

It is known that the adopted method may not capture all the research activities done on the topic of coffee, although it was the most adequate one given the information available. Such information is restricted to the database that contains 471 observations which, if on the one hand does not represent a census of the research activity, on the other hand it may be considered a less robust database.

2.6.1 Lines of Research from the mapped researchers

Research lines were categorized as:

- Chemical Analyses.
- Biotechnology.
- Food Science.
- Climatology.
- Harvest, Post-Harvest and Coffee Quality.
- Diseases and Nematodes from the coffee plantation.
- Economics and Management.
- Coffee Tree Physiology.
- Genetics and Improvement.

- Innovation and Technology.
- Crop Management.
- Climate Change.
- Coffee Tree Pests.
- Soils and Nutrition.
- Others

According to the mapping, Genetics and Improvement was the most disseminated line amongst coffee researchers, accounting for 22.1% of the full amount, followed by Soils and Nutrition, Economics and Management and Handling. (Figure 2.6.1)

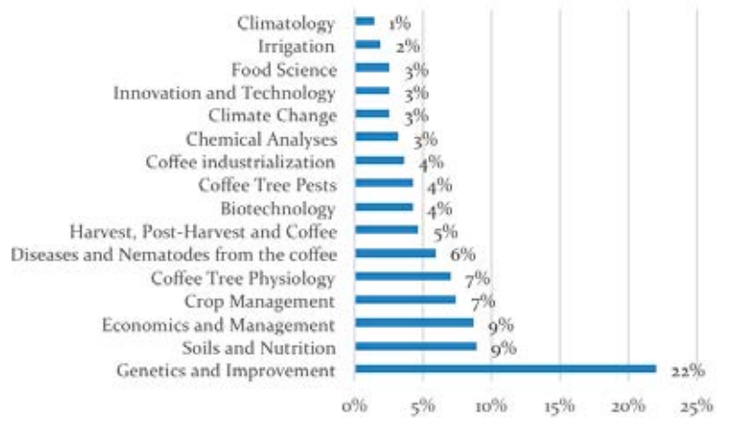


Figure 2.6.1 Research topics found on a percentage basis

Source: Study data

It is observed that coffee researchers do not hold back to areas associated with agronomy, on the contrary, scientists in several knowledge fields are observed, such as economics and management (8.7%), chemical analyses (3.2%), food science (2.5%) and innovation/technology (2.5%).

The "Others" category, which accounts for 9% of the total, is composed of the following topics:

- Precision Agriculture.
- Organic Agriculture.
- Agroecology.
- Agroforestry.
- Sensorial Analysis.
- Plant Anatomy.
- Molecular Biology.
- Coffee and Health.
- Forest Engineering.
- Pharmacy.
- Phytotechny.
- Journalism and Communication.
- Animal Nutrition.
- Probability and Statistics.
- Image Processing.
- Sociology.

2.6.2 Researchers by Federation Unity

The origin of the mapped researchers indicates that they are distributed into 14 Brazilian states and the Federal District. Partnerships with five foreign research centers were identified.

Figures 2.6.2 and 2.6.3 represent the researchers' frequency in the Brazilian Map and the distribution on a percentage basis.

Figure 2.6.2 Frequency of mapped researchers in Brazilian states and the Federal District

Source: Study data

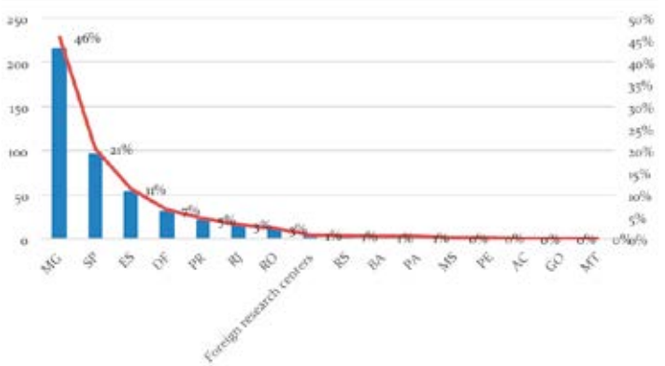


Figure 2.6.3. Frequency and percentage distribution of researchers identified in Brazilian states and Federal District

Source: Study data

The state of Minas Gerais, leading coffee producer, stands out in the number of researchers dedicated to the topic, 216 being identified, which represents 46% of the data. The state of São Paulo is ranked second, with 21% of researchers, followed by Espírito Santo, with 11.5%. The three states combined represent 78% of researchers from the mapped total and 84% of the overall coffee production for 2017 estimated by CONAB (2.6.4).

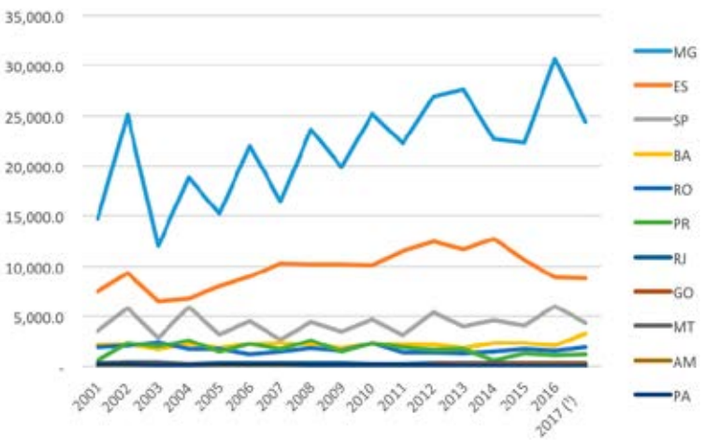


Figure 2.6.4 Historical series of total coffee production in Brazil

Source: Elaborated from Conab data. (1) – Estimated in September 2017.

In spite of the fact that the Federal District is not a coffee producing region, the federal unity stands out scientifically due to the Brazilian Company of Agricultural Research – EMPRAPA Café.

Research activity in federation unities apart from coffee tradition was also observed. Rio de Janeiro stands as an example, accounting for 3% of researchers in spite of not featuring among the main national producing areas.

All identified lines of research (except existing derivations from the "Others" category) are found in Minas Gerais.

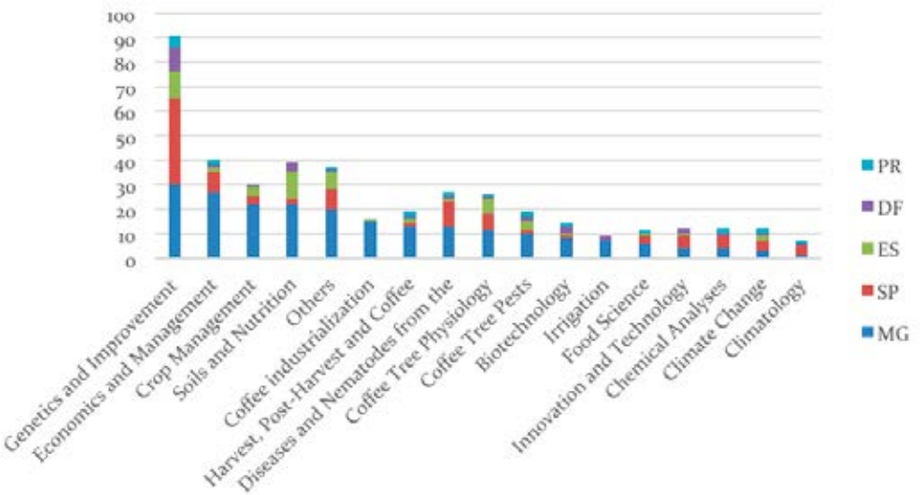


Figure 2.6.5 Research topics by Federation Unities

Source: Study data

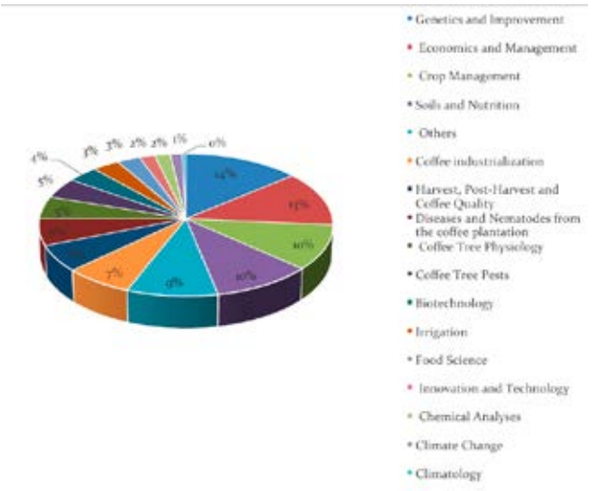


Figure 2.6.6. Research topics from Minas Gerais

Source: Study data

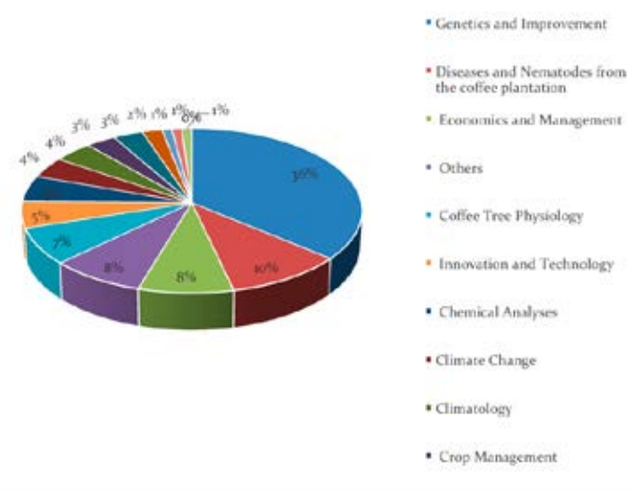


Figure 2.6.7. Research topics from São Paulo

Source: Study data

In São Paulo the Genetics and Improvement topic was mostly regarded (36%), followed by Diseases and Nematodes (10%).

2.6.3 Institutions, research centers and their research lines.

In spite of the multitude of centers and institutions (88), only four of them concentrate nearly half of coffee researchers: Viçosa Federal University (20%), Lavras Federal University (15%), Agronomic Institute of Campinas (8%) and the Capixaba Institute of Research, Technical Research and Rural Extension – INCAPER (6%).

At the other distribution end, 55 institutes (or 62.5% of the total) present one coffee researcher only – which goes to show a very concentrated distribution. On the other hand, this data also shows that coffee has stimulated researchers from several knowledge fields, even if they are distant from the producing regions.

The Viçosa and Lavras Federal Universities both account for 35% of coffee researchers in Brazil. In Minas Gerais these two institutions account for 76% of the sampled scientists.

Two São Paulo's institutes, the Agronomic Institute of Campinas and the São Paulo Agency of Agribusiness Technology, both account for as much as half of coffee researchers in the state.

2.6.3.1 Research topics from the four main sampled research centers

The Viçosa Federal University was the institution counting on the largest number of researchers found in the mapping. It featured 93 researchers, who represent 20% of the observations. The working areas are focused on: Economics and Management, Genetics and Improvement; Soils and Nutrition; Coffee Industrialization and Crop Management, as indicated in Figure 2.6.8

In the mapping carried out in this study 71 researchers from Lavras Federal University, 15% of all the data, who work with coffee in different areas, were identified. The five main research lines were: Economics and Management, Genetics and Improvement; Harvest, Post-Harvest and Coffee Quality; Coffee Tree Diseases and Nematodes and the "Others" category, which covers the following areas:

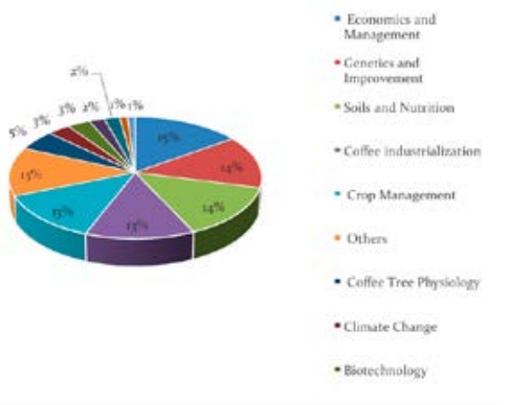


Figure 2.6.8. Coffee research topics from Viçosa Federal University

Source: Study data

- Probability and Statistics (4)
- Food Science (3)
- Chemical Analyses (2)
- Precision Agriculture (1)
- Agricultural Engineering (1)
- Journalism and Communication (1)
- Animal Nutrition (1)

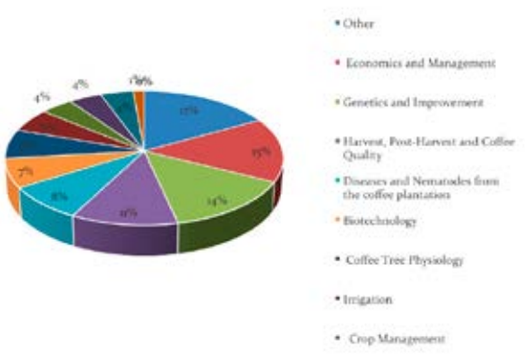


Figure 2.6.9 Coffee research topics from Lavras Federal University

Source: Study data

According to the mapping from this study, the main IAC's area of work in coffee research is Genetics and Improvement, accounting for 61% of researchers. The remaining areas can be viewed in Figure 2.6.10.

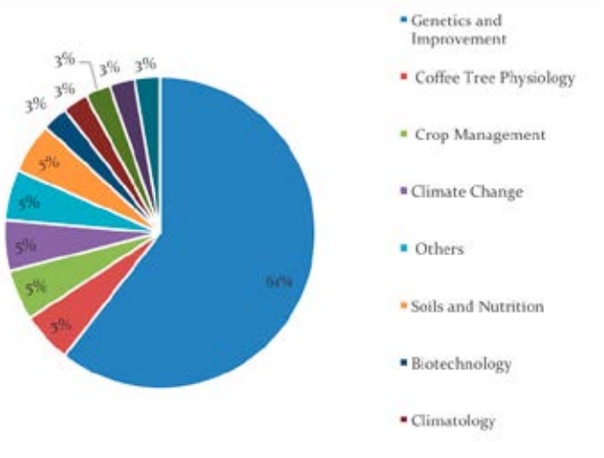


Figure 2.6.10 Coffee research topics from Agronomic Institute of Campinas

Source: Study data

We identified 29 INCAPER researchers who work with coffee through the following themes: Genetics and Improvement; Soils and Nutrition; Other; Crop Management, Coffee Tree Pests, as indicated in Figure 2.6.11.

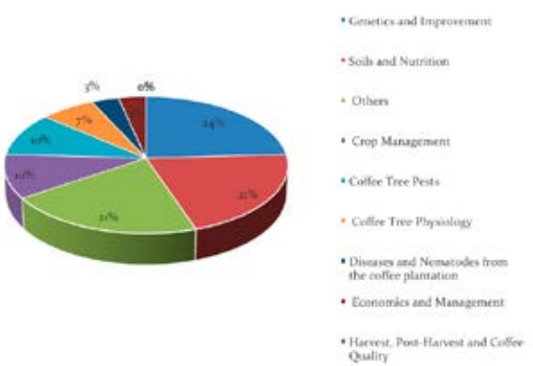


Figure 2.6.11. Coffee research topics from INCAPER

Source: Study data

In this case, the "Other" category concerns Agroecology (2); Phytotechny (2); Organic Agriculture; Probability and Statistics.

2.6.4 Results of in-depth interviews with questionnaire

We performed face-to-face and distance interviews by filling in the data collection instrument (Annex 2.1). This information was relevant for complementing the one obtained from publications, and was proven useful in the obtention of opinions and perceptions from the interviewed research leaders. Some highly-regarded leaderships were not available during interview application.

Answers will be presented according to the following sequence:

- 2.6.4.1 Research Center Identification.
- 2.6.4.2 Institutional Partnership in Research.
- 2.6.4.3 Description of the main ongoing research projects.
- 2.6.4.4 Identification of Network activities.
- 2.6.4.5 Activity relating to the Climate Change topic.

2.6.4.1 Research Center Identification

In total 34 questionnaires were filled in by researches from the following institutions and research centers:

- Alcides Carvalho Coffee Center / Agronomic Institute of Campinas
- Embrapa Café
- Embrapa Cerrados
- Embrapa Agricultural Computing
- Embrapa Rondônia (Center of Agri-Forestry Research of Rondônia)
- Company of Agricultural Research from the State of Rio de Janeiro / Research and Development State Center for Dairy Farming (PESAGRO-RIO/CEPDPL)
- INCAPER
- Agronomic Institute of Campinas – Alcides Carvalho Coffee Center
- Agronomic Institute of Campinas – Ecophysiology and Biophysics Center
- Agronomic Institute of Paraná – Iapar
- Biological Institute
- Institute of Food Technology – ITAL/Center of Packing Technology – CETEA
- National Institute of Coffee Science and Technology – Coffee INCT
- Lavras Federal University – UFLA – Soil Science Department
- UFLA – Food Science – Inova Café – Quality Center
- Federal University of Rio de Janeiro – UFRJ – Chemistry Department
- Viçosa Federal University – UFV

The surveyed researchers informed that 12% of centers have an external council in the governance structure.

The main source of resources is the Coffee Research Consortium, followed by FAPEMIG, state resources, Fapesp and CNPq.

2.6.4.2 Institutional partnership in research

It was observed that 35% of the surveyed researchers work in partnerships for the accomplishment of the research projects. According to them, partnerships involve the coordination of research projects and the publication of results, as well as face-to-face or virtual meetings for background exchange.

The contact between the researcher and the research users occurs mostly by means of:

- Experimental tests set up at the growers' facilities;
- E-mail and telephone contacts, and regular meetings;
- Field days;
- Technical meetings;
- Technical folders;
- Scientific articles;
- Communication at Congresses and Symposia;
- Extension Projects;
- Visits;
- Lectures;
- Individual Attention;

2.6.4.3 Researchers' Activity

The research lines of the surveyed researchers are graphically represented (Figure 2.6.12). As can be seen, the main are of work was "Crop Management", followed by "Harvest, post-harvest and quality" and "Genetics and Improvement".

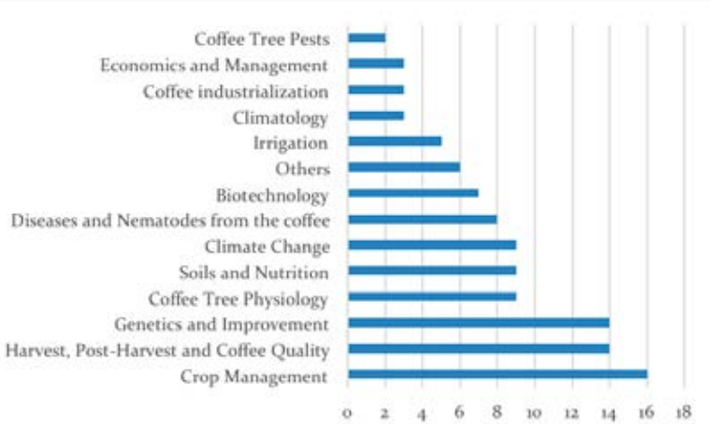


Figure 2.6.12. Respondents' Research Topics

Source: Study data

Other research areas were also mentioned by the respondents, which are:

- Technology dissemination and communication;
- Study on chemical composition; biological activity of coffee components
- Life cycle assessment – ACV – estimate and environmental impacts
- Drought tolerance and water use efficiency
- Usage of coffee husk as feed for ruminant animals
- Sensorial Quality

Amongst respondents, 63% claim that they kept focus of their research lines over the last 5 years. Those who switched research focus claimed that the change was made to the topics listed below:

- Climate and final product quality ratio
- 1- Biotic stresses, 2- Clonal selection of robusta coffee plantations with arquitectural adaptation to semi-mechanized harvest
- Application of the life cycle mindset (simpler method than the ACV) to improve the environmental profile of diverse products
- Spectral, thermal and fluorescent sensors in genotype characterization for drought tolerance,
- Greater focus on Climate Change,
- Focus on coffee beverage quality,
- Add production with better quality and drought tolerance,
- Greater focus on consumer health.

2.6.4.4 Description of the main ongoing research projects

The origin of the funds for research development was mostly Coffee Research Consortium (36%). CNPq, FAPEMIG, FAPES, FAPERJ, CAPES, UFV, private enterprises, Forschungszentrum, RIO RURAL and CNA were also cited, as shown in Figure 2.6.13.

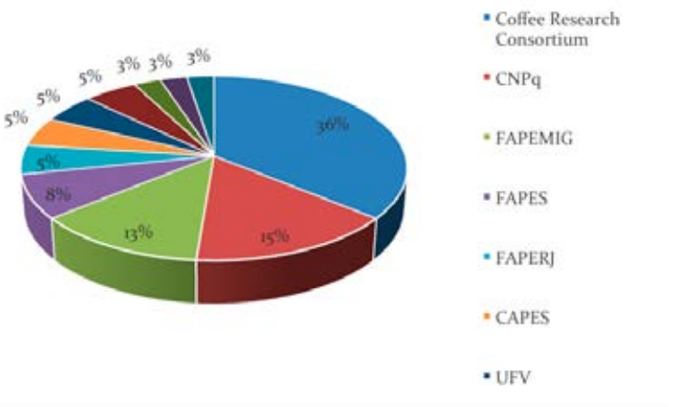


Figure 2.6.13. Origin of funds for the development of the studies cited by researchers

Source: Study data

The project lifecycle is of 4 years on average, nevertheless 2 to 20-year projects were cited.

The main form of result publication was through the presentation of papers in congresses, followed by the publication of scientific papers. Figure 2.6.14 represents the cited options, which are not excluding.

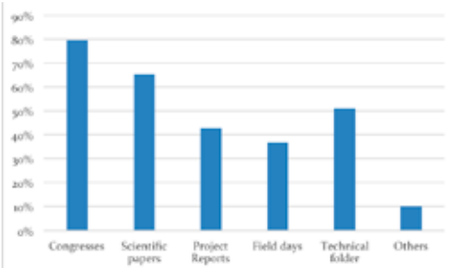


Figure 2.6.14. Main forms of research result publication

Source: Study data

Besides the proposed alternatives, it was observed that the dissemination of generated knowledge also occurs by seminars, training courses, radio programs, agricultural exhibitions, theses and dissertations, technical visits, academic events and lectures. Amongst respondents, 20% affirm having interacted with other countries in the form of partnerships and/or publications during project performance. The cited partner institutions were: YORK UNIVERSITY, CANADA; UNIVERSITY, AUSTRALIA and Forschungszentrum (Germany).

2.6.4.5 Network indications

The question about which research centers are considered paramount for coffee research has proven useful to show the ongoing activity in Brazil. The main mentioned centers were UFLA, EMBRAPA CAFÉ, INCAPER, EPAMIG, IAC and UFV (Figure 2.6.15)

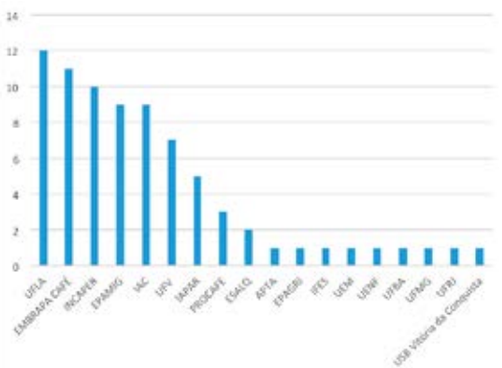


Figure 2.6.15. Research centers cited as paramount for coffee research

Source: Study data

In spite of representativeness constraints, results were in line with what was perceived in the research mapping, once the main identified institutions were also the most cited ones.

2.6.4.6 Climate change

The topic of climate change was considered a study interest for 62% of respondents. Cited studies were on:

- Climatology
- Genetic improvement for coffee plantation devoted to the mitigation of impacts caused by climate change
- Drought tolerance
- Assessment studies of life cycle – ACV, method that deems climate change as one of the potential environmental impacts of the assessed system
- High carbon effect and drought.
- Physiological assessment, growth and Agroforestry System production. Effects on gas exchange, fluorescence, physical, chemical and sensorial beverage quality; soil humidity, temperature and air quality.
- Conservationist handling systems that contribute with soil carbon input and that allow for a better interaction of productive systems with external events, especially those related with water deficit.
- Nitrogen absorption and enzymatic activity under water stress conditions

As discussed in previous chapters, it is observed that the issue of climate change is relevant and has encouraged research in several areas, central or transversal, for instance, those concerning genetic improvement, nutrition, plant physiology, handling, irrigation, among others.

2.6.5 Evolution of themes from the Research Symposium of Coffees from Brazil during the 2000-2015 period

According to the surveyed Symposium themes, which took place during the 2000-2015 period, 28 themes were identified:

1. Genetics, improvement and biotechnology
2. Crop system improvement
3. Agroclimatology and physiology
4. Adding quality to coffee
5. Handling of coffee tree pests and disease

6. Technology and communication exchange
7. Improvement of harvest and post-harvest processes
8. Social and economic development of coffee-producing regions
9. Improvement of industrial processes and new coffee-based products
10. Rational water use in coffee production
11. Mechanization of coffee crop and harvest in plain and highland areas
12. Coffee benefits to human health
13. Organization of coffee-growing knowledge and documentation
14. Environmental protection and social and economic development
15. Agro-Ecological or organic systems
16. Alternative use for coffee residues and by-products
17. Alternatives for family coffee-growing activity
18. Irrigated coffee production
19. Diagnosis and information for the Formulation of Strategies and Policies
20. Physical, chemical and biological hazards to coffee production
21. Crop system optimization
22. Broadening of knowledge base
23. Biotechnology applied to coffee agro-industrial chain
24. Coffee quality and industrialization ion
25. Coffee plantation management
26. Socioeconomic, Markets and Total Quality in the Coffee Chain
27. Soils and Coffee Tree Nutrition
28. Technology transfer and Diffusion

Along the period 2000-2015, there were 9 Symposium editions: 2000, 2001, 2003, 2005, 2007, 2009, 2011, 2013 and 2015. Figure 6.16 presents the themes that were present in most editions (above 6) and the number of presented papers.

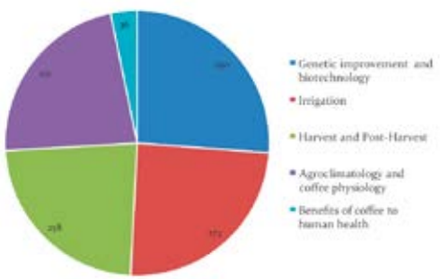


Figure 2.6.16. Themes that arose in nearly all symposium editions (above 6)

Source: Study data

The Figure 2.6.17 shows the ranking of 10 themes that received the highest volume of presented papers between 2.000 and 2.015.

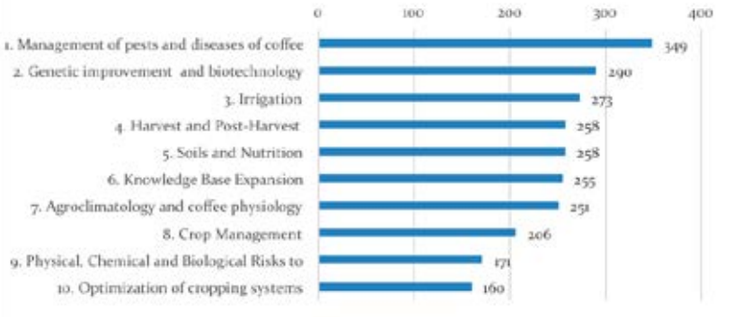


Figure 2.6.17 Ranking of the 10 main research themes from the symposium from 2000 until 2015

Source: Study data

Nevertheless, the themes that received the fewest number of presented papers at the Symposium are also ranked (Figure 2.6.18).

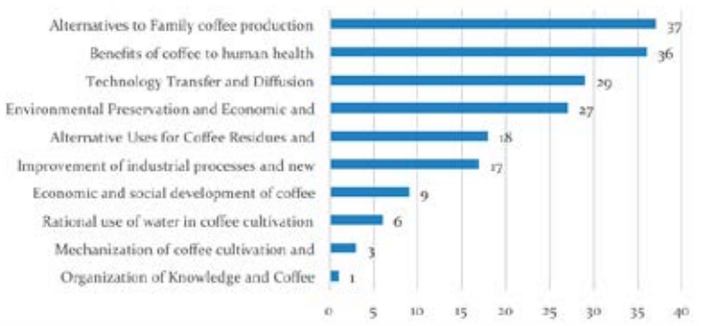


Figure 2.6.18. Ranking of the 10 least contemplated research themes at the 2000-2015 symposium

Source: Study data

The authors narrowed down the number of themes, the 28 Symposium themes were grouped in 10, according to Table 2.6.1:

Table 2.6.1 – Symposium Themes grouped in 10 major themes

1.Genetics, improvement and biotechnology	- Genetics, improvement and biotechnology – Biotechnology applied to coffee agro-industrial chain
2. Crop management	- Improvement of coffee-growing systems – Optimization of coffee-growing systems – Handling of coffee plantation
3. Coffee plantation physiology and climatology	- Coffee plantation physiology and climatology
4. Harvest, Post-Harvest and Coffee Quality	- Adding quality to coffee – Improvements in harvest and post-harvest – Mechanization of coffee crop and harvest in plain and highland areas
5. Coffee Tree pests, diseases and Nematodes	- Management of coffee tree pests and diseases –Physical, Chemical and Biological Hazards to Coffee Production
6. Economics and Management	- Social and economic development of coffee-producing regions – Organization of coffee-growing knowledge and documentation – Environmental protection and social and economic development – Alternative use for coffee residues and by-products – Alternatives for family coffee-growing activity – Diagnosis and information for the Formulation of Strategies and Policies – Socioeconomy, Markets and Total Quality in the Coffee Chain
7.Coffee Industrialization	- Improvement of industrial processes and new coffee-based products – Industrialization and Coffee Quality
8. Irrigation	- Rational water use in coffee production – Irrigated Coffee Production
9. Soils and Nutrition	- Agroecological or organic systems – Soils and Coffee Tree Nutrition
10. Others (Technology and knowledge)	- Technology transfer and Diffusion – Coffee benefits to human health – Broadening of knowledge base – Technology transfer and Communication

Source: Study data

This way, the number of works distributed into 10 significant themes and ranked by volume of presented works during the 2000-2015 period is shown in Figure 2.6.19:

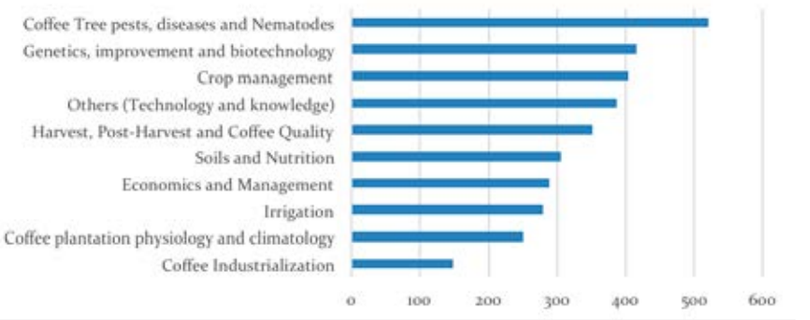


Figure 2.6.19. Ranking of the amount of presented works by theme

Source Study data

2.6.6 Mapping and analysis of existing networks

As part of the objectives of this study, we have the mapping of the existing networks done by Ucinet software. The joint publications are the connections between researchers. The nodes are individual researchers or research centers in different analyses, as shown below.

2.6.6.1 Mapping and network analysis between individual researchers

The network analysis will begin with the review of individual researchers identified in the sample (471) who have ties with one of the research centers (88).

After feeding the data about the joint publications mapped in the study, the connection map was generated, as shown in Figure 6.20. The map contains:

Nodes: identified researchers

Links: are the lines between the nodes, which means, at least, one publication between two or more researchers.

The “nodes” on the left are those researchers who do not have any connection.

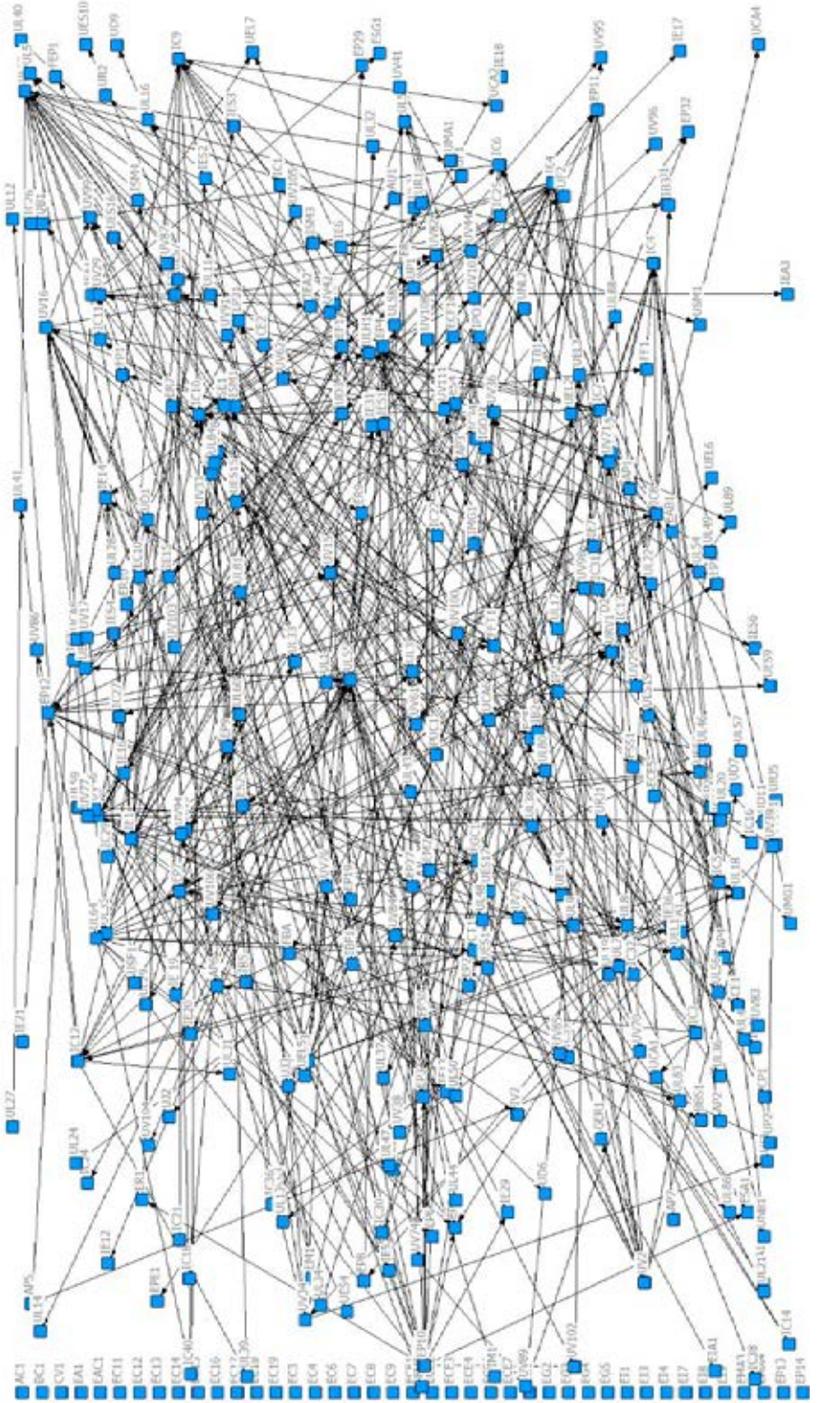


Figure 2.6.20. Map of identified networks

Source: Study data

At first, the number of links between the "nodes" may be confusing and convey the impression of a dense network of connections among agents.

The method chosen for measuring the network density was the centrality degree, which is formed by the number of actors a given researcher is connected. Hence, the bigger the number of interactions with other researchers, the higher the centrality degree will be.

Table 2.6.2 shows the descriptive statistic results of the centrality degree for the network, calculated by the software ,itself. The data draw attention to the average of centrality degree, 0.18%, which signals low network activity in the form of integrated research networks. On the other hand, the variation and standard deviation show that there is a dispersion around the average.

Table 2.6.2 Descriptive Statistics pertaining to the centrality degree of the complete network

	Output degree	Input Degree	Normalized Output Degree	Normalized Input Degree
Average	0.908	0.908	0.182	0.182
Average Deviation	3.432	1.058	0.688	0.212
Variation	11.780	1.120	0.473	0.045
Minimum	0.000	0.000	0.000	0.000
Maximum	23.000	6.000	4.609	1.202

Source: Study data

The dispersion around the average means that some researchers have a higher interaction degree, or centrality degree, than others. Figure 2.6.21 shows the network map focusing on researchers who have a higher centrality degree. Differently from the previous figure, in this one, the size of the node represents its centrality degree (The bigger the node, the higher its interaction degree).

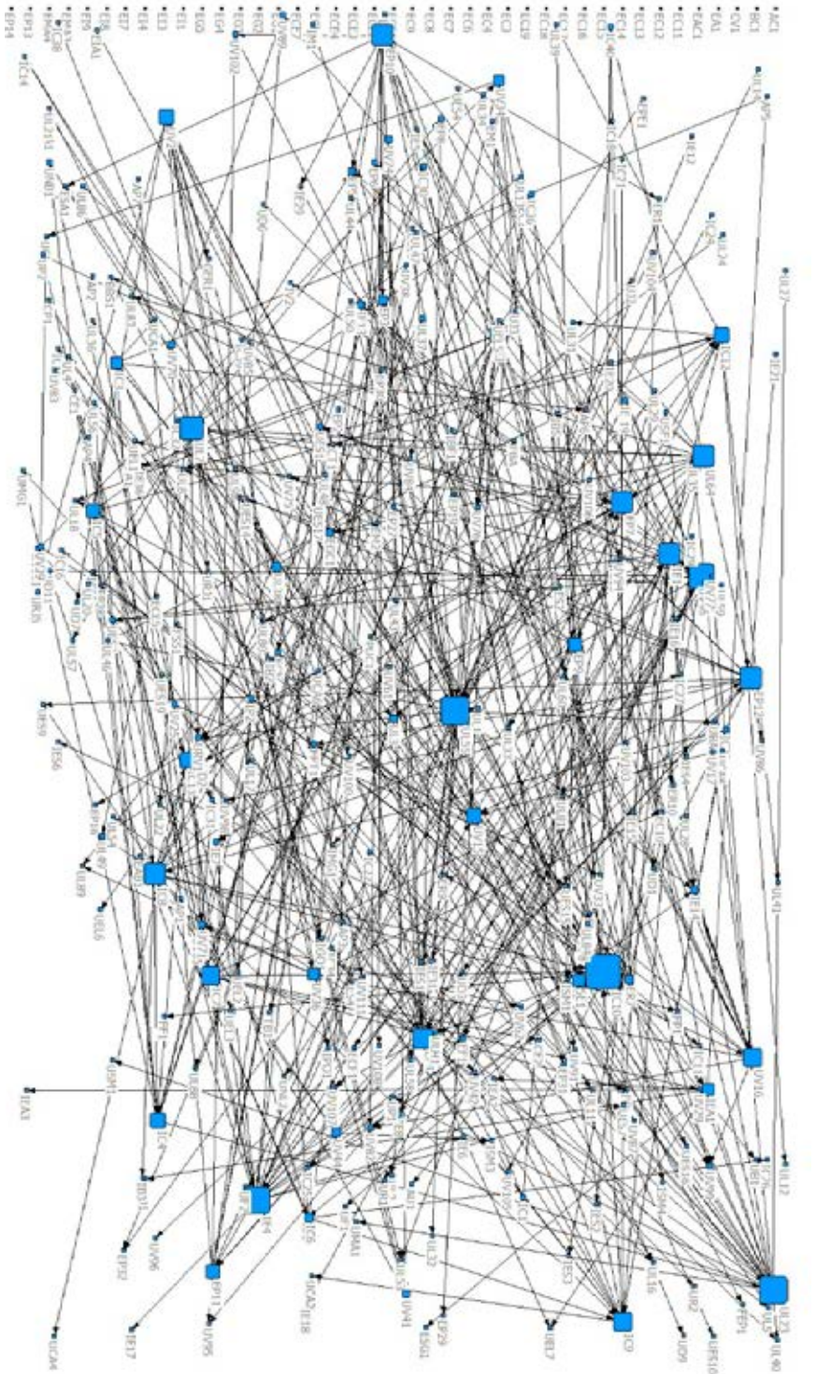


Figure 2.6.21. Map of identified networks with the centrality degree of 471 researchers

Source: Study data

From the results yielded, and as to facilitate reading, Table 2.6.3 was assembled, which brings together the five researchers with the highest number of interactions in the sample, ranked by centrality degree. ,The output degree shows the total amount of interactions that the researcher has with others, and the input degree shows the total amount of interactions that others have with him/her. The normalized output and input degrees are the percentage representation of the latter. An IAC researcher represented the highest number of interactions, followed by researchers from Incaper, UFLA and Embrapa Café.

Table 2.6.3. Data of centrality degree of the complete network

ID	Output Degree	Input Degree	Normalized Output Degree	Normalized Input Degree
IC10	23.000	6.000	4.609	1.202
IE4	22.000	1.000	4.409	0.200
UL23	22.000	2.000	4.409	0.401
UL55	21.000	3.000	4.208	0.601
EC2	19.000	2.000	3.808	0.401

Source: Study data

In the interaction maps shown so far (2.6.20 and 2.6.21), it is not possible to distinguish which institution each researcher belongs to because all are featured the same color. The map from Figure 2.6.22 was generated to differentiate the origin of the 471 researchers.

To facilitate viewing, colors identify the six institution that presented the highest frequency in the sample: UFV, UFLA, IAC, EPAMIG, INCAPER and EMBRAPA CAFÉ. In order to make the map, the institution of origin was included as an attribute, as follows:

1. UFV researchers – purple color
2. UFLA researchers – salmon color
3. IAC researchers – yellow color
4. Incaper researchers – blue color
5. EPAMIG researchers – green color
6. Embrapa Café researchers – red color
7. Researchers from the remaining 82 institutions – white color

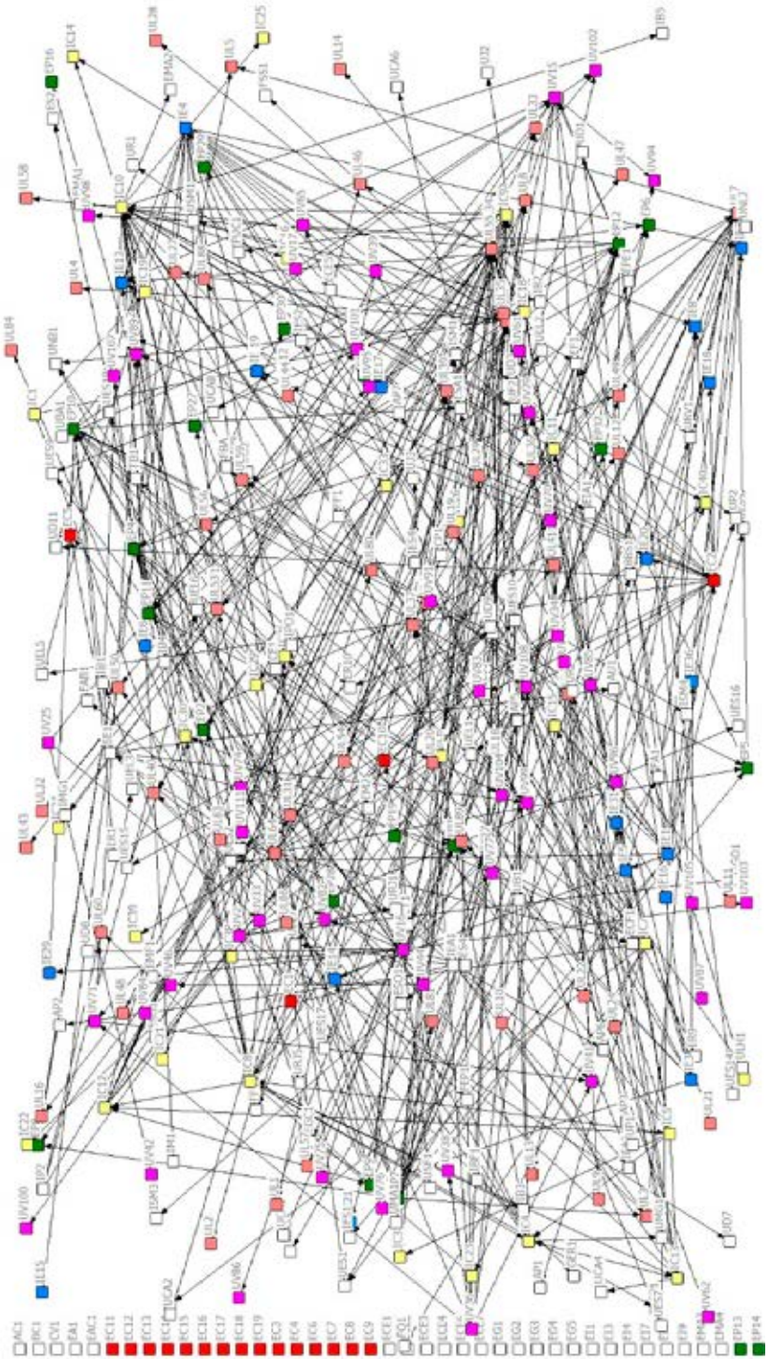


Figure 2.6.22. Map of researchers' identified networks with colors distinguishing their origins institutions (attributes)

Source: Study data

Figure 2.6.23 is distinguished from the previous one (2.6.22) for presenting their nodes by the centrality degree (Number of connections). One can notice that the highlighted researchers are those described in Table 2.6.2 because they are the ones who represent the highest number of interactions: IC10 in yellow, IE4 in blue, UL 25, UL55 in salmon and EC2 in red.

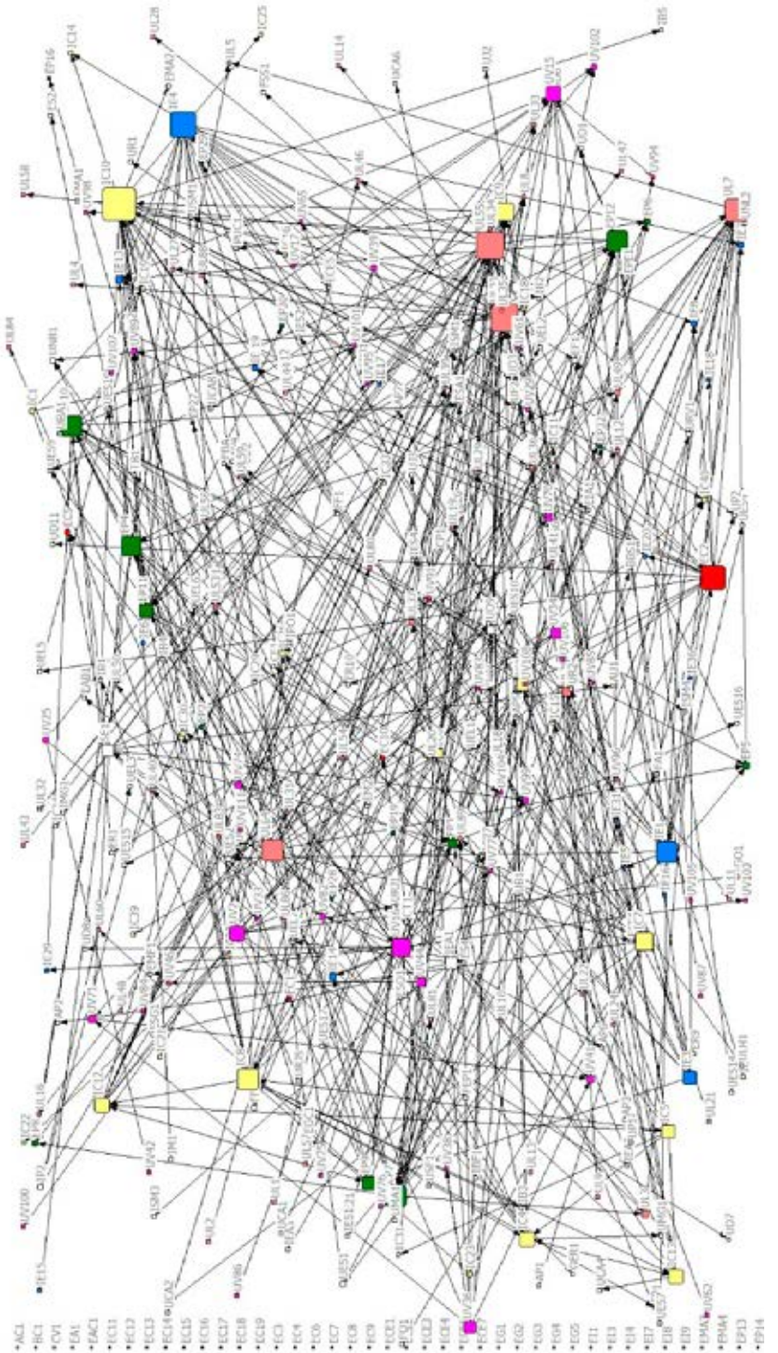


Figure 2.6.23. Map of researchers' identified networks with colors distinguishing their origins institutions (attributes) and centrality degree

Source: Study data

Even with color distinction, the map reveals itself confusing, because it shows all the identified connections of the 471 researchers.

As a next step, Figure 2.6.24 shows the nodes and connections among the researchers from the six institutions featuring the highest number of researchers identified. In better words, researchers from the remaining 82 institutions were removed. In this case, the sample ended up having 275 observations.

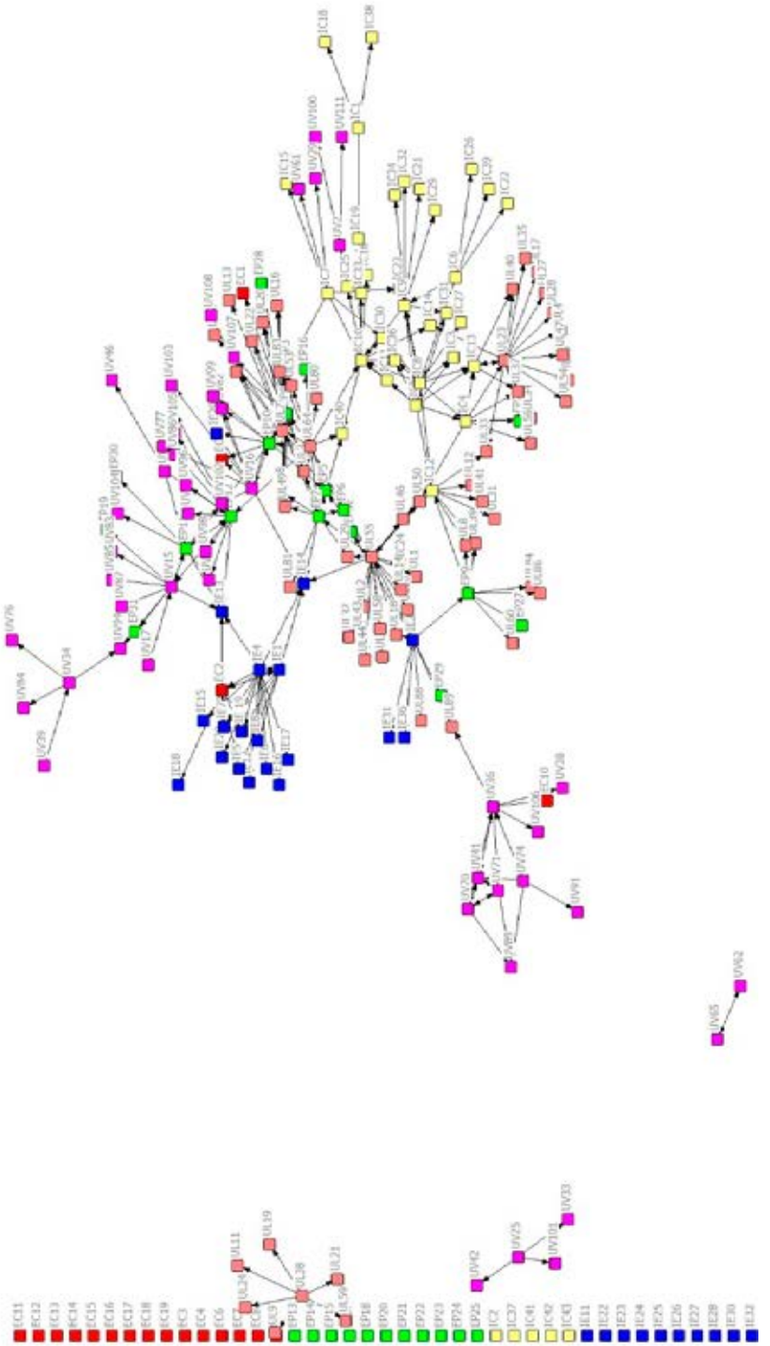


Figure 2.6.24. Reduced network map with attributes (Origin institutions)

Source: Study data

Thus, Figure 2.6.24 shows the interaction among researchers from the centers featuring the highest frequency in the sample. This map was generated to observe whether these researchers interact even with those from their own centers or others with other institutions.

Table 2.6.4 brings the new researcher ranking by centrality degree, now with the sample reduced to 275 observations.

Table 2.6.4. Data from the centrality degree of the reduced network (Researchers from the six main institutions)

ID	Output Degree	Input Degree	Normalized Output Degree	Normalized Input Degree
UL55	18.000	3.000	6.272	1.045
UL23	16.000	2.000	5.575	0.697
UL64	15.000	0.000	5.226	0.000
EP4	14.000	3.000	4.878	1.045
IE4	13.000	1.000	4.530	0.348

Source: Study data

With the sample being reduced it is observed that the centrality degree was modified. It is interesting to note that UFLA now has a prominent role in the number of connections. It is possible to interpret that these researchers present a higher interaction with same-institution ones and/or with the other five who still remain in the sample.

Table 2.6.5 Descriptive Statistics of the centrality degree of the reduced network

	Output Degree	Input Degree	Normalized Output Degree	Normalized Input Degree
Average	1.007	1.007	0.351	0.351
Standard Deviation	2.991	1.140	1.042	0.397
Variation	8.944	1.299	1.086	0.158
Minimum	0.000	0.000	0.000	0.000
Maximum	18.000	6.000	6.272	2.091

Source: Study data

Table 2.6.5 brings together the data from the descriptive statistics. It is observed that the average degree of centrality rose to 0.35%, mainly because researchers with low or zero interaction were removed. In the next item, the "nodes" will be represented by institutions and no longer by researchers, which will generate an indicative map of how research centers are connected.

2.6.6.2 Mapping and analysis of networks among research centers

After the analysis of interactions among researchers, the next step will be the behavior analysis among institutions. In this phase, the relation among the 88 research centers are shown in the next network, Figure 2.6.25.

Nodes: Identified research centers

Links: are the lines connecting the nodes, which means that there is at least one publication between two or more centers.

The "nodes" singled out on the left are those centers that do not identify with any connection from their researchers with others from the samples.

It is important to note that this map does not reflect the endogenous interactions, just the interaction between institutions.

In the same way as the first analysis, the next step was the insertion of attributes for the nodes to visually distinguish them by color.

The colors identify the six institutions that represented the highest frequency in the sample, as follows:

1. UFV researchers – purple color
2. UFLA researchers – salmon color
3. IAC researchers – yellow color
4. Incaper researchers – blue color
5. EPAMIG researchers – green color
6. Embrapa Café researchers – red color
7. Researchers from the remaining 82 institutions – white color

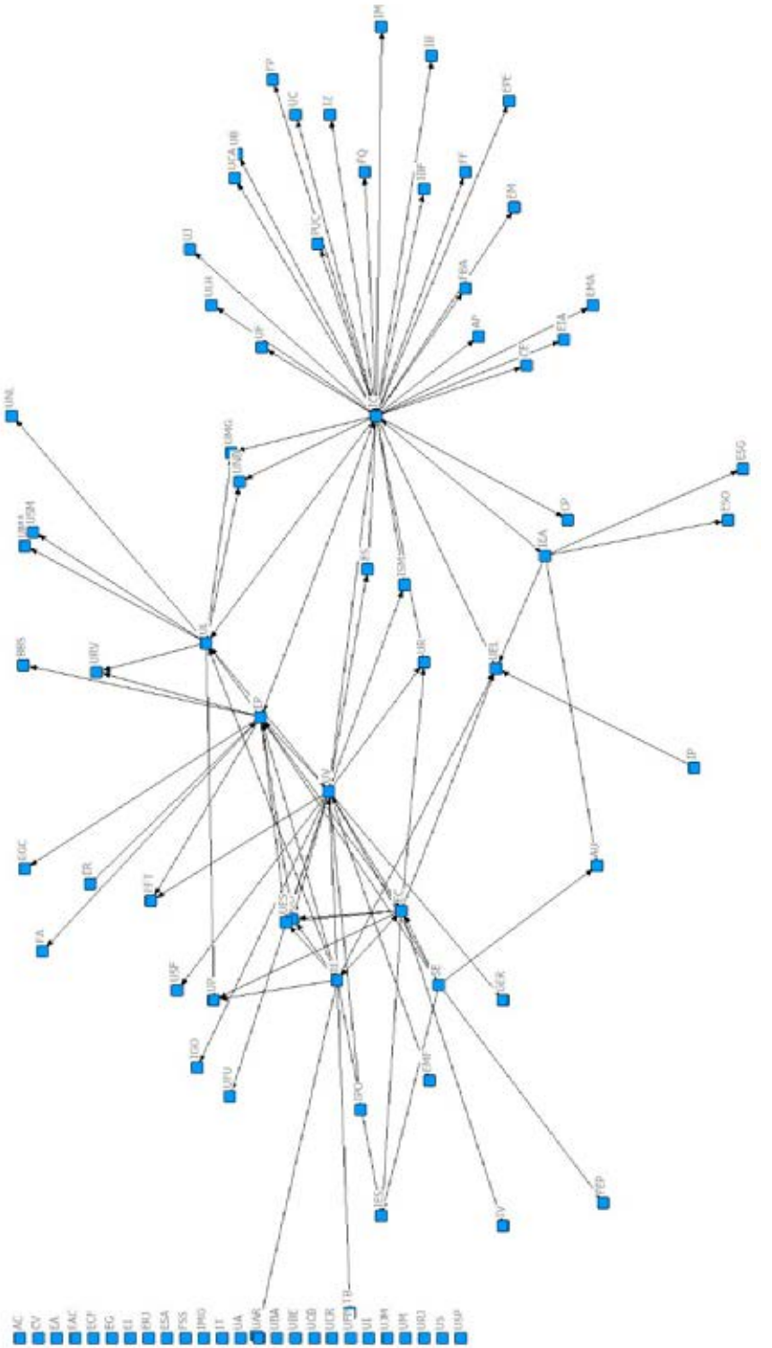


Figure 2.6.25. Complete map with institutions

Source: Study data

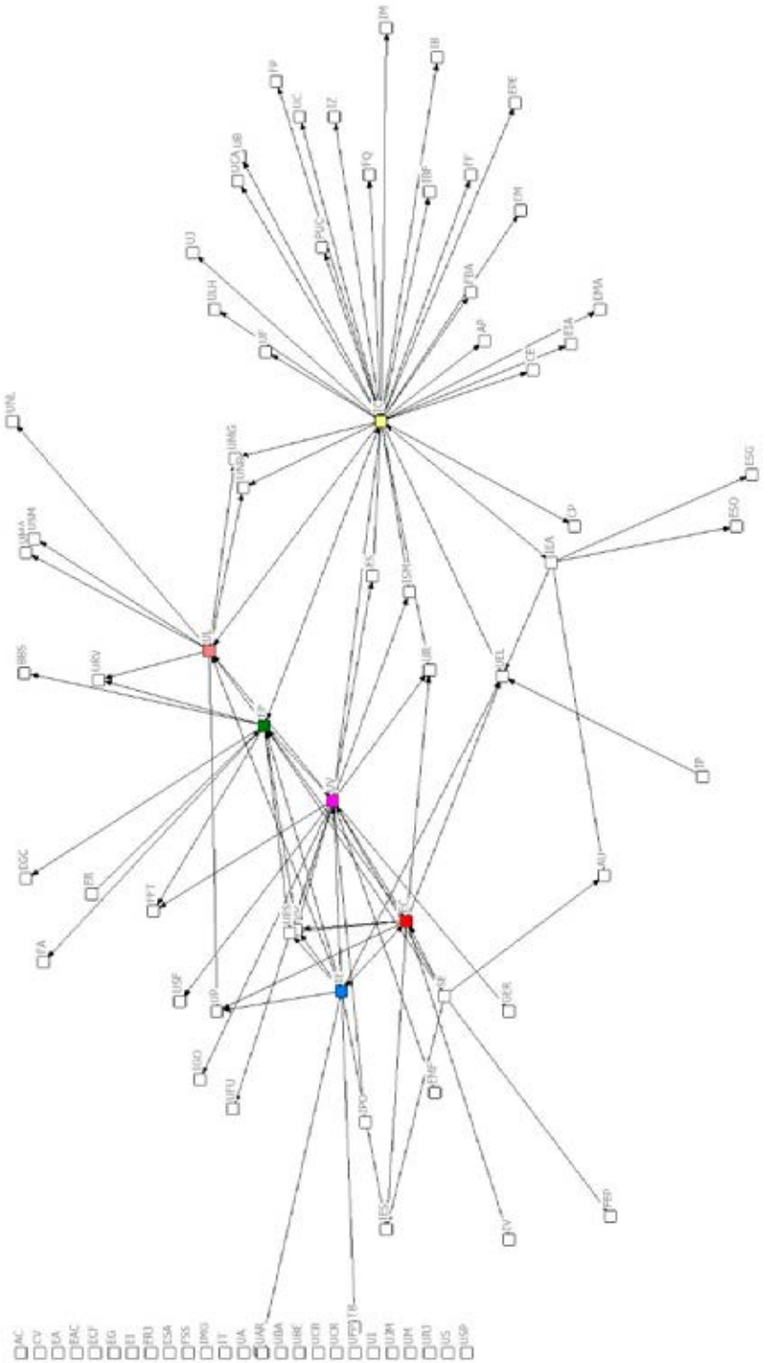


Figure 2.6.26. Complete map with institutions identified by color

Source: Study data

In Figure 2.6.26 it is possible to observe how some institutions interact more than others, which is more evident when the nodes are differentiated by their degree of centralization (Figure 2.6.27). As expected, when ranked by their centrality degree, the six main institutions present a higher degree of interactions. The highlight was for IAC, followed by Viçosa Federal University and Epamig.

Table 2.6.6. Data from the network centrality degree with institutions

ID	Output Degree	Input Degree	Normalized Output Degree	Normalized Input Degree
IC	32.000	2.000	36.782	2.299
UV	17.000	4.000	19.540	4.598
EP	12.000	5.000	13.793	5.747
IE	11.000	3.000	12.644	3.448
EC	8.000	4.000	9.195	4.598
UL	7.000	4.000	8.046	4.598

Source: Study data

Table 2.6.6 shows that IAC has 36% interaction with other institutions, whereas UFLA has 8%. The latter has an interaction that seems to be mostly among same-institution researchers. Yet Table 2.6.7, with descriptive statistics, brings a much higher interaction average in comparison to the previous item when researcher interaction was considered. In this analysis, all interactions from researchers with those from other institutions were added up. Even so, the average was 1.3%, which indicates low interaction in publications among institutions. The variation around the average indicates that there are centers with much higher interaction than others, which is IAC's case.

Table 2.6.7 Descriptive statistics on the network centrality degree with institutions

	Output Degree	Input Degree	Normalized Output Degree	Normalized Input Degree
Average	1.136	1.136	1.306	1.306
Standard Deviation	4.317	1.198	4.963	1.377
Variation	18.640	1.436	24.627	1.897
Minimum	0.000	0.000	0.000	0.000
Maximum	32.000	5.000	36.782	5.747

Source: Study data

With these various findings, the next and last chapter will focus on conclusions and strategic suggestions.

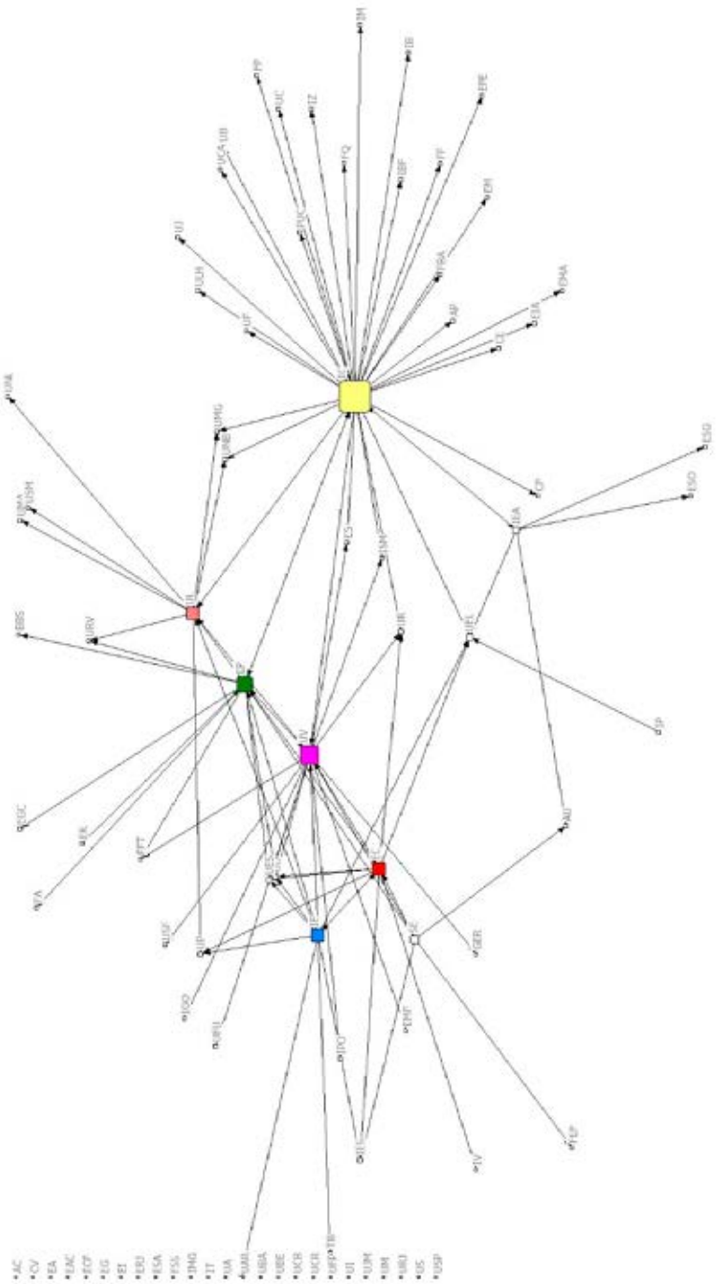


Figure 2.6.27. Complete map with institutions featured by color and centrality degree

Source: Study data

2.7 Conclusions and Suggestions

The agricultural research activity is one of the cornerstones that help assure Brazil's permanent presence in the international scenario of quality coffee supply. Whereas there are traditional research lines that must be preserved, there are new challenges that imply finding new areas for research. An example of a problem to be faced by agriculture in general and by coffee production, in particular, is within the climate change theme. It was the determining factor for this study, appointed by Illycaffè's senior management in 2016.

The PENSA-UDC Brazil team initiated the research mapping work by focusing on the chosen topic and soon realized the lack of studies that identified coffee research activity in the country. Without sidetracking from the initial goal, we decided to amplify the analysis by promoting the mapping of coffee studies conducted in Brazil between 2012 and 2017. We perceived this map had never been made before and represents an Illycaffè's contribution to public and private decision-makers tied to innovation in the coffee agro-industrial system.

Besides the mapping, which in itself would prove a revealing effort with regards to the research paths, we understand it is important to veer into a crucial aspect of the research organization. We raised the following question: How do knowledge centers connect with one another for fulfilling integrated research plans? In times of scarce public funding, fine coordination actions may result in real progress and lead to better use of existing equipment, besides fostering new knowledge from researcher interfaces.

Findings bring up relevant aspects that could be discussed within companies, governments, and research institutions. Some of the major aspects were the following:

– It was identified that using software specialized in network mapping, there are poles that concentrate research activity, whose poles were identified either by research leaders or by institutions.

– Through the software, we were able to measure the degree of existing connection among specialized centers, and the obtained index signaled low connection. In better words, there is room for creating incentive mechanisms for the cooperation among specialized centers and researchers devoted to the theme.

– From researchers' names, the most highlighted focal points were IAC, INCAPER, and Lavras Federal University. The latter stood out for having an essential in-house network that congregates research endeavors among same-university unities. This observation signals to a positive aspect, because we know how hard it is to promote cooperation actions amongst specialized integrations within the universities.

– As for knowledge centers, the software revealed that the concentration degree of connections stands out in IAC, Viçosa Federal University, and EPAMIG.

– From the face-to-face interviews, we identified the importance of the Coffee Research Consortium, which aims at promoting the coordinated action of the research. Nevertheless, all interviews raised criticism over the effective operacionalization of the system as an actual network. The delayed release of funds and lack of short and medium term signaling jeopardize the efficiency of the existing mechanism. The Consortium has conditions to become an integrated research network, and to meet that goal it deserves a revision of currently proposed governance procedures.

– The study indicated a wide range of researched themes related to the coffee system. The highest frequency was marked by research activity on genetics and improvement and soils/nutrition. Nevertheless, socioeconomic and organizational issues, among others, also turn up in the survey.

– It was identified that there is a variety of knowledge centers that showed some involvement with coffee research. 88 research centers were listed, some of which are traditionally involved with the theme applied to coffee. This result suggests a real potential to, in case of a strategic decision in the sector, mobilize knowledge centers or specialized researchers to tackle pressing problems.

– The profile of approached themes varies sharply among the surveyed centers. IAC focuses its efforts on Genetics and Improvement, whereas UFV and UFLA present a more diversified research standard.

– The research on the climate change theme was observed in two dimensions. One of them, a broader one, focuses the phenomenon impacts on all the agricultural activity. To a lesser extent, but present in the results, some concern about the coffee production was observed.

In general, the results from this study suggest the existence of an underestimated research potential in the country. In other words, we support the assumption that, if adequate funding and governance mechanisms are implemented, research geared towards the Coffee Agro-Industrial System may give rise to more vigorous results and the ones we have observed. It is the duty of R&D public policy managers to identify institutional mechanisms that apply the connections among agents still isolated so that they can work in the form of research networks, with generated targets, deadlines and knowledge dissemination.

The near absence of international connections for the research centers observed using the adopted methodology, based on the researchers' publications, is worthy of a critical view. Likewise, the near absence of interaction with companies and the low connection index among knowledge centers deserves a rethinking of research governance.

2.8 Annexes

Annex 1 – Questionnaire

Questionnaire: Supporting research for Coffee Production in Brazil: paving the way to the future

I – Research Center Identification

Name:
Administration:

Director? ( ) Yes ( ) No
If so, continue. If not, go to Part IV
Does it have an outside counsel? ( ) Yes ( ) No
If so:
_____
_____
_____
_____
Number of ACTIVE researchers:

Annual Budget: ( ) Up to R$ 200,000.00 ( ) Up to R$ 500,000.00 ( ) Up to R$ 1,000,000.00 ( ) Above R$ 1,000,000.00
Source of Funds: ( ) State ( ) Coffee Consortium/ EMBRAPA ( ) FAPESP ( ) CNPQ ( ) FAPEMIG Other: _____

Location:
Founded in:
Coffee Research History: who, when, timeline
_____
_____
_____
_____
Are annual reports on the activities published? ( ) Yes ( ) No
If so, are they available for consultation? ( )Yes ( )No
Outra documentação?
_____
_____

II – Center's Researcher Profile

Number of Researchers: ____
Leading Researcher(s):
1. Name:
Contact: E-mail: Tel.:
2. Name:
Contact: E-mail: Tel.:
3. Name:
Contact: E-mail: Tel.:
4. Name:
Contact: E-mail: Tel.:

III – Institutional Partnership in Research

Are there institutional partnerships for the conduction of research projects?
( )Yes ( )No
If so, please answer the questions below:
The research partnership involves:
( ) Joint coordination of the research projects
( ) Joint definition of the research project focus
( ) Joint publication of articles with research findings
( ) Division of financial resources for research
( ) Participation of researchers in the field
( ) independent projects or action plans
Joint financing?: ( ) yes ( ) no
If so, what is the joint resource input?

_____
_____

Are there formal follow-up meetings about project status?
( ) Yes ( ) No and informal? ( ) Yes ( ) No
Is there face-to-face or virtual exchange of information? ( ) Yes ( ) No
( ) none ( ) 1 ( ) up to 5 ( ) up to 10
Is there contact between the researcher and the research users? ( ) Yes ( ) No
How?

_____
_____
_____
_____

Do the researchers from this center also work in other centers/institutions or partner research agencies? If so, who and which centers?

_____
_____
_____

IV – Researcher's Research Activity

Research lines on coffee: (Please, rank the top in order of importance)

( ) Coffee Tree Physiology	( ) Climate Change
( ) Climatology	( ) Coffee Tree Diseases and Nematodes
( ) Genetics and Improvement	( ) Coffee Industrialization
( ) Biotechnology	( ) Crop Management
( ) Irrigation	( ) Coffee Tree Pests
( ) Soils and Nutrition	( ) Economics and Management
( ) Harvest, Post-Harvest and Coffee Quality	( ) Other:_____

Was there a focal change in the research lines over the last 5 years?
( ) yes ( ) no
If so, what was the change?

_____
_____
_____

Description of the top two ongoing research projects
How many ongoing research projects are there? _____
Project 1.
a) Title:
b) Leader:
c) Other collaborators/researchers:
d) Partner institutions:
e) source of funding:
f) project length:
g) project summary:
h) key words:

i) In what ways have results been disseminated?
( ) presentation in congresses
( ) publication of scientific articles
( ) Field days
( ) Technical folder
( ) Project Completion Report
Other:

j) Were scientific articles published?
If so, how many (and which) published articles over the last 5 years on this article:

_____

k) Was there interaction with other countries (partnerships, publications)? ( ) yes
( ) no . What type of interaction?

_____

_____

Project 2.

a) Title:
b) Leader:
c) Other collaborators/researchers:
d) Partner institutions:
e) source of funding:
f) project length:
g) project summary:
h) key words:

i) In what ways have results been disseminated?
( ) presentation in congresses
( ) publication of scientific articles
( ) Field days
( ) Technical folder
( ) Project Completion Report
Other:
j) Were scientific papers published?
If so, how many (and which) published articles over the last 5 years on this article:
k) Was there interaction with other countries (partnerships, publications)? ( ) yes
( ) no . What type of interaction?

_____

_____

_____

V – Network Indications

Which other names do you consider fundamental for coffee research? (centers and researchers)

_____

_____

VI – Does this center carry out research relating to climate change and its effects?
( ) Yes ( ) No

Annex 2 – Identified institutions in alphabetical order

Identified Research Institutions	Abbreviation
Associação Cultural São Joao Bosco	AC
Agência Paulista de Tecnologia dos Agronegócios	AP
Addis Ababa University, U.ADDIS ABABA, Etiópia.	AU
Barenbrug do Brasil Sementes Ltda	BBS
Centro de Energia Nuclear na Agricultura, CENA USP	CE
Centro Nacional de Pesquisa em Energia e Materiais, CNPEM	CP
Centro de Excelência do Café das Matas de Minas (Viçosa)	CV
Embrapa Agroindústria de Alimentos	EA
Embrapa Acre	EAC
Embrapa Café	EC
Embrapa Cerrados	ECE
Embrapa Centro Nacional de Pesquisa de Florestas	ECF
Embrapa Recursos Genéticos e Biotecnologia	EG
Embrapa Gado de Corte	EGC
Embrapa Informática Agropecuária	EI
Embrapa Instrumentação Agropecuária	EIA
Embrapa – Centro Nacional de Pesquisa de Monitoramento e Avaliação de Impacto Ambiental, Fitopatologia Microbiologia	EM
Embrapa Meio Ambiente	EMA
Embrapa Mandioca e Fruticultura	EMF
Empresa de Pesquisa Agropecuária de Minas Gerais – EPAMIG	EP
Embrapa, Centro de Pesquisa de Pecuária do Sudeste	EPE
Embrapa Rondônia	ER
Empresa de Pesquisa Agropecuária do Estado do Rio de Janeiro	ERJ
Escola Superior de Agricultura Luiz de Queiroz/USP	ES
Embrapa Semiárido	ESA
EMBRAPA Secretaria de Gestão e Desenvolvimento Institucional – SGI.	ESG
EMBRAPA, Centro Nacional de Pesquisa de Solos	ESO
Fazenda Amizade Agropecuária LTDA, Campos Altos.	FA

Faculdade de Ensino Superior Santa Barbara	FBA
Fundação Estadual de Pesquisa Agropecuária	FEP
FACULDADE DE ENSINO SUPERIOR E FORMAÇÃO INTEGRAL – FAEF.	FF
Faculdade do Futuro -MG	FFT
Faculdade Pitágoras, Unidade Teixeira de Freitas / BA	FP
Faculdade de Quatro Marcos/MT	FQ
Fundação Educacional Comunitária de São Sebastião do do Paraíso	FSS
Max Planck Institute For Molecular Plant Physiology, Department Lothar Willmitzer, Central Metabolism Group. Alemanha	GER
Instituto Biológico	IB
Instituto de Botânica, Divisão de Fitotaxonomia	IBF
Instituto Agronômico de Campinas – IAC	IC
Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural – INCAPER	IE
Instituto de Economia Agrícola	IEA
Instituto Federal de Educação, Ciência e Tecnologia do Espírito Santo	IES
Instituto Federal Goiano	IGO
Fundação de Apoio à Tecnologia Cafeeira – PROCAFE	PC
Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas Gerais	IMG
Instituto Agronômico do Paraná – IAPAR	IP
Instituto de Investigação Científica Tropical – Portugal	IPO
Instituto Federal do Sudeste de Minas Gerais	ISM
Instituto de Tecnologia de Alimentos – ITAL	IT
Universidade Federal do Paraná	UPA
Instituto de Zootecnia	IZ
Pontifícia Universidade Católica de Campinas	PUC
Secretaria de Estado de Ciência, Tecnologia e Ensino Superior – polo excelência florestal	SE
Tbio Soluções Biotecnológicas	TB
Universidade Federal de Alfenas	UA
Universidade Estadual Paulista – Unesp ARARAQUARA	UAR
Universidade Estadual Paulista – Unesp BOTUCATU	UB
Universidade do Estado da Bahia, Departamento de Ciências Humanas e Tecnologias – Campus XXII.	UBA
Universidade de Uberaba	UBE
Centro Universitário Central Paulista, UNICEP	UC
Universidade Estadual de Campinas – Unicamp	UCA
Universidade Católica de Brasília	UCB
Universidad de Costa Rica, Centro para Investigaciones en Granos y Semillas.	UCR
Universidade Estadual do Norte Fluminense Darcy Ribeiro	UD
Universidade Estadual de Londrina – UEL-	UEL
Universidade Federal do Espírito Santo – UFES	UES
Universidade de São Paulo, Faculdade de Ciências Farmacêuticas de Ribeirão Preto, Departamento de Ciências Farmacêuticas	UF
Universidade Federal do Pampa, Câmpus Itaqui	UFP
Universidade Federal de Uberlândia	UFU
Universidade Federal de Itajuba	UI
Universidade Estadual Paulista – Unesp Jaboticabal	UJ
Universidade Federal dos Vales do Jequitinhonha e Mucuri	UJM
Universidade Federal de Lavras – UFLA	UL
Universidade Lusófona de Humanidades e Tecnologias	ULH
Universidade Federal de Minas Gerais	UM
Universidade Estadual de Maringá	UMA
Universidade do Estado de Mato Grosso	UMG
Universidade de Brasília	UNB
Centro Universitário de Lavras, UNILAVRAS	UNL
Universidade Tecnológica Federal do Paraná	UP
Universidade Federal de Rondônia	UR
Universidade Federal do Rio de Janeiro	URJ
Universidade José do Rosário Vellano, Instituto de Ciências Agrárias, Faculdade de Agronomia.	URV
Universidade Federal do Rio Grande Do Sul	US
Universidade Federal do Vale do São Francisco	USF
Universidade Federal de Santa Maria	USM
Universidade de São Paulo	USP
Universidade Federal de Viçosa	UV

3. Case studies about innovation in the Brazilian coffee production – 2016

Decio Zylbersztajn • Samuel Ribeiro Giordano
Christiane Leles Rezende de Vita • Caroline Gonçalves

3.1 Introduction to Agricultural Innovation: Innovating and adding value

Innovation is a continuous process which is very typical of life in society. Animals do not innovate, otherwise acting by instinct, although one can observe some efficiency logic in the mechanisms they bring to bear, for example, to feed themselves and to reproduce. But primitive society generated innovations that transformed life to bring benefits to men. Claude Levi Strauss, in his book "Le Cru et Le Cuit"[1] ("The Raw and the Cooked"), analyses the use of fire from the mythology of the Brazilian indigenous populations. Most likely the use of fire, which allowed for cooking meat, was an innovation that generated a significant impact by facilitating the digestion of proteinaceous food. The increase in digestive efficiency shortened the necessary length for continuous harvest, easing the onerous task of obtaining food. The same effect occurred in the organized agriculture, which replaced food gathering, a much less efficient effort regarding time consumption of the populations.

In modern agriculture, the advances in the traditional genetics initially occurred due to the mere observation of the most capable individuals, by the form of a mass selection of the most productive individuals, as possibly happened to the corn in the origin region in Central America and Mexico. The addition of empirical knowledge to the one structured by scientific logic represents another example that led to a breakthrough, first of genetics and classic improvement intended for the controlled recombination of genes in search of more productive individuals, thus giving rise to technologies such

1 Lévi-Strauss, C. 1994. O Cru e o Cozido: mitológicas1. Ed. Cosac Naify. 442 pp.

as the hybrids. At another moment, biotechnology emerged, which generated impacts as it introduced other mechanisms to promote the genetic recombination aimed at specific objectives.

Innovations occurred in different knowledge areas, many times from the astute observation of productive agents, at times from scientific knowledge. Innovations are observed and incorporated in the generations of agricultural equipment, in agriculture inputs, in the industrial food processing, in agrarian practices monitored by remote sensing, among many others. There are innovations in products as well as processes, whose flagship is the production of value for society, either via the manufacturing of a new product that will replace the existing ones or via improvement of production processes, thus making them more efficient.

The milestones that affect agriculture may permeate the supply chain, the input industry until the final consumption. New ways to prepare food, as it was shown in the introduction of sachets by Illycaffè, which opened prospects for the use of capsules.

Doing it differently, creating something that does not exist and generating value for the consumer and society are the motivations for the generation and adoption of innovations. It is worthy to question which are the propellers of the innovation process. Among many plausible explanations, we identified two main aspects, which are not excluding. The innovation as a response to prices and the innovation as a response to institutional changes. The Innovation induced by prices: Vast literature produced in the 70's and 80's demonstrates the role of prices as technological change inductors. If there are no failures in the market functioning, it is expected that prices reflect the relative shortage of a given production factor, which leads to funding, so research develops alternatives to save the use of the scarce factor. The mechanization in regions lacking labor force, or the strengthening of fertilizer use in areas that have poor soil for expanding and producing food, all represent such mechanism. Prices may signal either the choice of a given technology by the grower, like, in the long term, the orientation of technological advances towards the economic use of the scarce factor. A good example would be the research lines of plant varieties that are water-stress tolerant.

Innovation as a response to institutional changes: It is necessary to consider that every so often markets fail and prices do not reflect the shortage of factors. A classic example would be the environmental problems arising from the so-called negative externalities not captured by the markets. In this case, there are two solution paths. The first one suggests that the parts involved can negotiate by seeking alternatives to internalize costs not captured by the markets. The second one, which is true when the first one does not succeed, requires regulatory intervention. The environment example is enlightening. The legislation from many countries may curb the adoption of specific technologies, or even set boundaries to land use for agriculture, as it occurs in Brazil with the Forestry Code. In this case, the innovation process reacts as a way to identify alternatives to statutory requirements. Such process, even though not being induced by prices, may be influenced by institutional restrictions imposed by law.

For many years innovation has been discussed only under the view of agriculture, as a sector disconnected from the other economic ones. There is a gain of insight when we adopt the systemic perspective to analyses innovation in agriculture. That is what we will be discussed subsequently.

INNOVATIONS IN AGRO-INDUSTRIAL SYSTEMS.

The analysis of the Agro-industrial Systems (SAGs) has been adopted as a leverage for the study of phenomena about agriculture. Initially proposed in the 60's to explore the connection between agriculture and other sectors, this vision was widened in the 90's to study the organizational role and firm-to-firm contractual arrangements along agro-industrial chains. SAG's representation can be seen in Figure 3.1.

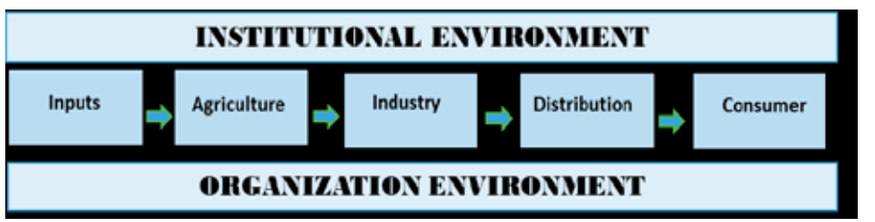


Figure 3.1 Agro-industrial System (SAG) distribution

The interest proposition for this study can be formulated from the original concept behind SAG. Goldberg defines it as the set of interwoven operations among input and equipment industries, agriculture, processing, distribution, up to food, fiber, and final bioenergy consumers. This proposal that emerged at Harvard in the 60's suggests that agriculture can't be studied without considering the other sectors connected to it.

If we apply innovation processes to agriculture, we can generate relevant propositions for understanding the way it works, by the systemic view as follows:

- Innovation can occur in processes as well as in market-oriented products.
- Innovation can happen in the scope of organizational forms that connect producers-processors-distributors to the market, which means the production factors to the final consumers.
- Changes and organizational innovations were neglected for a long time among agriculture experts.
- Innovation that occurs in consumption, food processing industry and equipment industry can induce adjustments to agriculture. In better words, the innovation process is interdependent and simultaneously involves different sectors.
- The ones can cause innovation in farming experimented the input industry, which is adopted by agriculture. This is a passive form of innovation, through which agriculture receives the alternative from the industry.
- Agriculture is funded to innovate utilizing traditional mechanisms, and these allow innovation to be fostered in research centers, and they lean towards growers via a rural extension.
- Alternatively, agriculture also works together with research institutes on co-innovation, through which growers, individually or as a group, interact with research institutions for the generation and dissemination of innovation.

There is an essential local innovation process, which we will address as "micro-innovations" in this study, which occurs within the agricultural activity, and which is influenced by the growers' competence – on their educational level – and which are unappreciated. The changes introduced through new consumption concepts lead the industry to seek or generate innovation that meets such requirements. Growers work day by day working out practice-laden problems and through the exchange of information and experimentation, even if the latter is not supported by scientific methods. The occurrence of this process will be tackled in the case studies that compose this study.

Innovations are interdependent, as aforementioned. For instance, we can cite the use of information technology by bringing information online for consumers or the use of capsules for the preparation of espresso coffee.

The traceability process demands structured connections among growers, processors, and supermarkets, which uncovers the need for technological adaptation throughout the SAG. In the industrial processing phase, the concerns about the balance between scale and the assurance of quality and social and environmental adjustment suggest interconnected control mechanisms that may require technological changes in every step of the way.

THE AGRICULTURE CASE

The agricultural sector, on a large scale, suffers the innovation effects triggered out of its grasp. In many cases, the grower must choose between the options of input packages that are offered to them by the industry. The busier cooperatives and processing industries represent an important selective mechanism for the support of growers in the choice among alternative technological packages. This form of horizontal organization is, by itself, a relevant innovation so that growers can enhance choice efficiency. Likewise, the requirements from demanding industries regarding the quality of agricultural products represent a strong encouragement for potential technological adequacy. More advanced industries, i.e., Illycaffè, offer support to growers in the technical adequacy process as a means to improve the quality of the product.

The least studied process is micro-innovation. The sum of knowledge gained over time, either concentrated on the grower or present in the grower's practice within the property, represent a factor that generates useful knowledge and adds value.

DEVELOPED CASE STUDIES

Innovation is paramount to the survival and advance of modern agro-industrial systems. Either those originated by input sector or those motivated by processing industry, or those arising from the research structure that involves universities and institutes, or even those developed in rural properties.

The innovation process can't be ignored. This the central motivation of this study. Since it maintains close ties with coffee growers, Illycaffè has a unique way of valuing and disseminating what has been produced in the plantation. This action potentially adds value to the relationship with the grower.

This document consists of ten case studies, seven of those on forward-thinking quality coffee producers in South of Minas Gerais, Cerrado Mineiro, Matas de Minas and Espírito Santos regions, two of those on collective actions, one on Educampo Project, one on Origin Denomination of Cerrado Mineiro and an utmost case study focusing on an institution that generates knowledge, the Lavras Federal University. Each case identifies significant learning elements and various aspects of innovation in coffee production.

3.2. Case Study

Fazenda da Serra/Botelhos – South of Minas Gerais

"I yearn to live on the earnings I make from coffee growing. I don't mind if equipment-producing companies come here and copy whatever they want. I'm fine with whoever uses it. For me, acknowledgment is what matters."

Mário Ferrari, forward-thinking coffee grower.

The innovative Mário Ferrari

Amidst the 90's agricultural price deregulation introduced incentives for the production of quality coffee. Some growers faced the challenge of producing specialty coffee. The South of Minas region has well-known soil and climate characteristics that, back then, made it a potential area for distinguished coffee production. At the same time, the stumbling blocks that differentiate South of Minas from the other producing regions in Brazil were recognized. Coffee-growing activity needed innovation to tackle two problems. The first one concerning the predominance of irregular topography that hinders farming practices, especially harvest. The second one concerns labor cost in a region with a high degree of industrialization, such as South of Minas Gerais. These challenges linger until nowadays.

In 1995, a casual meeting caused an effect that would positively impact coffee production costs in the South of Minas. In a regular visit to the Guaxupé Cooperative, Agronomic Engineer Mário Ferrari, a grower from the city of Botelhos, met his friend, Dr. Isaac Ferreira Leite, then President of COOXUPÉ, coffee export. Dr. Isaac was an engineer, and his family bonds led him to the Guaxupé region, where he settled down. In 1995, when he returned from a trip to Italy, he brought a manual stripping machine that was used for harvesting olives. His idea was to

adapt it to coffee harvest, tackling the two mentioned problems, the one of mechanization in rough regions and the one of labor cost. Equipment handling would allow its use in mountainous regions with positive impacts in the harvest operation. Dr. Isaac was an observer and, in Italy, he looked on olive harvest carried out by a small number of workers with the support of manual equipment, whose size would allow one worker to handle it easily.

Figure 3.2.1: "Coffee" (1940) – Cândido Portinari

Source: Acervo digital Projeto Portinar

In the meeting with Agronomic Engineer Mário Ferrari, Dr. Isaac showed him the equipment and pointed out a problem. That tool was not fit for coffee because the plant is more delicate than an olive tree. There should be adaptations. Mário Ferrari liked the challenge and asked:

– Dr. Isaac, may I take the equipment along with me and make some changes to it in my repair shop at the Serra Farm in Botelhos?

Dr. Isaac knew of his longtime friend's ingenuity and dedication. This meeting spawned the adaptation of the coffee stripping machine by Mário Ferrari in his model repair shop situated at the Serra Farm from the Ferrari Family. The equipment was soon named "mãozinha" ("small hand" in English) for featuring a set of shafts on its end, and each shaft is called "finger." This fact marked a long history of micro-innovations made by this grower from South of Minas, most of them focused on the construction, adaptation, and improvement of equipment for coffee production and processing.

History of the property

Mário Ferrari's family came from Italy in the middle of the 19th century and since then has been dedicated to coffee production. Therefore there are four generations of growers: The grandfather – João José Ferrari, the father – Antônio Ferrari Sobrinho, just like Mário Ferrari, were coffee growers. The farm's activities are conducted with the help of Andrea Ferrari and Alberto Ferrari, children of Mário Ferrari and his wife, Sirlei Ferrari. The new generated remains in the activity. Based in the city of Botelhos, the earliest members of the family experienced the entrance of coffee in the South of Minas, coming from Ribeirão Preto. Coffee production in the South of Minas was settled initially in the lowlands of Serra da Mantiqueira region. Over time it embraced new areas, including the city of Botelhos, as can be observed in Table 3.2.1.

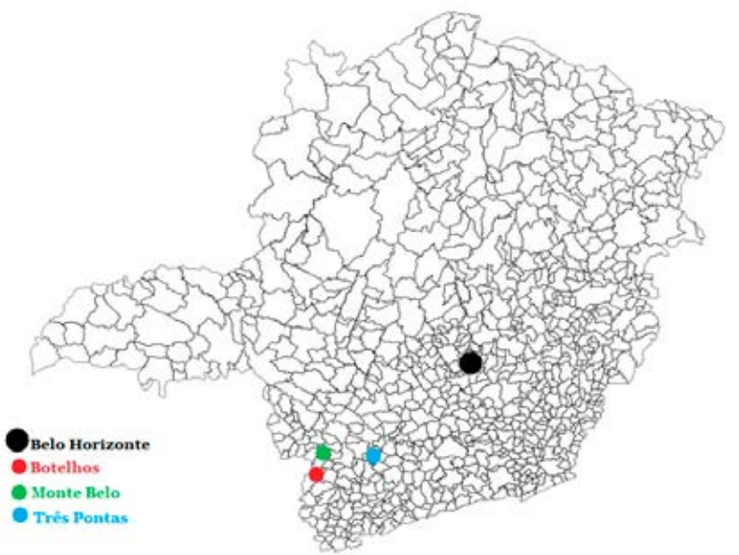


Figure 3.2.2 Map of the region

Table 3.2.1: Coffee Production in the city of Botelhos

Coffee Data in Beans (2014)	Botelhos	Minas Gerais	Brazil
Establishments – over 50 trees of arabica coffee (units)**	577	104.939	199.492
Establishments – over 50 trees of Canephora coffee (units)**	-	8.488	87.350
Arabica Coffee – Amount produced (tons)	8.161	1.346.517	2.012.172
Arabica Coffee – Production Value (a thousand reais)	56.033	9.301.169	12.726.052
Arabica Coffee – Planted area (hectares)	4.690	995.621	1.550.112
Arabica Coffee – Average yield (kg/hec)	1.740	1.352	1.298
Canephora Coffee – Amount produced (tons)	-	17.892	791.898
Canephora Coffee – Production Value (one thousand reais)	-	67.669	2.957.870
Canephora Coffee – Harvested Area (hectars)	-	13.469	452.039
Canephora Coffee – Average Yield (kg/hec)	-	1.328	1.751

****Data available only for the year of 2006, provided by Agricultural Census. Source: Municipal Agricultural Production (2014). IBGE.**

Producer Mário Ferrari carries, in his surname, the suggestive brand that suggests the interest in mechanics. Besides his name, his interest in mechanics made him think of entering Engineering school. The fact is that the course would take him away from production activity on the farm. Since he did not want to leave agriculture, young Mário Ferrari decided to attend the agricultural technical course at the Pinhal School, and then he attended Agronomics at the Machado College. To his practical knowledge about mechanics, Mário Ferrari added his Agronomic Engineer degree, which he later applied in the production activity at the farm. He never stopped accomplishing adaptation and improvement projects of equipment. What drives his actions are the difficulties that he tries to counteract at low cost, and often giving a second life to some equipment part that would otherwise be scrapped.

Agronomic Engineer Mário Ferrari nurtures the interest in problem-solving, which he showcases by focusing exclusively on producing activity and on the details that go unnoticed by conventional wisdom. His major concern is: "What can be improved here?

Coffee production from the Ferrari family is performed in 250 hectares of self-owned lands and little-rented land, which is uncommon in perennial agricultural activities. Production areas are located in the region that comprehends the cities of Botelhos, Caconde e Cabo Verde. Annual production amounts to an average of 10 thousand bags of green coffee and counts on 25-30 permanent employees, which means one for each ten production hectares. The family works directly in production and activity management operations.

For harvest operations, as it demands intense labor use, the family outsources labor, which is hired within the region. To do so, they offer required legal conditions to their workers, who are transported daily back home, avoiding investments in accommodation, which are needed in case employees have to stay in the facilities. Part of the property's topography is slightly rough, with 10 to 15% of slope, allowing for the mechanization of farming practices and the adoption of the mechanical combine harvester in 40% of the total area. The most significant portion of the area tops this declivity level, benefiting from the stripping machine. Soils tend to be deep and feature good original fertility, and the water regime is 1500-1600 mm each year. Rainfall, in typical years, is distributed suitably for coffee demands.

Challenges faced

A 10,000-bag production per year may mean an adequate income in case costs are controlled accordingly. The quality of coffee is susceptible to the compliance of practices and conditions during fruit maturation and, particularly, from the harvest, which implies controlling each post-harvest phase. Thus, drying, storage, and processing operations in appropriate conditions lack special care. The region's rainy season does not always allow for natural dryness, which leads to investments in adequate equipment and the production of pulped coffee. Depending on the crop year, 30% to 40% of production undergo the sun-drying process.

Even though Brazil has an industry specialized in coffee-growing equipment, according to Mário Ferrari, not always are some important details contemplated in product lines. His perspective continually questions which adaptations can be made to improve performance. Thus, either through reused metal scrap, transformed into useful tools, or through the adaptation of line equipment, Mário Ferrari innovative canon is shown.

Figures 3.2.3 and 3.2.4: Photos of the repair workshop

Particularities of the innovations

A regular visit to Fazenda da Serra begins and ends at the repair workshop, where tools can be seen, and they are organized on impeccably conserved wooden counters (see photos above). At the back of the repair workshop, there is a warehouse with spare parts organized on shelves just like books at a well-cataloged library. Nearly aseptic cleaning and well-crafted furniture are worthy of attention, all produced by Mário Ferrari at the carpentry where he works on Sundays. He affirmed:

– The work at the carpentry is my weekend pastime. It is the place where I produce furniture, carts, bodyshells and some equipment like the wooden cells.

Figure 3.2.5. Mr. Mário Ferrari's sawmill

If the plantation is the important area by nature, it can be noticed that the repair workshop holds the innovation heart of the farm, and Mário Ferrari's own heart, given the outstanding care in that place. Family involvement is worthy of attention. Visits are hosted by wife Sirlei and by daughter Andrea, a soon-to-be Agronomic Engineer. During the visit, his son Alberto took care of the coffee combine harvester cleaning which he handles himself because harvest operation in plain areas could be made in advance in that crop year of 2016. Technician Valdeci joined us, and he is a specialist in post-harvest and an experienced entrepreneur. He reported:

– Indeed Mr. Ferrari hardly ever leaves the property, and he does not fly or likes to go to banks, and he does not take Saturdays or Sundays off. Want to see him happy? Leave him a problem to be solved at his repair shop or at his carpentry.

The innovations

Some of the innovations developed by Agronomic Engineer Mário Ferrari are described as follows, less in order to break down on the technical aspects and most likely to draw attention to the pursuit of innovative solutions.

a) The stripping machine case was the first that attracted attention.

According to the grower, the economic result of the equipment adaptation allowed the increase of a worker's income, hitting the jugular vein of the cost issue in the harvest operation. Thus, the primary factor generating costs to highland coffee can be controlled. All over the property's 250 hectares a worker using a stripping machine was able to replace 4 employees during the harvest phase, receiving attractive salaries that suit the market.

Figure 3.2.6: Stripping Machine

According to the model prevailing in the region, each employee is the owner of the stripping machine, which facilitates efficient funding allocation for equipment care. This means that technology supported the continuity of coffee production activity in competitive conditions and generated demand for paid labor and market-range salaries. The alternative would possibly be the migration of coffee-growing operations to other regions.

The stripping machine is made up primarily of a broom, the "mãozinha," with vibrating shafts, or fingers, which is passed through bean-covered coffee branches. Vibration is triggered by a coastal motor that allows for continuous performance with the controlled effort by the operator.

When asked whether there was, at any moment, the interest in requesting a patent derived from the original equipment, which would even be possible in the Brazilian legislation, Mário Ferrari's answer was surprising and was endorsed in the other innovations we got to know. He stated:

– I yearn to live on the earnings I make from coffee growing. I don't mind if equipment-producing companies come here and copy whatever they want. I'm fine with whoever uses it. For me, acknowledgment is what matters.

His mindset suggests that he pioneered the "open innovation" "[2] concept in Brazil.

Innovation circulated rapidly all around the South of Minas producing areas, allowing for the continuity of the activity at competitive costs.

b) The "vassourão" (raking machine) for the patio

The "vassourão" (raking machine) came up between 2009 and 2011 and was developed as a means to rake the coffee in the patio, reducing labor force during the drying process of the coffee, which requires constant movement of the product in order to boost homogeneous dryness. Such continuous movement during sun dryness in an important practice that affects quality. The intended goal is to promote a homogeneous dryness, although labor force is required for the product raking.

2 Open innovation is a term created by Henry Chesbrough (2003) at the University of Berkeley for industries and organizations that promote open ideas, thoughts, processes and research in order to improve the development of their products, provide better services to their customers, increase efficiency and enhance value added. Open innovation is a paradigm that assumes that organizations can and should use internal and external ideas as well as internal and external paths to the market.

Figure 3.2.7: Vassourão

Mário Ferrari reflected upon and developed a 2.20-meter "vassourão" that can be hitched to the tractor. The simple conception equipment worked very well and enabled patio dryness quality standard to be kept homogeneous. The vassourão has a blade that touches the product and can be made of different materials, and it should be replaced as it wears out. The idea spread out, and similar innovations were identified by the same time at Zona da Mata, as related in the Café Point bulletin on 10/26/2009.

Agronomic Engineer Mário Ferrari mentioned how difficult it was for him to talk equipment industry into developing a prototype. Currently, the equipment is available in the market, and there are several types being manufactured by different competitors. Indeed this case demonstrates that the issue of a specific activity perceived by growers triggered efforts in the properties to find a solution. Dissemination was motivated by the interest on the growers' and industry's parts, and market potential for innovation was perceived. Participation from universities and research centers was not mentioned. A simple engine hitched to the fan was conceived by the grower.

c) Coffee Fanning (Abanação do café)

The coffee fanning operation is portrayed by different Brazilian painters, which imparted the image of the worker launching the beans into the air with a sieve. The separation of external elements from the harvest operation precedes

the processing, either for the production of coffee by natural dryness or the production of pulped or natural-pulped coffee.

Figure 3.2.8: Forced fanning coffee

What can be observed in Mário Ferrari's facilities is the simple usage of forced ventilation in the receiving hopper for the coffee that comes straight from the plantation. It consists of a ventilation-based wiping system that removes leaves, clods and several motes, allowing only coffee to get to the drying machine. By viewing the waste disposal besides the aerator, one can notice how efficient the operation is. As for Mário Ferrari's case, the equipment was developed locally.

d) Forced ventilation

The process coffee might imply bean storage at different silos. The grower perceived that bean moisture homogeneity would leverage quality in the final product. Mário Ferrari thought up two improvements. The first one would be keeping the product in automatic circulation as a way to re-feed the drying machine, dispensing labor use. The second one would be a cold air flow injected into the coffee silo, to make the moisture content of the product in storage homogeneous. Equipment for this operation was designed by industry, which turned this activity into everyday practice.

Figure 3.2.9: Aerator

e) A home-made Jeep

Any engines, axes and chassis can be brought to life in the hands of Mário Ferrari. The best example, but not the only one, is the Jeep car made at home, which can go up any slopes safely, cost-efficiently and even in a stylish way. Visitors also offered bids for the uncanny vehicle, but Ferrari won't sell it. Whoever wants it has to copy it, says the grower. The Jeep case illustrates a set of small pieces of equipment made in the facilities, reutilizing machine parts that would eventually be scrapped. Mechanical skills, organization, and inventiveness, endorse micro-innovation potential in a production activity. The sum of all these innovations generates a result that is hard to be measured but seems to be significant.

Figures 3.2.10 and 3.2.11: Jeep. "Old Junk."

MICRO-INOVATION: According to Josh Linkner in an paper published in the journal Forbes on January 18, 2016, most of the progress comes from small creative changings that, together, result in significant impacts. Examples: A new way of conducting a sales meeting, redesigning of the layout from a store, a new way of conducting a press conference, a new way of receiving a customer complaint, the development of a new item in a restaurant menu.

Teachings from the case

The number of small solutions that we could observe is significant. Simple adjustments made to coffee reception, a slightly steep slope in the coffee patio, everything contributes to raise productivity and reduce costs. Whereas other growers resort to equipment companies, Mário Ferrari makes the best of his unique competence to cater to the needs his property has.

The real problems faced by growers in their daily activities propel innovative actions. Intensive labor operations in labor force shortage conditions are the driving axis of Mário Ferrari's actions.

Growers working in the same region may find different solutions to the problems faced. The skills and competencies that each grower brings from their background enable everyone to discover different ways to deal with similar issues. Mário Ferrari has peculiar characteristics that are hardly found in other growers.

We should cast light on two aspects: dedication to work and talent for mechanics. Commitment is represented by the grower's full-time devotion to his property, where he lives and engages in his activities. His leisure time, taken up at his carpentry, is associated with his productivity spirit. Talent for mechanics means a competence standout that pushes small innovations towards cost efficiency. Not having to hire specialized services for mechanical repair, wooden silo construction and production-related repairs all represent a surplus that the entrepreneur rakes in along his activity.

As for the process of innovation generation and dissemination, this case presents us food for thought. In the generation phase, Mário Ferrari did not count on the support from research institutions. Even though a portion of the equipment developed had been enhanced in research centers or by the industry, apparently Mário Ferrari discovered singled-out solutions by himself.

The dissemination of knowledge can be considered peculiar to the focused case. The innovative grower did not lift the barrier for distribution and intended to bear fruits of the potential commercial outcome. He would rather be a "showcase," enjoys welcoming visits and witnessing his ideas attracting curious people. That might be a good example for the debate on the so-called "open innovation."

Some observations can be made when it comes to the future outlook. The profile of the couple's children suggests these youngsters share strong bonds with the agricultural activity. The concerns over youngster dropouts from such activity in search of commitment in other economic activities are real and deserve special attention. Mário Ferrari's wife and children's involvement in the productive activity might point to another direction. In better words, there are challenges in the agricultural activity that demand an entrepreneurial spirit that innovates and views the field from different perspectives. Perhaps this case will encourage us to think up ways to motivate new generations to keep working in the field on the same level of encouragement a big town youngster has. Be income-wise, challenge-wise or in the quest for new horizons for the productive activity.

Finally, this case puts forward the need for studies that focus on the impact of micro-innovation. Those that stem from day-by-day experience, inventiveness, and problem-solving skills. Each one might seem small, but the whole set brings impacts that deserve to be studied properly.

Figure 3.2.12: Coffee in Botelhos

Figure 3.2.13: Patio with coffee and drying machines.

Figure 3.2.14: Coffee in the patio

Figure 3.2.15: Coffee washer

Figure 3.2.16: Scrap metal truck

Figure 3.2.17: Scrap-metal truck

Figure 3.2.18: Home-made transport wagons

3.3 Case Study

Passeio and Lagoa/Monte Belo farms – South of Minas Gerais

"The European buyer wanted a small piece of land with special features. He accepted to pay a price way above the market range. I just happened to understand it later on, when he described his activity to me. He sells roasted coffee beans, covered with a chocolate coating. It is a delicacy."

Adolfo Henrique Vieira Ferreira

Introduction

In the early 1980's the production of highland coffee at altitudes of over 1000 meters in rough lands still represented a controversial issue for many growers. In general, priority was given to low and plain areas. Adolfo Henrique Vieira Ferreira's family grew coffee in the city of Alfenas, in low and flat lands, and had started the commercial activity with the product in 1889, with his great-grandfather, Mathias Vieira. The family, who came from Portugal, represents the fourth generation dedicated to coffee production. In the 70's the family's professional interests revolved around the dentistry and agricultural areas. Dr. Benedito Ferreira became a dentist and Adolfo, his oldest son, following his father's steps, also received a Dentistry degree, and the same career plan was followed by his younger brother. The taste for agriculture lured in the two brothers and dentists, who set themselves to work at the family's farms.

Between 1970 and 1981, repeated episodes of frost in the Alfenas region devastated the coffee production that the family then kept up. Adolfo had concluded his Dentistry school and his father wanted his sons to take over the management of the properties in the city of Alfenas and the Passeio and Lagoa farms, the latter two located in the neighboring town of Monte Belo, in an altitude region of rough topography, where the family maintained dairy farming.

The father yearned to engage in his dental clinic, and the oldest brother saw the potential of the Passeio farm with skepticism. He preferred to keep up with his activity in Alfenas, giving up on coffee production. Adolfo knew very little about highland coffee production and, in the 70's, the product was still affected by government intervention, which regulated prices and discouraged the production of quality coffee. Adolfo was at crossroads with a tricky decision: keep up with his father's career and lead a comfortable life in the city or face the challenge of growing coffee in the Passeio and Lagoa farms. Gradually dentistry gave way to coffee production, and Adolfo developed a unique vision towards the product. His intuition said that there was value to be uncovered in highland coffee production.

History

There are records of coffee commercialization made by Adolfo's great-grandfather in 1889. In 2016, Adolfo and his wife Edilene represent the fourth generation of the family and take over the production conducted in 450 hectares, of which 220 are for coffee. The Lagoa farm, rental property from relatives, was added to the area handled with coffee. Annual production is made up of 10,000 bags of coffee on average. In 1997, Adolfo noticed the Passeio farm's potential to produce coffee with distinct quality features and his intuition was eventually confirmed. The grower sought and couldn't find structured scientific information about the technology to be adopted, therefore much of what he derived from experience, the support from the Guaxupé Cooperative (COOXUPÉ) and the possible assistance of rural extension from EMATER. Along with the increased technical demands from his activity, Adolfo decided to hire a specialized agronomic engineer to kick off the implementation of changes that would lead up to the production of quality coffee. Hence agronomist Guy Carvalho was hired, and he still consults in the property.

In the year of 1998-1999, the Brazilian growers were appointed to comprise the Café Gourmet project, set up by ICO in partnership with BSCA. The goal was to analyze the economic feasibility of producing specialty coffee. Adolfo was among the growers, six from Minas Gerais and four among São Paulo, Espírito Santo, and Paraná, who were selected. The project provided the opportunity for direct networking from growers with international clients, most of them on behalf of small roasters interested in specialty coffee lots. Adolfo gained the confidence to delve into the strategy of specialty coffee production.

Production relied on two factors. The first one is based on the best agronomic practices aiming at cost efficiency. Aware that the cost of highland production was higher than the one of the new producing regions, it was necessary to seek out adequate technology for his very purpose. There was little research material that tackled spacing, stand, varieties, post-harvest practices and much less on the connection between farming practices and beverage quality.

Figure 3.3.1: Farm Overview

Figure 3.3.2: Full Load

The second success factor is focused on the search for price prizes that markets pay for quality coffee. In 1999, Adolfo decided to participate in the first quality contest promoted by Illycaffè, ranking among the top 50 finalists. This prize was a decisive factor for the continuation of the specialty coffee production since Illy was one of the few companies that valued and awarded quality coffee.

COFFEE WITH CHOCOLATE In a meeting with an European importer, Adolfo managed to negotiate an award of fifty points above New York markets. It was a very high value for that time, although the quantity was small. When he asked what use would be made of the coffee, Adolfo noticed the answer inside a well-crafted packing. The delicacy was beans of roasted coffee beans covered with a chocolate coating. Hence the prices that the important accepted to pay. It was the kind of client he was looking for.

The grower's regular participation in international events drew him closer to buyers and interest was revved up on both parts. Specialized traders began to visit the facilities, where he looked on selective harvest practice as well as special cares for dryness and preparation of the coffee lots.

Figures 3.3.3 Suspended dryness

Description of the property and the challenges faced

The Monte Belo region features a rough topography and average altitude of 1,100 meters. Soils are not deep, and erosion can be a problem in case handling measures are not adopted. The water regime is of 1,600 mm rainfall each year, with a dry season that does not expose production to jeopardy.

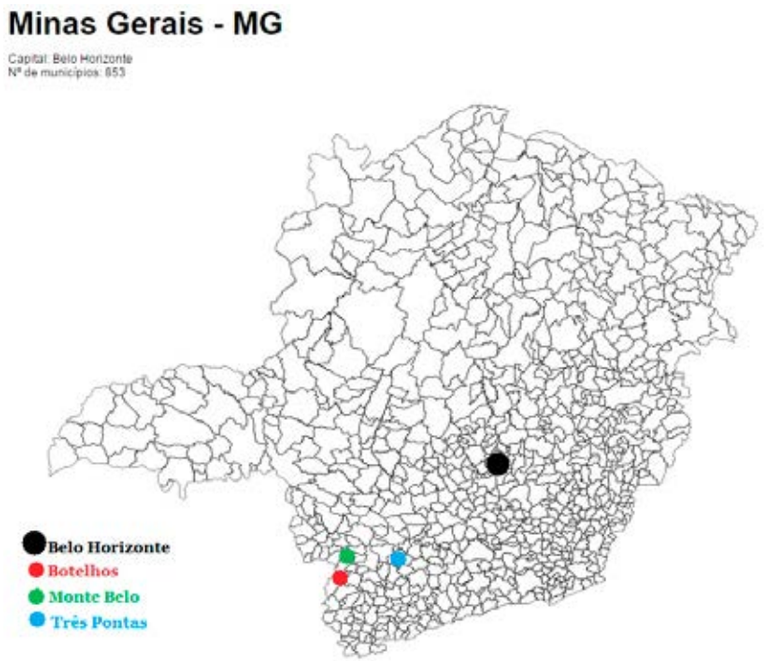


Figure 3.3.4: Map of the region

Table 3.3.1: Coffee Production in the city of Monte Belo

Coffee Data in Beans (2014)	Monte Belo	Minas Gerais	Brazil
Establishments – over 50 feet of Arabica Coffee (units)**	896	104.939	199.492
Establishments – over 50 feet of Canephora coffee (units)**	-	8.488	87.350
Arabica Coffee – Amount produced (tons)	5.492	1.346.517	2.012.172
Arabica Coffee – Production Value (a thousand reais)	38.533	9.301.169	12.726.052
Arabica Coffee – Planted area (hectars)	3.980	995.621	1.550.112
Arabica Coffee – Average Yield (kg/hec)	1.380	1.352	1.298

Canephora Coffee – Amount Produced (tons)	-	17.892	791.898
Canephora Coffee – Production Value (a thousand reais)	-	67.669	2.957.870
Canephora Coffee – Harvested area (hectars)	-	13.469	452.039
Canephora Coffee – Average Yield (kg/hec)	-	1.328	1.751

**** Data available only for the year of 2006 provided by Agricultural Census. Source: Municipal Agricultural Production (2014)**

The production migration to the city of Monte Belo was faced with two starting challenges. The first one, demonstrated by high production cost, when compared with coffee grown in plain areas. The second challenge emerged with the absence of technical information about spacing, varieties and fair farming practices to the region. Over time the grower was supported by specialized consultants like Guy Carvalho and practiced his scientific curiosity by testing new genetic material and farming practices. The cost effects were equated, obtaining a 30% reduction in fertilization costs, maintaining a "green roof" on the soil (preventing it from exposure) and adopting special care in each compartment. Costs were equated with the use of the manual stripping machine. The grower states that off-season costs do not differ from the one observed among large-scale growers from cerrado.

Innovation, dissemination, co-innovation

The leap between production and market represents a well-known challenge to the Brazilian agribusiness. Its leaders write about it, criticizing the lack of aggressiveness to penetrate other markets worldwide, especially with branded products. There is certain self-indulgence from Brazilian agricultural growers when it comes to commodity production. That is precisely what Adolfo sought to tackle to set new targets:

1. Proactive involvement with specialty coffee entities. The Brazilian Specialty Coffee Association was a vital venture Adolfo did not take part in. In 2001 he was accepted as a member and began to work diligently in international trade fairs in the United States, Japan, Korea and China. In December 2015 he takes over the presidency of BSCA and brought the entity closer to the initiatives from Export Promotion Agency – APEX, and also entered partnerships with SEBRAE and the Agriculture Ministry – MAPA. The growers' physical presence in the market creates an extra personality for the quality product, working as a brand. One of the tangible outcomes of this initiative was the production of coffee by a roaster from Japan, and it features the grower's picture printed on the packing.

2. Co-innovation: Together with the cellulose-paper and packing company Klabin and counting on a partnership with BSCA and Lavras Federal University, he explored the introduction of new paper packings for small lots. Traditional solutions were not necessarily useful for high-quality products with limited production scales. In some cases, clients demand micro-lots whose packing just did not exist in the market. This joint venture with Klabin led up to a value-adding partnership, once it opened the market for differentiated packing designs. The project led to the production of 5, 10, 20 and 30 kg packings, creating alternatives for distinguished producers.

3. Long-term contracts with buyers: Transactions effected in traditional chains are different from those made in specialized ones. The adoption of trading contracts is not a typical practice among coffee growers and prevails in annual crops. Adolfo realized that it could be leveraged to sign contracts that outline quality, quantity and price features to be practiced upon delivery. Many growers believe that such practice sets boundaries to the margins in the event of market price markups. Adolfo is not concerned about potential price fluctuations since he thinks that his buyers to pay the price above the market range, which means that, regardless of the fluctuation extent, he will already have assured an income that provides him with the intended profit to keep up in the activity. Even if he could receive a little more without the contracts, he prefers to be secure, avoiding shrinking fluctuations.

4. High-demanding buyers such as Illycaffè and small Japanese roasters represent a challenge that Adolfo learned to face, and so he became a long-standing supplier to these markets. As for Japan's case, the grower reports his long-term commitment with Tokio's Café Paulista, as well as with Illycaffè. Social, environmental and technical demands of these markets make the grower qualifiable to supply to any buyers globally.

Certification and residue level cares led to the adoption of distinguished practices that affect the choice of adopted technologies, as in the case of the significant reduction of herbicide use. In the current handling, Adolfo spends 70% less than he used to in the past, once the past 3 annual applications were cut down to a single application, performed on the pre-harvest basis. The limitations of adopted residue levels in the end market demand attendance and continued moni-

toring on the growers' part, particularly of molecules for which there are no fixed technical limits, cases that adopt narrower safety limits.

5. Lot preparation cares: The grower's activity in the search for niche markets led to the development of specialized knowledge in the facility. The preparation of lots with special destination should meet the requirements from each client. Thus, Adolfo innovated with a set of small inventions, as exemplified by suspended coffee dryness in greenhouses. The product without contact with the soil and no rain exposure leads to a homogeneous dryness and prevents from fermentation. The grower was inspired by cocoa bean dryness in high rainfall rate regions of Zona da Mata in Bahia and also drew inspiration from the practice observed in African countries. This practice is widely used by specialty coffee growers, as can be found at Jatobá farm, which composes this set of case studies.

Characteristics of the innovation process

The case observed at Passeio and Lagoa farms demonstrate that innovation goes beyond the traditional mindset associated with production technology. Innovation is present potentially throughout the supply chain, which includes the trading processes (contracts), transportation and logistics (packing) and the preparation of micro-lots. Notably, the profile of the examined grower suggests the distinction between the product and its association with his name. That means exactly the same process that a big company adopts to create and strengthen a brand.

When it comes to the innovation process, this study suggests that the grower utilizes a continual search for the best agronomic practices, with special attention to those that go beyond productivity factors. The association of technological details with beverage quality still stands as a gap in the study, to which the grower needs to attend to. Co-innovation is present in the case of packages, which involved from the industry in niche markets.

Knowledge and innovation dissemination occurs by means of export-centered collective actions. Adolfo perceives the relevance of the association of specialty coffee growers. The exchange of knowledge can deliver real benefits to everybody. The more good growers, the better.

Teachings from the case

The study on the Passeio and Lagoa farms brings a wide range of relevant information for the coffee chain as well as for other agricultural products with differentiation potential for quality. We will point out some of the information below.

Agricultural research has challenges to be faced, and they resonate with the growers. The search for quality-differentiated products requires proactivity from universities and research centers, especially in the pioneering phase, as occurred with highland coffee. The factors associated with the production of quality features deserve a commitment from researchers and research programs.

Studies on business models are essential as long as the market drifts towards putting an end to commodities. Thus, the topics contracts, interpersonal relationships, and collective associations gain prominence when it comes to the production of specialty coffee. There is groundbreaking innovation in the design and experimentation of new organizational arrangements, perpetrated by many actors.

Innovation occurs either in big corporations or small growers. Long-term outcomes may surprise, showing that some deficiencies can be equated or compensated.

The proactivity of the forward-thinking grower is a characteristic associated with his success. There is an important challenge because, besides catering to the productive activity, the entrepreneur begins to take over new functions that exceed the farm gates.

The starting effort from grower Adolfo Henrique Vieira Ferreira with his involvement with Gourmet Coffee Project in 1998, which focused on the export potential of 10 Brazilian properties, yielded good results. Since it was considered the best result out of 10 properties that participated in the project, he noticed the potential of the effort of producing specialty coffee. The perception that it could be cost-efficient was endorsed by the result of the quality contest by Illycaffè. By that time the grower noticed the relevance of the specialization in the production of micro-lots, which are called nano-lots by some, and the direct connection with international roasters. In better words, after catering to production details and the lessons from the post-harvest practices, Adolfo perceived the importance of looking at the final market, overcoming one of the known challenges in the Brazilian agriculture, which is the distance from such markets.

At last, it is worth observing that the knowledge generated within the property can be utilized commercially, which is the case of sales of lot preparation services. The grower uses potential idle capacity to provide services to other growers.

Figure 3.3.5: Patio preparation

Figure 3.3.6: Patio preparation

Figure 3.3.7: Operators with stripping machines

3.4 Case Study

Caxambu Farm/ Três Pontas – South of Minas Gerais

Music in the wooden warehouse: The coffee buyer, a German man who is the owner of a roasting company, entered the wooden warehouse, listened to the ambient music and the following explanation from Ucha:

– The coffee bean goes through a process that involves stress. A bean is a living being whose biology is under construction and undergoes several operations during production. It needs and deserves a resting period before going forward to the market. So we provide moments of peace and harmony. Our coffee rests by listening to classical music.

Surprised, the buyer looked at Ucha and asked to stay alone for a while in that environment. After some time, the grower came in and ran into the man sitting on the floor, filled up with emotion. He never stopped buying the Caxambu Farm product.

In Ucha's words

– The coffee flavor is a sensorial feature that adds up to other aesthetic attributes that can be explored to add value. Hence, working on quality within a holistic outlook is a groundbreaking vision that belongs in our model. That is why we have music in the wooden cell.

Aside from this practice, the Caxambu Farm showcases a series of innovations with two central focuses. The first one is the relationship with collaborators and with the neighboring community. The second one is the concern about innovation in coffee processing. The Caxambu farm's case suggests that innovations can overextend the technical processes and focus on non-agricultural phases of the supply chain as well as organizational aspects.

A HOLITIC VIEW concerns the integrated development of the human being in his/her different dimentions, which include: physical, emotional, mental and spiritual.

Brief history

At two neighboring farms, Caxambu and Aracaçu, Chaves de Brito family has been growing coffee for three generations. The proximity to the city of Três Pontas-MG allows three siblings to live in the city, utilizing the former farmhouse as a point of support, as well as for welcoming clients and visitors. There are five siblings in total, out of whom three work in coffee production. Out of the three siblings, two are women, Carmem Lúcia Chaves de Brito, who everybody calls Ucha, and Denise. They work side by side with brother Nando at the farms that account for 384 hectares, of which 210 are dedicated to coffee. Located in the city of Três Pontas in the south of Minas Gerais, they have been growing coffee for over a century. Coffee is the city's core activity, dominating the landscape, generating income and fostering local commerce.

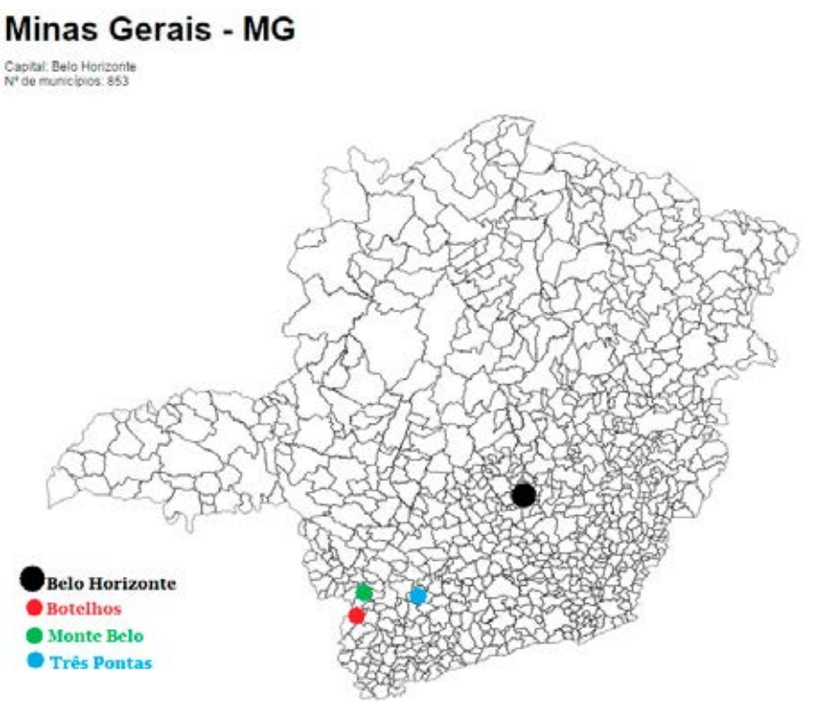


Figure 3.4.1: Map of the region

Table 3.4.1: Coffee Production in the city of Três Pontas

Coffee Data in Beans (2014)	Três Pontas	Minas Gerais	Brazil
Establishments – over 50 feet of Arabica Coffee (units)**	939	104.939	199.492
Establishments – over 50 feet of Canephora coffee (units)**	-	8.488	87.350
Arabica Coffee – Amount produced (tons)	18.440	1.346.517	2.012.172
Arabica Coffee – Production Value (a thousand reais)	129.080	9.301.169	12.726.052
Arabica Coffee – Planted area (hectars)	18.000	995.621	1.550.112
Arabica Coffee – Average Yield (kg/hec)	1.024	1.352	1.298
Canephora Coffee – Amount Produced (tons)	-	17.892	791.898
Canephora Coffee – Production Value (a thousand reais)	-	67.669	2.957.870
Canephora Coffee – Harvested area (hectars)	-	13.469	452.039
Canephora Coffee – Average Yield (kg/hec)	-	1.328	1.751

**** Data available only for the year of 2006 provided by Agricultural Census. Source: Municipal Agricultural Production (2014). IBGE**

The Chaves de Brito family descends from the Spanish and the Portuguese and is in the third generation of coffee production and the three siblings perform complementary activities. Their parents' passing motivated them to make a decision about the management of the activities. The situation created the risk of property division, as can be observed in similar situations, which would jeopardize the continuity of the business. Ucha decided to leave his professional activities in Psychology and Physical Education and began to work with coffee. Her brother Nando was already undertaken to the production routine at the property and sister Denise began to support the company's Executive Secretariat, which is responsible for welcoming visitors and public relations. The family, supported by family succession plan, took over the farm management in 2007, as a way to prevent from the dissolution of the property and the fateful discontinuity of the production.

The city of Três Pontas produces between 600 and 700 thousand bags of coffee each year. The topography is moderately rough, allowing for mechanical harvest of part of the production. Soils are well-weathered, deep and the average annual rainfall is of 1,800mm, not suggesting the presence of water deficit that jeopardizes coffee production, unless in unusual crop years.

Description of the challenges faced

Coffee activity in Sul de Minas, mainly in small properties, suffers from cost pressure. Unable to benefit from scale economies as it occurs in the Cerrado region, one of the possibilities is the search for margins through the production of specialty coffee. Adding value relies on the positioning in privileged trading channels and on the gradual improvement of quality standards, all connected to strict production cost-efficiency.

The institutional environment, that is to say, the laws the regulations of the sector, particularly the Brazilian labor and landholding laws, do not foster the initiative of having workers living in the properties. Thus, what can be observed in the region is the hiring of temporary workers during busier phases of labor use, mainly the harvest. Such condition created organizational needs for adapting to harsh legal criteria and requirements of working conditions offered to temporary workers. In the general run, Brazilian agricultural growers do not have workers living in their properties, and they invested in improvements required by the labor legislation.

The Chaves de Brito family decided to follow the reverse path by keeping residing workers in the property. Ucha sought in her psychology degree a groundbreaking management model focused on worker appreciation and on maintaining families residing on the farm. Production calls for 40 employees who come from residing and non-residing families.

Ucha explains that it is not only about keeping part of the employees as property residents, but basically, the idea is to keep workers involved in the decision-making processes, departing from the discourse to the practice of participative management. The model is deep-rooted and was demonstrated through the maintenance of 17 houses for workers' families, who work in an environment that encourages the involvement in production activities.

The "Lolita de Brito Dias' model school" (Escola modelo) was managed by the family and offered quality educational support to children in general, workers' children and to the families of the surrounding communities. The structure of the school reflected the participative model, with the involvement of mothers in the educational activities. For some years the workers' families were assured while children received an excellent education. This scenario changed, as we will explore thereafter.

Women empowerment work and the involvement in the "model school" exposed Ucha's profile in the entities that seek the empowerment of the gender. She played an important role in the fulfillment of the Brazilian chapter of IWCA (International World Coffee Women). Ucha found new perspectives of working and established relationships with SEBRAE. The grower preferred not to keep within the feminist speech, but otherwise to work in the women's strengthening and qualification as social agents, providing them with tools to generate income and, at the same time, keep up the educator's role, dealing with children. As

part of a personal project, Ucha valued female activities in the local society. The grower states:

– *Women will not gain positions merely for the sake of being women.*

Ucha is supportive of the importance of a female viewpoint in the production, which can be unique as a means to generate an empathetic and involving workplace for employees in general.

The lingering challenge was to keep labor force within the property as part of the strategy aimed at the production of quality coffee. It would be necessary to assure to keep the production and post-harvest processes along the lines of the best agronomic and embark on the road of differentiation. Quality was year after year, proven by the industry's demand, that requires coffee or higher quality standards, through the influence from specialty coffee grower associations and, particularly, through the interest shown by international buyers, who visit the facilities every year in order to purchase specialty coffee lots.

Challenges are everywhere. The adopted social model was strongly affected by the State politics of closing down rural schools, concentrating education in urban institutions. The new rule has its reasons, although same treatment adopted for different situations affected the Chaves de Brito family's project. The closing of the "Escola Modelo" was inevitable, in spite of the efforts closely with the Public Ministry and the city hall. Everybody agreed that the "Lolita de Brito Dias" school was different from the others, but had to be closed down. And so it was done, which directly impacted the ruling model at Caxambu farm, reflected upon the decrease of property residents from 17 to 11. Ucha states:

– Mothers who want to be close to their children did not approve of the quality of the transport offered by the city hall. Little by little some families moved to the big city.

INNOVATION, DISSEMINATION, AND CO-INNOVATION

The innovations observed in the case of Chaves de Brito family are focuses on two mentioned priorities: adding value via a human relationship with emphasis given to gender and aesthetic, social aspects as well as product differentiation with eyes riveted on interest attributes on the part of industrial processing companies. Such approach can only be successful if production activity, covering crop, post-harvest, and the first product processing is conducted within the best existing practices, aiming at the production of quality coffee.

A **sigla BAP** designates the concept of best agronomic practices. The phrase Best Agronomic Practices originated the abbreviation.

With regards to farming practices, the property counts on Guy Carvalho's tech support and constant attendance in activities promoted the rural extension service, always looking forward to the adoption of the best-known practices. The structure of coffee preparation is modern and has high-end equipment offered in the market by specialized companies. The land design and the location of facilities denote the former occupation that was revamped over time. The following elements were considered innovation indicators:

Figures 3.4.2. and 3.4.3: Receivement and processing structures

Germplasm collection: This activity is aimed at testing the agronomic performance of different coffee cultivars in local conditions. The concern about productivity, resistance to pest and response to fertilization extends to the cup by means of cup tasting tests.

Relationships with Universities: The grower pointed to a close relationship with Lavras Federal University and Paraná Federal University, which, by itself, suggests a co-innovation model, distinguished from the traditional one through which a research center innovates, the technical assistance transfers and the grower adopts. In the observed case, production goes hand in hand with research.

Ucha has a critical view of traditional research programs. She turns her attention to the known institutes and research programs, and also to the resistance attributes and phytopathological problems and physical productivity. According to Ucha, such emphasis, though necessary, is not enough to modernize the tra-

ditional coffee production, shying away from the issue of product quality aimed at the final consumer of the supply chain. Ucha postulates that conventional research programs focus on the reality of commodity coffee growers and refrain from conducting support research for specialty coffee growers. Such bias is not limited to coffee research, and it deserves attentive discussion in research programs on agriculture.

Seeking out new beverages: It is common to fathom that the observed innovations within the agricultural property are focused on the productive agronomic process. This view is challenged by the Chaves de Brito family, which can be observed in the activity developed in the small laboratory for the development of differentiating beverage processes through changes made to the bean processing. The generation of innovation, in this case, may draw attention from the roasting industry.

Figures 3.4.4, 3.4.5 and 3.4.6: The laboratory. José Carlos in the laboratory. Samples of processed coffee.

Encouraged by Prof. Flavio Boren from the Federal University of Lavras, a specialist in post-harvest and quality, and by researchers from Paraná Federal University working in the fermentation area, this line of innovation led to the installation of a laboratory where one seeks to experiment on different fermentation processes and cup tasting. The bean goes through different treatments before moving on to the roasting phase, giving rise to distinguished beverages bearing special names like "cervejinha" (small beer), to call the referred product on the basis of yeasts. The activity has been developed on the bench level at the farm and nods to an interest in the processing, roasting and production phases for coffee distinguished by fermentation processing, but not only that. The relationship with the university brings about immediate implications, like the attendance of internship students and the hiring of a technician specialized in processing, dedicated to the differentiation work.

Agronomic Engineer José Carlos Fante Neto leads this activity, and he has been trained for sensorial perception and knowledge about bench research and strives to seek out novelties. He is the one who set up the tasting session whimsically, showcasing thorough involvement with the concept proposed by the family.

The findings obtained motivated entrepreneurs to start thinking about the issue of intellectual property rights with possible patenting of the processes. Such fact suggests an important step towards the opening of new paths for the activity, treading the route of the supply chain towards product processing.

The gender issue receives special attention on the basis of Ucha's profile. The productivity-focused male view, where technology is concerned, and the female view, where aesthetics, beauty, and ethics are treated in a complementary fashion. Ucha worked with HR management companies for many years and combined experience with an aesthetic view. The grower considers coffee consumption a sensorial experience that encompasses ethical and artistic elements. Thus, these dimensions resonate with the product profile that remounts to the particular concept of wine production and is in line with the idea defended by global leaders in coffee quality, which is the case of Illycaffè. Ucha knows that information on the hardships and demands for the obtention of high-quality beverages must be forwarded to the consumer.

The relationship with the innovation factor: Ucha prioritizes local employees and admits that there are simple solutions that they are able to work out. She states:

"Knowledge comes from the university and research, and its completed by the wisdom that comes from the employee";

People management enabled the enhancement of coffee harvest activities, which are mostly carried out by women, and Ucha maintains that such actions are the most closely aligned ones to operational needs.

Innovation characteristics

Innovation stemming from the enterprise-university relationship has its own characteristics. The first one suggests the pioneer spirit of the forward-thinking agent who has immediate access to innovation. Even though the latter is bound to spread out, the forward-thinking agent takes advantage for pioneering it. The second one relates to the indirect effects of working closely with research cen-

ters that raise the probability of access to relevant information for the solution of problems encountered in the daily activity. The third characteristic sits upon the possibility of generating knowledge prone to the protection of property rights. Unlike a one-off impact, co-innovation creates dynamic effects that turn up over time.

Besides being concerned about research, the Chaves de Brito family works in the exchange of knowledge, adding opportunities to the relationship with other growers. An example is the organization of post-harvest courses in the Caxambu farm facilities.

The attendance from university interns in post-harvest processing projects generates a multiplying effect. Young professionals identify the concept of quality and learn about elements that will be passed on to their professional careers. In a very remarkable way during the fulfillment of this study, a female intern, an Agronomy student, worked in the laboratory under the coordination from Engineer Agronomic José Carlos Fante Neto, specialized with organoleptic and processing evaluations, kicking off work with non-traditional fermentation and processes.

Teachings from the case

Activities carried out by the Chaves de Brito family at Caxambu, and Aracaçu farms point to innovative characteristics that give rise to future possibilities. The first of those reinforces the competitive possibility of coffee-growing medium scale, whenever the grower can add value associated with quality traits. This perception collides with many studies that point the other way around, focusing only on scale gains.

The second characteristic observed is the search for shared control models of agricultural activity that allows for the active participation of employees, as well as the continuity of the company in the event of succession, preventing from the dissolution of properties, as frequently observed. The family counteracted on the generation succession problem, which enabled the opening of new perspectives for the company.

The third characteristic observed shows the concern about the adoption of state of the art in production technology and the search for different paths for the product, as exemplified by the beginning of the coffee processing activity. It opens the way to advances towards intellectual property rights, technology licensing and the potential synergistic diversification of activities by entering partnerships with processing companies, always rooted in coffee.

Finally, actions on social and gender areas and the product concept with quality features that go beyond conventional wisdom align the activity with more advanced market trends, which can pay for quality traits associated with the ethical product and aesthetic values. It's no wonder the German buyer comes back every year to listen to the "music in the wooden cell."

Annexes – Figures

Figure 3.4.7: Coffee plantation view

Figure 3.4.8: Drying machines

Figure 3.4.9: Processing Center

Figure 3.4.10: Brazil and Coffee

3.5 Case Study

São Paulo Farm/Patrocínio – Cerrado de Minas Gerais

"Well, if it works for soybeans, why wouldn't it work for coffee?"

Marcelo Montanari

Marcelo Montanari graduated in Agronomic Engineering from the Federal University of Lavras, a traditional school in academic teaching, extension and, coffee research in Minas Gerais. He began his career working with soybeans and corn in the cerrado Mineiro. That differed a little from the centenary tradition of his family with coffee plantation. But Marcelo hardly knew this passage through great crops would flare up his curiosity about grass management.

BUSH (UNDERGROWTH) Very often does bush also receives the name of "invasive herbs" or "competitor herbs", or "weed". In some cases, depending on the approach, it is called "companion herbs".

The interaction of soya roots and its rhizobium with the soil, nitrogen fixation through symbiosis, that organic matter mass and nutrients lying on the ground, in addition to the remains from the previous surface crop, all drew Marcelo's attention, who pondered:

– Why not do that with the coffee plantation? I know there won't be nitrogen fixation, but there can be other advantages."

The São Paulo, farm, in Patrocínio, 75 hectares of coffee-planted area, which is the object of this study, is one of the three farms from the Montanari Group, belonging to the family, which includes Rainha da Paz and Montanari farms.

Agronomic Engineer Marcelo Montanari is the current executive manager, representing the fourth generation of growers in his family. In spite of the coffee production tradition coming from many years of dedication, the new Montanari generation introduced distinguishing traits in the group, such as:

- Strict cost-efficiency;
- Intensive mechanization for reducing costs:
- direct export of over 90% of production through contracts with clients:
- clients from several countries and continents worldwide;
- production of custom-made coffee to the client;
- inclusion of "third wave" coffee[3];
- Adoption of innovative technologies like grass management and bio-activators;
- Participation in the program Educampo-Sebrae[4] along with 17 growers.

Through this stream of actions, the innovative canon of the group is observed, and more innovations will be mentioned subsequently.

Centenary history in coffee

Since Ferdinando Montanari, Marcelo's great-grandfather, originating from the Rimini province in the 19th century, and settling down in the Zona da Matas de Minas in a property between Ubá and Cataguases, the Montanari family's history began, always tied with the coffee crop.

The family has been involved with coffee for 110 years. From the example of many immigrants who could not adjust to the new world, Ferdinando Montanari went back to Italy. When he arrived in Europe, he found his parents facing a world conflagration that made him frightened and shocked.

It was the First World War, from 1914 to 1918, in which Italy participated alongside the allied armies against Prussia and the Austrian-Hungarian Empire.

3 THIRD-WAVE COFFEE is a movement that seeks the production of high quality cofee, considering coffee a handicraft element, such as wine, and not a large-scale product. This involves improvements in all coffee-related, from the plant to the cup. agribusiness segments, passing through closer relations among growers, traders and roasters. Analogically to small beer breweries, the movement might give rise to micro-roasters, and in fact these are beginning to thrive. The aim of the third wave is to make the most of the coffee flavor subtleties, its varieties, producing regions (terroir-DO) in the same way as it's done in other food specialties. Guimarães,E.R. – Terceira Onda do Café: Base Conceitual e Aplicações.

4 The Educampo Program is the theme of case study Educampo/Manuaçu – Matas de Minas Gerais, chapter 3.9.

Insecure about wartime and uncertainty, undoubtedly way worse than the environment of the new world, he ended up returning to Brazil definitively.

This time around he settled down in the south of Minas Gerais, in the city of Ouro Fino, where he lived for decades. In 1950, his son João Batista followed the coffee march, heading for the north of Paraná, in the Apucarana region. By that time great inflows of farmers were lured to "purple" earth and its legendary fertility. In the 1980's, overwhelmed by constant frost that devastated plantations in the states of Paraná and São Paulo, João Batista migrates once more.

This time, along with his three children, he made his way to the Cerrado Mineiro, where they live until today. Significant inflows of growers from Paraná and São Paulo migrated to that region in the Cerrado Mineiro seeking greater safety against frost-inflicted losses. The enormous black frost of 1975 had left deep scars on the growers.

Today Montanari group has Mr. João Batista Montanari as president. His three children take over three specific areas. Marcelo, due to his Agronomy degree, takes care of the execution of the activities in the facilities. Roger, Dental Practitioner, who has a way of dealing with people, caters to people management, and Patrícia, because of her academic background, is responsible for the financial management.

Having worked as an agronomic engineer at the beginning of his career, specifically with soybeans and corn productions, Marcelo learned a lot about biomass formation in the soy crops, propelled by the direct plantation in the remains from other crops. The process of rhyzobium nodulation in the soybean roots provided the fixation of nitrogen from the atmosphere, as well as other benefits for the soil, conditioning it physically and improving it biologically. This coverage, as commented by Marcelo, provided every year, not only volume increases of organic matter, nutrients and microorganisms, but also of water, precious elements and scarce in the cerrados at times. Even though he knew that coffee could not promote the nodulation process in the leguminous plants, he began to think up a way to dock biomass for coffee crops. After reading the similar findings from research on coffee-originated carbon emissions, which handicapped the Cerrado region in comparison to the other regions from Minas Gerais, Marcelo felt challenged as a technician and undertook the creation of a handling system that could dock organic matter, nutrients and trap carbon, all at once. In his view, carbon trapping would prove to be socio-environmental and economic leverage for the coffee produced there.

Along with those concerns, another problem that aroused concern was the issue of what to produce. He needed to change the direction of his firm. In his words:

"If I were to produce standardized coffee, my product would resemble the one from the others and would have no protection... I would be left to the market prices operated for common coffee. I needed to stand out."

Hence the option for the production of high-quality specialty coffee.

He was able to produce more and better by means of a well-structured program, departing from the traditional mindset and standing out in the market. Side by side with management, Marcelo began to give a lot of thought to other innovative aspects of his production.

Always innovating

Up until some years ago, there was a conception that the competed with coffee and, therefore, should always be eliminated from plantations. That mindset derived from research that showed that the was a plant community with fast overgrowing, proliferation, water and nutrient retention capacities, making it a great competitor. Negative interference on crops was then proven. Lacking any control, those intruders may really cause damages to the coffee crop, leading it to degradation. Thus, the practice of keeping the plantation clean was usual, either on the line or interline. The pattern of farming practices occurred through operations of mechanical pruning, either manual or chemical.

Recently the handling technique has emerged as an alternative to grass mowing. Through such handling system, the plantation line is always kept clean and without live, but always covered with a haystack, and the interline is maintained -covered. According to some technicians, the more the better and the more diversified the number of species that compose that , the better too. The general idea is to keep the soil interline covered and return, to the plantation line, the haystack that will be transformed into organic matter. Mineralization will occur and make water and nutrients available.

As stated by specialists and skilled people, the advantages of handling are many:

- In the plantation lines, germ proliferation and the development of plants competing with coffee are prevented.
- With soil coverage comes a significant decrease in soil temperature and its stabilization, providing a more auspicious environment for coffee radicles (structures that absorb nutrients).
- The level of organic matter in the soil is raised and, this way, improvements to the physical characteristics of the soils are made, such as drainage, structure, porosity and also chemical characteristics such as fertility, nutrient retention, and recycling, increasing nutrient trapping.
- Due to the improvement of physical conditions of the soil by means of organic matter, the edaphic environment promotes the increment of fauna in the soil, enhancing its biological conditions.
- Erosion is decreased and soil loss is deriving from it.
- Water trapping in the soil increases as a result of superficial evaporation reduction and of the water trapping promoted by the green matter from the .

(Ronca, P.P.de Faria,2007; Fernandes A.L.T.; Santinato R.; Silva R.O. ;Teixeira A.N. Estudo da viabilidade da viabilidade de disponibilização de potássio e fósforo em solos do cerrado com a utilização de penergetic em 6 safras-2012)

Handling plays the important role of saving irrigation water and generating organic matter, also making the radicular system of the coffee to source, from the soil, the nutrients that are then made available. Bioactivators are utilized, working as propellers for the existing microbiology in the soil. These are products that contribute to the balance of the crops, aimed for soil microorganisms. Among the organisms that have their performance favored by soil, bioactivators is the mycorrhiza, a fungus that thrives on the roots and is responsible for up to 80% of mineral salt and water conveyance to plants.

As for biostimulants, they assist in additional energy supply to the plant so that it can produce photosynthesis. Through stimulus to a larger quantity of photosynthesis completions, the plants obtain more leaves and, consequently, can lead up to a better yield.

The Montanari method for grass manegement

Seeking the goal of being practical and making his methodology available for the coffee community, the following questions were simulated, considering a grower is visiting São Paulo Farm:

1) When is grass mowing conducted?
In the rainy seasons.

2) How is the mowing performed on the streets?
Mowing is interleaved on the streets, that is to say, that one street is mowed and the next isn't, and the goal is to control erosion and keep a haven for the fauna.

3) How many times a year is the grass mowed?

There are three mowing operations, not allowing implements like the brush or shearer to touch the ground.

4) What's the undergrowth level for mowing?

The grass is mowed when it is at the chest height and when most species already have viable seeds (that is the timing for handling). The goal is to promote a wider range of plant species.

5) What's the undergrowth level after mowing?

It is mowed down to a 5cm height from the soil.

6) What is made of the after the mowing process?

The must be left on the soil so that a plant biomass layer can be formed on the soil.

7) How is the and soil property activated?

Bioactivators are applied directly in the "drenched" soil, so microorganisms can be activated and stimulated and will, therefore, act in the soil, in the plant and mainly in the biomass composting.

8) Which are the bioactivators?

There are 2 groups: 1) Enzymatic bioactivators that are applied twice in the soil and twice in the coffee plant; 2) Sugars, amino acids, proteins, seaweed extract (Litotanium and Ascophyllium genders) and organic carbon in 3 applications, performed in October, December, and February, always in a drenched soil. Some experiments start to support these techniques[5].

5 Estudo da viabilidade da viabilidade de disponibilização de potássio e fosforo em solos do cerrado com a utilização de penergetic. Fernandes A.L.T. ;Santinato R. ; Silva R.O.

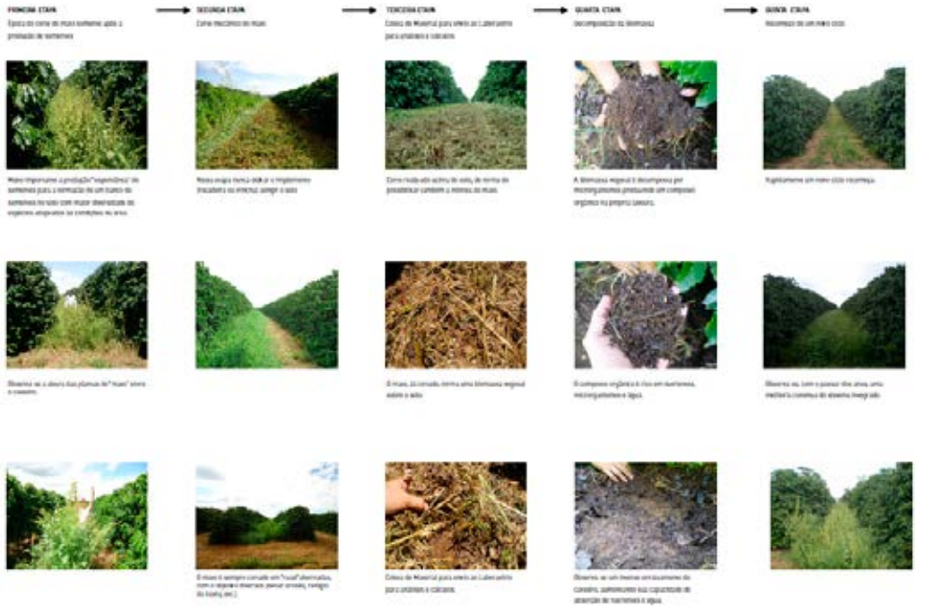


Figure 3.5.1: Phases and cycles of handling

Source: Photos of study done by São Paulo Farm -Grupo Montanari

Initial results (partnerships)

All the handling work is performed with the assistance from a professor from the Agronomic Sciences College from Patrocínio, employing a scientific methodology for that intent, and an undergraduate student attends it as a farm intern, and will take the opportunity to also work on his course conclusion paper.

Marcelo has been recruiting, for more than 6 years, 4 Agronomy undergraduates to accomplish their course conclusion papers on his farm, offering food, transport, and means for the development of coffee-related and common-interest works.

Reduction of limestone and fertilizer use

One of the positive and interesting points of handling and bioactivation is that, aside from soil conditioning, there is a real reduction of limestone and fertilizer use, verified in the laboratory soil analyses.

The reduction between the estimated and the reality was very significant: limestone 11%, nitrogen 43%, phosphorus 54% and potassium 56%.

Tabela 1 - Quantidade Total de Fertilizantes (ano agricola 2015-16)

Nutriente	Orçado (et. al. Santinato)	Realizado	Diferença (Redução)
Calcário	1.132 Kg/ha	1.008 Kg/ha	11%
N	415 Kg/ha	235 Kg/ha	43%
P2O5	74 Kg/ha	34 Kg/ha	54%
K_2O	314 Kg/ha	139 Kg/ha	56%

Gráfico - Quantidade Total de Fertilizantes (ano agricola 2015-16)

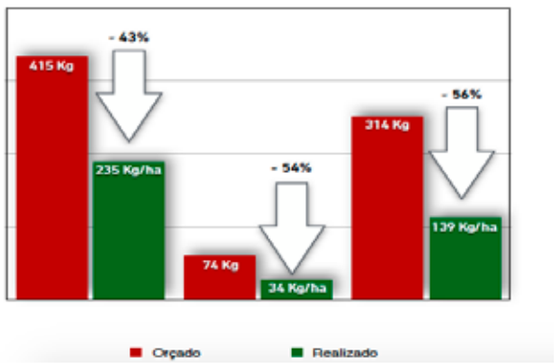


Figure 3.5.2: The reduction in the use of limestone and fertilizers

Source: Photos of a study done by São Paulo Farm -Grupo Montanari

Reduction in the use of pesticides

The reduction in the use of pesticides has a critical dimension at a farm since it implies several positive aspects. The first one to be regarded is the socio-environmental, in its social dimension, because it lowers the likelihood of accident occurrences, poisoning, food contamination, natural resources, fauna, and flora. The other aspect is economic, which comes from cost-efficiency in the product purchasing and application. On the other hand, bioactivators are applied, and the same area is rubbed more times. Also, it is important to consider the reduction in the traffic of agricultural machines in the facilities, which brings benefits like fuel saving, reduction in soil compaction and the possibility of having specialized workers perform other tasks. The impressive overall reduction in pesticide use, along the measured six crop years, dropped from 42.4kg/ha to 13.7 kg/ha and, more importantly, the use of the most dangerous toxicological classes was suppressed: Ia, Ib and II, using only class III in a much lower amount than before.

Table 3.5.1: Toxicological classification of pesticides

Classes	Groups	DL50 (mg/kg)	Strip color
I	Extremely toxic	≤ 5	Red
II	Highly toxic	5 – 50	Yellow
III	Moderately toxic	50 – 500	Blue
IV	Low toxicity	50 – 5000	Green

Source: adapted; Brazil (2005, 1998), MACEDO (2002) and PERES; MOREIRA (2003).

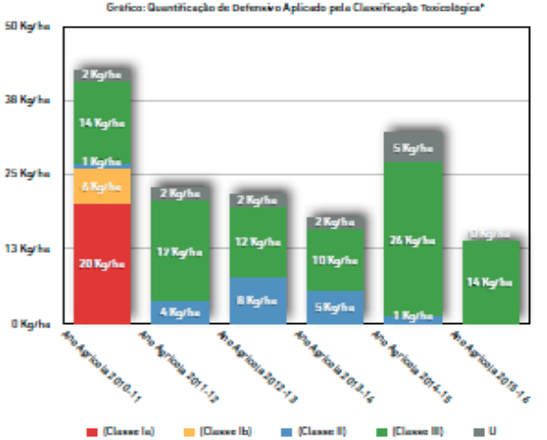
Another important fact was the total elimination of herbicide use in the last year (called U in the chart).

Fazenda São Paulo - Classificação Toxicológica*

Classificação Toxicológica	Ano Agrícola 2010-11	Ano Agrícola 2011-12	Ano Agrícola 2012-13	Ano Agrícola 2013-14	Ano Agrícola 2014-15	Ano Agrícola 2015-16
(Classe Ia)	20,0	0,0	0,0	0,0	0,0	0,0
(Classe Ib)	5,9	0,0	0,0	0,0	0,0	0,0
(Classe II)	0,9	3,7	7,7	5,5	1,2	0,0
(Classe III)	13,6	16,8	11,8	10,3	25,7	13,7
U	1,9	2,4	2,2	2,0	5,0	0,0
Total	42,4	22,9	21,7	17,8	31,9	13,7

*Classificação Toxicológica segundo Organização Mundial da Saúde (OMS)

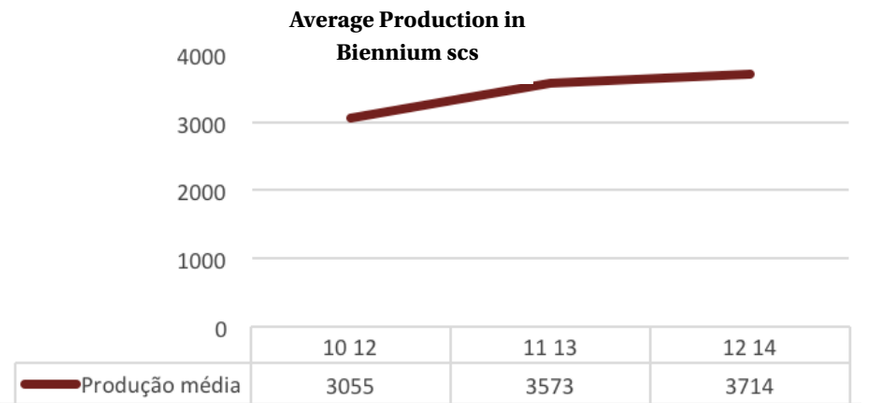
Gráfico: Quantificação de Defensivo Aplicado pela Classificação Toxicológica*



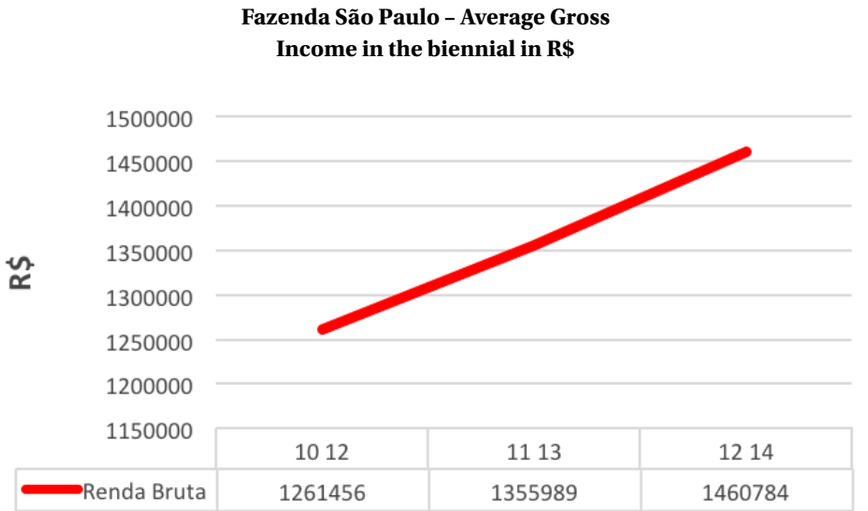
*Classificação Toxicológica segundo Organização Mundial da Saúde (OMS)

Figure 3.5.3: Pesticides

As one important sustainability flagship, the economic factor plays an important role in the grower's professional longevity. The economic issue of handling must be one of the main points to encourage growers to adopt it. This way, Marcelo presents a set of promising data relating to economic performance, all of those supported by soil and water analysis, and strict cost-efficiency. The following is a production performance chart, measured in three biennia (since coffee is a biennial plant, the biennial must be the interval during which results are not computed – the biennial cycle is the sum of two years, a high and a low one). Crops presented a total production growth for the three measured biennia of 21.57%, corresponding to the gross income growth of 15.8%, measured in the same period and presented in the chart below.

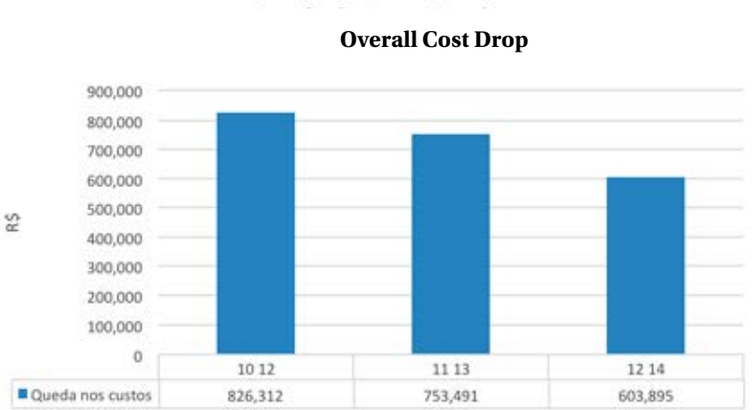


Biennium	Production Growth (%)
11-12/12-13	16.95%
11-13/12-14	3.94
Whole Period	21.57

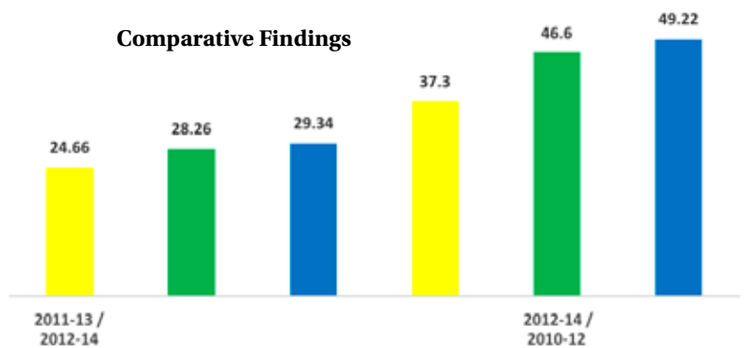


Biennium	Gross Income Growth (%)
11-12/12-13	7.49
11-13/12-14	7.72
Whole period	15.8

For the same period, there was also the reduction of the overall crop costs by 26.91%, presented in the chart below. This total cost reduction and the increase in the gross income corresponded to a 37.3% increase in the gross margin, 46.6% in the net margin and 49% in the profit, which is important. Marcelo proves that handling is sustainable by means of data and analyses, assessing sustainability under its three aspects: socio-economic and environmental.



Biennium	Overall Cost Drop
11 12 11 13	8,81%
11 13 12 14	19.85%
Whole period	26,91%



Gross Margin	Net Margin	Profit
24,66%	28,26%	29,34%
37,30%	46,60%	49,22%

Tests with varieties

Marcelo holds, at his farm, a cultivar collection of 17 different coffee varieties, the foremost of which are: Catuaí, Mundo Novo, and Bourbon. They are selected for planting according to the beverage characteristics that attend to the clients. The company exports nearly 90% of its production mainly to the United States, Japan, and Europe.

Mechanized selective harvest

Mechanized harvest also has its innovations because it is selective in spite of being mechanized. It is performed every three months, and the beans are separated entirely: cherries, green, floaters and overripe. The combine harvester is regulated so that its rods harvest only the upper part of the coffee tree because fruit maturation occurs on a top-to-bottom basis. Afterward, in a second performance, the remaining fruits are removed.

Greatest difficulties encountered

The most significant difficulty encountered by Marcelo was the paradigm shift of departing from herbicide technology. By the time he implemented this new handling system, it was still cheaper to use agro-chemicals, due to the intensive use of brushes to mow the , which demanded time, effort and hour/men and hour/machine costs. By the time Marcelo ventured into this change, six years ago, the handling concept was coming from some Agronomy schools and from fruit farming and preconized the planting of Brachiaria ruziziensis in the coffee plantation interlines. Marcelo did not approve of the idea very much, pondering that he would be moving from a monoculture to a double culture and he reasoned over the advantages of such transition. He got to the conclusion there wouldn't be any. So, he seeks out what he calls "companion plants." It wasn't about weeds, invasive or competitor plants, but companion herbs. Along came the challenge of attempting to enrich and diversify and plant species in the interlines, adjust the soil pH via analyses to check if it was too acid or too basic, whether it required limestone compensation not. Another challenge was to plan a mowing that would trigger the proliferation of a bigger diversity of species, for example, Brachiaria and/or Caruru and so on, so forth. The concept was changed thoroughly once more when it allowed species to seed so that the brush cutter could be applied to create a mixture of plants adapted to local edafoclimatic con-

ditions. Marcelo stimulated plant biodiversity for the sake of nature as a whole, verifying which predator wasps of "leaf miner" needed pollen from what specific companion plants. But those difficulties were, and still are, being gradually overcome with persistence and science. Nowadays, six years after the beginning of handling practices, Marcelo informs that the "leaf miner" pest is under biological control and the measured crop infestation is below economic-risk levels.

Challenges for the future

Marcelo sees the possibility of improving the sweeping and gathering process of the coffee from the ground mechanically. Also, one of the options is to try reducing coffee dropping on the ground even more. Nowadays, with better care – a better harvester adjustment, either by dimensioning and positioning of the rod, vibration control and/or speed control of the harvester movement – this dropping level was very reduced. But it is not enough to meet the standards that Marcelo wants. His goal is to reduce and/or prevent that part of the coffee falls on the ground, reducing the amount of coffee to be swept and improving the harvest process and preventing from coffee quality depreciation and reducing the probability of pest proliferation such as coffee berry borer. Today 15-20% of the coffee produced at the farm is swept coffee. His goal is to avoid the production of this coffee.

Another interesting aspect was the visit of buyers from Russia. As he saw the explanation of all the carbon fixation work with the handling, the client asked: Would you be able to quantify how much carbon you are fixating? If so, would you manage to sell that? Those points can also constitute a future agenda for Marcelo. Steps in this direction are being taken. At best selling the idea of carbon fixation is a fascinating sales appeal as a standout point in this world where third-wave coffee sales will be more and more competitive. According to Marcelo, he took a way of no return, but also of no regrets, because he sees and proves the cumulative benefits every year in his crops.

Teachings from the case

A radical paradigm shift in the use of herbicides for handling requires technical knowledge, activity and result in records, implementation of consistent methodology, investment in knowledge, fearlessness for the unknown.

The balance that can be struck with changes of practices can bring out cumulative benefits in the sustainability tripod. Environmentally, there is a better soil-plant ecosystem balance, enriching the fauna and flora biodiversity, improving physical, biological and chemical soil conditions. Socially, there are better working conditions for workers and residing owners because of the decreased or interrupted use of certain pesticides. Improvement of the farm's finance, providing palatable economic results, making it possible to bring incentives to workers and indirect benefits and profit in the activity.

The presence of the University in the property, with students and their professors, performing hands-on research in the field, they gain knowledge with the support from science. That provides safety for the manager because he can make managerial decisions and discover unique characteristics at his farm, through simple experiments, but with scientific methodology.

Technical innovations can lead up to managerial and organizational innovations, like in this case, bringing changes to all action plan structure, its modus operandi, schedule of activities, acquisition alterations, interruption or alteration in the type and amount of inputs utilized.

Bibliographical references

Carvalho, M. E. A. e Camargo e Castro,P.R. Extratos de algas e suas aplicações na agricultura / Piracicaba: ESALQ – Divisão de Biblioteca, 2014. 58 p. : il. (Série Produtor Rural, nº 56) Bibliografia. ISSN 1414-4530. Disponível em http://www4.esalq.usp.br/biblioteca/sites/www4.esalq.usp.br.biblioteca/files/publicacoes-a-venda/pdf/SPR56.pdf

Fadini,M.A.M ; Regina,M.A.; José Carlos Fráguas,J.C. ; Louzada, J.N.C. Efeito da cobertura vegetal do solo sobre a abundancia e diversidade de inimigos naturais de pragas em vinhedos. Disponível em http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-29452001000300025

Fernandes A.L.T. ;Santinato R. ; Silva R.O. ;Teixeira A.N. Estudo da viabilidade da viabilidade de disponibilização de potássio e fosforo em solos do cerrado com a utilização de penergetic em 6 safras-2012 Consultado em 01/09/2016 Disponível em http://www.fenicafe.com.br/assets/uploads/pdf/6.pdf

Guimarães,E.R. – Terceira Onda do Café: Base Conceitual e Aplicações. Lavras: UFLA,2016. 135 p. Dissertação (mestrado acadêmico) – Universidade Federal de Lavras, 2016.

Ronca, P.P.de Faria Manejo do Mato: Mudança de paradigma na cafeicultura disponível em http://www.cafepoint.com.br/radares-tecnicos/manejo-de-lavoura/manejo-do-mato-mudanca-de-paradigma-na-cafeicultura-34267n.aspx postado em 23/02/2007

3.6 Case Study

Jatobá Farm/Patrocínio – Cerrado de Minas Gerais

"The coffee rake weighed more than 10 kilos. After a day's work raking the coffee, feeling very tired was no wonder. Amauri, the production manager at Jatobá Farm, encouraged by Thiago, came up with an idea. A piece of plastic pipe fixed to the end of a light handle. A nine-kilo weight difference was eliminated, which as the cause of fatigue at work."

Introduction

The Jatobá Farm is unusual for the standards of Cerrado Mineiro due to its dimensions. According to the data from the Agricultural Census from the Brazilian Institute of Geography and Statistics – IBGE, from 2006, Minas has 551,617 rural properties, distributed over 853 towns in the whole state. Smallholdings prevail from this total. The average area of the state's establishments is 60.8 hectares. Given the land-ownership structure in Minas Gerais, it is considered small to the standards of the Cerrado Mineiro region and also the state as a whole.

The Jatobá farm has an area of 42 hectares, situated in the city of Patrocínio.

Out of the total area, 26 hectares are dedicated to the coffee plantation. The current owner, Thiago Motta, represents the third generation of growers. The early years of production had his maternal great-grandfather as the pioneer, his grandfather running the property and the land division that passed on the portion to Thiago's family nucleus.

Thiago's father had a Communication degree and was responsible for editing technical magazines about farming research, rural extension, and cooperative. This background drew him to the farm, and he was full of new ideas in the early 1990's.

A little bit of history

Paulo Motta, Thiago's father, took over the farm in 1994, looking forward to knowing everything about coffee, the region and top-notch technologies ever adapted to the Cerrado Mineiro.

Easy access to information and new sustainability trends and also due to previous experience with property in Bahia, a rainforest region, Paulo always preserved the cerrado-native trees, even though they were in the middle of a coffee plantation. That practice clashed with the conduct of most growers, who preferred to keep the plantation in full sun and with no obstacles to machine use.

Once he could not rely on the production scale, Paulo sought to add value to his product. One of the ways he found to do so was the production of monitored and certified coffee beans.

Paulo then set up his plantations with coffee cultivars recommended by EMBRAPA's physiologists and EPAMIG's geneticists and began to produce the seeds.

He started to sell the considerable part of his production by the kilo and no longer by the bag. In order to grasp the idea of the price differential reached by the seeds, the kilo of coffee seeds is, in 2006, marketed at R$30.00/kg, reaching the ceiling price of R$40.00/kg depending on the cultivar. Good quality running coffee – named "a good selection" – is worth around R$600.00/bag (60kg) or R$10.00/kg. Summing up, producing coffee seeds may even make the product sales income three times higher.

When studying innovation in the properties, it was perceived that they hardly ever turn up by themselves. It seems that innovation is a phenomenon that contaminates people and comes up in loads.

Innovation at Jatobá Farm

In this farm, it is noticed that the employee's skills and qualification, hand in hand with the owner's innovative spirit, who culturally absorbed creativity and ingenuity from his father, resulted in several micro-innovations.

Some of the innovations from Fazenda Jatobá include the coffee raking instrument, developed together with Amauri and the owners.

The "Rodotigre," that consists of a piece of plastic pipe adapted to a wooden handle, confers lightness to the tool, which was not the case of the traditional wooden rake, usually very heavy and tiring to use. The weight difference is very high, and it may vary, depending on the wood the rake is made of.

Figures 3.6.1 and 3.6.2 – The Rodotigre/ Amauri and the Rodotigre

Another light and the innovative instrument is the "vaquinha." A hand-made tool, crafted and adapted at the farm to rake the coffee with a higher yield than the conventional rake, because it spans a larger width of the coffee to be moved. This implement is named "vaquinha," once there is the implement named "vaca" ("cow" in English), which is drawn by a tractor, however, it is much heavier and more likely to crush the coffee, which is not intended at all at Fazenda Jatobá. Here fine and specialty coffee seeds are produced.

Figuras 3.6.3 and 3.6.4 – Amauri and the "vaquinha"

The "biciamontador" is an implement entirely ideated and manufactured at the farm. It consists of a loading blade in the style of the ones used in tractors with two side bicycle wheels. The purpose of this tool is to pile up the coffee quickly, with high yield. In the event of rain, which makes a case for piling up and covering the coffee, this implement speeds up the process.

When the night comes, the coffee is also piled up in thick rows, and this tool is also used for this very purpose.

Figures 3.6.5 and 3.6.6 – Amauri and the Biciamontoador

The "motorodo" was not precisely developed at the farm like the two previous tools, but it was adapted to the property needs and was enhanced by Amauri himself. If you ask around the region, you can't reach a consensus on who conceived this implement, a motor-tricycle with reverse gear. It is believed that it might have emerged and progressively revamped at several farms, simultaneously. The legend says that a mechanic would have been the first one to make the adaptations, even trying to get the product patent, but unsuccessfully.

The shovels for moving the coffee must be light and resistant and can be made of wood (light and resistant) or rubber, and must have adequate spacing for operation. The shovel bar must have a lever with a locking system to disable it and clamp it whenever the motorodo is not operating, but moving along the land. This reduces wooden shovel attrition with the soil, and the coffee does not run the risk of being crushed.

A plastic gutter that collects oil drips was hitched to the motor housing to prevent from contaminating coffee. The base of the motorcycle was acquired in a repair shop in Araguari, which transforms scrap-yard motorcycles into tricycles, adapting the rear axis to two thin-tire wheels in order to soften contact with the coffee. The remaining enhancements were made at the farm.

Figures 3.6.7 and 3.6.8 – "Motorodo"

An innovative and differentiated farm

Since the beginning of his work at the far, Thiago's father undertook to accomplish standout actions to assure the sustainability of the property in the widest sense of the word: economic, environmental and social. He knew that he did not have the scale and he needed to take a different path as a result. And Thiago followed it.

The coffee seed production

Starting with the choice of the major activity, considerably different from the traditional one. Producing coffee seeds is not trivial, it requires refined technique, field staff training, extra cares and performance monitoring. An advantage was the fact that Thiago is an Agronomic Engineer, so he was able to manage the finest techniques and maximize productivity in the key point of this activity. The choice of cultivated varieties to be planted for multiplication were carefully selected through the consultation of plant physiologists from EMBRAPA and also from EPAMIG, which has owned an Experimental Field in the city of Patrocínio for more than twenty years, with very experienced researchers. There are a handful of cultivars produced and among which the following ones can be cited:

Acaiá Cerrado – MG 1474 (Red)
Bourbon IAC J 10 (Yellow)
Catuaí Red IAC 144
Catuaí IAC 62 (Yellow)
Catuaí Red IAC 99
Icatú precoce IAC 3282 (Yellow)
Catucaí IAC 2-SL (Yellow)
Oeiras – MG 6851 (Red)
Rubi – MG 1192 (Red)
Topázio MG 1190 (Yellow)
Tupi IAC 1699-33 (Red)

Not only that, but they also product important cultivars of Coffea canephora, Apoatã IAC 2258 Red, which is resistant to the main coffee nematodes, utilized in the grafting of arabica cultivars. Nowadays nematode infestations are an issue in the soils of specific cerrado areas, and also in some areas in Paraná.

The production of particular coffee

Aware that seed production by itself would not be viable for generating income, Thiago also invested in another product that is considered a specialty, shifting away from standardized coffees. This movement towards the so-called "Specialty Coffee," betting on the third wave of coffee, enabled the farm to pursue and achieve excellence levels that garnered several quality awards.

THIRD-WAVE COFFEE is a movement that seeks the production of high quality cofee, considering coffee a handicraft element, such as wine, and not a large-scale product. This involves improvements in all coffee-related, from the plant to the cup. agribusiness segments, passing through closer relations among growers, passando pelo estreitamento das relações entre produtores, traders and roasters. Analogically to small beer breweries, the movement might give rise to micro-roasters, and in fact these are beginning to thrive. The aim of the third wave is to make the most of the coffee flavor subtleties, its varieties, producing regions (terroir-DO) in the same way as it's done in other food specialties. Guimarães,E.R. – Terceira Onda do Café: Base Conceitual e Aplicações.

The coffee from Fazenda Jatobá is produced through the method of peeling the cherries (CD) for further dryness and also through the method of natural dryness in the patio with cherries. The coffee produced at the Jatobá farm is transformed into single-origin micro lots, so popular nowadays by gourmet roasters and cafés that roast coffee for their clients and want to offer exclusive products. Thiago makes direct-trade operations, always with the perspective of maximizing results. Over the last 15 years, he exported to Japan, Europe, and the USA.

THE SINGLE ORIGIN CONCEPT is widely associated with beans originated/acquired from a single grower, crop, region or country. Also, the single-farm and single-estate concepts, related to the origin/aquisition of beans from only one farm, mill or cooperative, enable the spread of a wide range of information previously not associated with coffee, such as the name of the property and specific origin lot of the beans. This also allows for product traceability, showing that this is an exclusive coffee, not a blend, which generally indicates that it is a top-shelf coffee quality, with unique characteristics pertaining to its production site. Guimarães,E.R. – Terceira Onda do Café: Base Conceitual e Aplicações

Forward vertical integration

A particular focus of attention that is innovative whatsoever was the opportunity that Thiago envisioned, taking advantage of the fact of being a resident from Brasília, a place that holds the highest per capita income in the country, where the residents' habits are relatively cosmopolitan. With this in mind, he decided to set up a vertical integration ahead, which is dreamed-of by any rural producers. On several field trips, the PENSA team has noticed this is a movement that is smoothly boosted but has relevant growth potential. This fact is reinforced by interviews given by the author in the International Coffee Week with representatives from Coffee Industries and Roasters, who have reported sales growth of small and medium-sized equipment for farms and small industries.

The industrialization of his product is aimed at the possibility of selling it at a higher added value. Thiago looked out for a good roaster in Araguarí to outsource roasting and packing processes for his product, ordered a logo and the graphic design for his leaflets and his website. So the Solo brand was conceived, and it was then renamed to Arbor Specialty Coffee, and Sollar Coffee, whose visual concept finishing touches are underway.

Figure 3.6.9 – New visual communication of Fazenda Jatobá

In Brasilia Thiago supplies exclusively to fine restaurants such as Aquavit, whose chef is Danish Simon Lau, eight-time awarded by Veja Magazine "Comer e Beber / Brasília". He also supplies for specialized cafés such as Bellini Café – The Coffee Experience, also elected by Veja as the best café in town; La Palma – renowned Delicatessen of differentiated products; Bio on (mini-eco-organic market) and restaurants like Piauíndia – "affective Indian cuisine." Aside from Brasília, he supplies his coffee to some houses in Curitiba and Rio de Janeiro.

Figure 3.6.10 – Where to find coffee from Fazenda Jatobá

Sustainability at Jatobá

Pursuing Paulo Motta's innovative actions once more, it is noticed that innovations come up together. The preservation of most native trees at the farm was pursued by Thiago, as well as the environment protection spirit, even more effusively because he has the technical knowledge and is willing to do so. The sustainability issue is tightly connected to the issue of production with productivity and also to the issue of innovations encountered at the farm. In 2012, Fazenda Jatobá was awarded the Outstanding Company Prize by SEBRAE, the maximum distinction of the II SEBRAE-MG Award of sustainable practices. The maximum highlight was the most sustainable company. Thiago has irrigation controlled by a tensiometer network (equipment used for measuring soil humidity and check the need for irrigation) installed all over the plantation, in order to rationally use irrigation water. He makes use of handling between coffee streets, conscious of the benefits this practice brings in terms of water saving and nutrients[6].

Fazenda Jatobá is certified RAS – Sustainable Agriculture Network – Rainforest Alliance Certified, also affiliated and member of Origin Denomination of Cerrado Mineiro and, also, is rated Platinum supplier to Illycaffè.

Figures 3.6.11, 3.6.12 and 3.6.13 – crtifications of jatobá

It is worth noting that Fazenda Jatobá pioneered the introduction of Sansão do Campo hedges (Mimosa caesalpineafolia) in the region; of TECA (Tectonia grandis), most valuable wood in the market, and of NIM (Zadirachta indica), tree whose leaf or fruit infusions fight insects fungus and 'pests', both of them of millenary knowledge, originated from India, in Asia.

Greatest difficulties encountered

Having solidified in singular market niches Thiago is involved with; the Sollo Café brand suffered a hard setback from INPI. He did not hesitate. Taking advantage of his SEBRAE award, complemented by his own resources, he hired one of the most regarded creation agencies (strategic design office Louren Costa, in São Paulo) to develop two new brands: Arbor Specialty Coffee and Sollar Café, and also all the farm's visual identity, with a well-crafted manual and cutting-edge marketing strategies that are in advanced stages of production. Sometimes changes arise from crises that propel to creativity, driving, when well managed, growers to new levels and challenges.

6 Grass management. For more information see chapter 3.5 Case Study São Paulo Farm /Patrocínio Cerrado de Minas Gerais.

Figure 3.6.14 – Arbor Packages – Specialty Coffee

Figure 3.6.15 – "Sollar" coffee package

Challenges for the future

For the future, Thiago sees the expansion of sales of selected and certified coffee beans. This step is an important advance towards raising coffee growers' awareness of new coffee cultivars that have been launched through research, and they have high levels of productivity, multiple resistances and, above all, they can offer a better beverage.

This is the technological breakthrough that will trigger added value to coffee produced at Fazenda Jatobá. Together with coffee growers, either for new plantations or for renovating them, it is fundamental that the beans to be purchased are certified with origin from responsible growers.

For this intent, says Thiago Motta, growers will have to change a current practice – highly harmful to his business – which is purchasing beans of unknown origin and not attending to the strategic importance of sourcing them from a Coffee Bean Field that is registered in the Agriculture Ministry – MAPA and rigorously monitored by its technicians. This inspection has to do with the origin and purity level of the cultivar, and also to its high level of germination and phytosanitary health. The acquisition any sort of beans, either because a nurseryman of neighbors said it is good, is a high-risk decision for the coffee grower, when he is unsure about the reputation and origin of the genetic material. It is not an overstatement to remind that extra care is important when it comes to the choice of the genetic material that will be implemented in a field, the more so as that material will be an expressive source in the production for the lengthy period of 20 years at the minimum. The grower wants a highly productive plantation and, to this end, he must seek maximum quality. As if that weren't enough, the "bean factor" weighs in very little in terms of costs of a new coffee plantation that is intended to be highly productive.

A bigger challenge will be the consolidation and scale expansion of roasted coffee trade, in-ground beans, from Arbor Cafés Especiais and Sollar Café brands. That will be the great step. As it has been done so far, it will always be anchored by consistent strategic planning orienting each step of the small, but highly creative, technified and productive Fazenda Jatobá.

Figure 3.6.16 – Fazenda Jatobá logo

Teachings from the case

One of the most important aspects of the agribusiness management is to know who you are, what you do best and where you fit in the system. That is what Thiago Motta knows quite well because his notion of scale is precise and his movement towards adding value in this business consolidates and moves forward.

Fostering creativity, open dialogue and a good relationship with employees generates positive outcomes to his business, sometimes at a very low cost. The examples are clearly exposed in this case.

The search for adding value in agribusiness is not a petty thing. It ought to be studied, planned, strictly documented and noted, and be put into commission in a progressive fashion according to plan. The biggest is not always the best, but the smallest does not always pale in comparison to the bigger one. Efficiency gains come from the sustainable organization of the economic tripod, social and environmental. No wonder Thiago was awarded prizes that helped him boost business through hardship.

Difficulties found in the course of the business operations or unsuccessful plans do not always mean tragedy and, most of the time, constitute opportunities to improve and boost business. The example is the reshaping of Thiago's coffee brands.

References

Guimarães,E.R. – Terceira Onda do Café: Base Conceitual e Aplicações. Lavras: UFLA,2016. 135 p. Dissertação (mestrado acadêmico) – Universidade Federal de Lavras, 2016.

3.7. Case Study

Denomination of Origin of Cerrado – DO/Cerrado Mineiro – Minas Gerais

"The achievement of the Denomination of Origin in the coffee from the Cerrado Mineiro region demanded 23 years of hard work, dedication, collective actions and focused on objectives to reach recognition and the granting of the certificate."

Introduction

When one thinks about innovation, the idea of technology is immediately attached to it. Other forms of innovation have different challenges. It is the case of the search for product differentiation, particularly the one obtained from collective actions. We will explore one of these cases, the Denomination of Origin (DO) in coffee from the Cerrado Mineiro region. The Cerrado DO demanded 23 years of hard work, dedication and focus on the objectives to achieve recognition and the granting of the certificate. This innovation challenge required efficient performance and participation of the local government to be reached.

The Geographical Indication (IG) is used to identify the origin of products and services when the location became well-known or when a given characteristic or quality of the product or service arise from its origin. In Brazil, it comes in two modalities: Denomination of Origin (DO) and Indication of Origin (IO)[7].

7 Law 9279/96
Article 177. An indication of origin is considered the geographical name of a country, city, region or locality of its territory, which has become known as a center for the extraction, production or manufacture of a particular product or service.
Article 178. The denomination of origin is the geographical name of a country, city, region or locality of its territory, which designates a product or service whose qualities or characteristics are due exclusively or essentially to the geographical environment, including natural and human factors.

The fundamental difference between both is that the IO is connected to the geographical name of a given country, city, region or location within its territory, which became highly regarded as an extraction, production or manufacturing center of a certain product or service delivery. Whereas DO consists of the geographical name of a country, city region or location within its territory that denotes a product or service whose quality or characteristics arise exclusively and mainly from the geographic area, including natural and human factors.

The importance of the Denomination of Origin of coffee from cerrado Mineiro sits upon the fact that, due to the characteristics of its coffee, it has the possibility of being qualifiable for a denomination of origin. To this end, there must be a minimum quality score in the sensorial analysis of the beverage. This quality draws on the SCAA[8] method. For this lot of coffee to be sealed DO, the resulting beverage evaluated must score at least 80 points.

These characteristics made Cerrado Mineiro the first Brazilian region to be IG certified and later was approved DO in coffee.

This case will focus on the origins of collective and coordinated actions, taken by groups of coffee leaders from Cerrado Mineiro, in search of added value and differentiation of their products. The DO will show the valuable power of collective actions in all sectors of society and turns out to be an iconic example for Brazilian agribusiness, which lacks joint coordination actions. We hope that other agro-industrial systems can learn from these experiences. History goes down with the achievement of geographical nomination and then the Denomination of Origin – DO, its attributes and externalities deriving from it.

The cerrado saga

The PENSA[9] group accomplished, in 1997, a case study about the topic called: "CACCER: Coordinating actions for valuing the coffee from cerrado"[10] elaborated by Prof. Maria Sylvia Macchione Saes, who already pointed this trend. By that time the main concerns were lack of resources for funding production and product trading and lack of tradition and legislation in the protection and control of denominations of origin in Brazil.,

8 SCAA-Specialty Coffee Association of America

9 Agribusiness Knowledge Center – FEA/USP and FIA

10 The Case study is available in Portuguese on PENSA website at: http://pensa.org.br/wp-content/uploads/2011/10/CACCER-_coordenando_acoes_para_a_valorizacao_do_cafe_do_serrado_1997.pdf

The stumbling block referring to the legislation was overcome by law 9279/1996, which regulated rights and obligations concerning industrial property. This law provides for the part relating to the denomination of origin.

Some companies observed the production potential of high-quality coffee in Brazil, from growers that began to be paid for the quality obtained to industries that had, in Illycaffè, their pioneering mark. Thus, when Dr. Ernesto Illy, in a decisive step, decided to set up an annual contest called "Brazilian Prize for the Quality of Espresso Coffee," the identification of the best coffee available in the Brazilian market began. Results showed, since the first contest edition in 1991, that most awarded growers worked in the Cerrado region. From this event, associated with the incentives from the deregulated market, prices could repay the quality that cerrado growers and their leaders set themselves to investing using strategies in the search for quality in the region's coffee. Cerrado, as it produces naturally dried coffee, had leverage. From the year 2000, Cereja Descascado (CD), or natural-pulped coffee began to be purchased by Illycaffè.

Taking advantage of this fact, CACCER[11]: began to conceive the contest as a marketing move to promote coffee from cerrado. The strategy began to be designed from the region's coffee quality, appreciated by high-demanding buyers. The idea of creating an origin region for the coffee from cerrado surfaced in 1993, in the ACARPA Board, Association of Coffee Growers from the region of Patrocínio, formed then by a group of growers led by Aguinaldo José de Lima. The implementation would include the use of appropriate technology and the adoption of marketing and trading strategies, and direct export through the Cooperative. The Association would be in charge of providing growers with the necessary technical support with the support from SEBRAE-MG, and also set up marketing and other actions as a representation entity.

In the beginning, this vision was faced with the objection on the growers' part. It is normal that changes and new ideas demand time to ripen until their adoption. What pushed for the introduction of new concepts was the fact that, as it was a new region with new ideas and people, there wasn't a tradition to be broken. As there were some grower associations, like São Gotardo and Araguari, new ones were created to introduce the new model in the Cerrado, as exemplified by Paracatu, Monte Carmelo, Araxá, Campos Altos, Carmo do Paranaíba and Coromandel. Thus, punctual actions led to the Committee of the existing associations, bringing them together so that collectively agreed actions could be taken. The existence of pioneering grower associations in the Cerrado was positive and paved the way for the creation of similar entities. The adoption of joint strategies

11 CACCER: Conselho das Associações de Cafeicultores do Cerrado

demanded coordinated actions, which, in 1992, motivated the directors from the seven existing associations to join forces and create an entity that could unite them – a Board of Associations – for keeping unified strategic management that could be consistently coordinated for the coffee from cerrado. The goal was to set a pattern for quality and stand as the only representation entity. Some months later, CACCER was created.

An intention protocol was signed, which involved the Mineiro Institute of Agriculture – IMA, EPAMIG, EMATER – MG, the Federal University of Uberlândia and CACCER. This document kicked off an array of joint actions that resulted in the publication of Ordinance 165/95 from the government of Minas Gerais two years later, which marked off the coffee producing regions from the State of Minas Gerais for the establishment of the origin certificate. This ordinance officially drew the lines for the four coffee-producing regions in the state: South of Minas, Cerrado, Jequitinhonha and Montanhas de Minas. It laid down the establishment of the origin certificate and also determined that "the regulation of the Origin Certificate would be set forth by a specific act."

As the next step, from December 1996, through Ordinance 38,559 from the government of Minas Gerais, the regulation of the origin certificate for the coffee from the four outlined regions was instituted – named Certicafé and launched in June 1997 – assigning the functions of issuing and controlling the use of the certificate for IMA. From then on, all the coffee produced in the Cerrado Mineiro and submitted to IMA for sample analysis had to be sealed, bearing information on product origin and so on.

The basis for IG and DO was launched.

This historical review[12] is necessary so that collective actions that led up to the success of the DO can be properly registered. It is never an overstatement to remind that the DO is a collectively built and enhanced organization, with participation from the private sector and the government.

The Denomination of protected Origin from Cerrado was acknowledged by INPI – National Institute of Industrial Property, Brazilian organization, that granted the registration of 'DO Cerrado Mineiro", published on the Union Official Diary on December 31st, 2013. Hence appeared the first Brazilian coffee-producing region that qualified for the status of Coffea arabica green coffee and industrialized roasted coffee in beans or ground. Even though, since 2005, the region had already gotten such recognition from IG – Origin Indication.

12 Saes, M.S.M. "CACCER: Coordenando ações para a valorização do café do cerrado" –PENSA-USP-1997 disponível em http://pensa.org.br/category/estudos-de-caso/page/2/

A product bearing a denomination of origin

Along with the advent of the Geographical Indications (IG) for coffee and later on with the DO, comparisons between coffee and wine characteristics began to be made, especially to what the concept of "terroir" is concerned. In spite of the controversy raised by the use of that word, regarded by some as snobbish, actually, it applies to wine and all products whose production characteristics are jointly defined as edaphoclimatic and social. With the support from the International Organization of Vine and Wine and the Great Larousse du Vin, it is concluded that:

"it is the link between soil and the particular micro-climate at the most intimate, which conceives a new type of grape, which freely expresses its quality, typicality, and identity in a great wine (...)".

The terroir[13] concept does not only encompass the environment elements per se but concerns the interaction, within a certain geographic area, among:

- natural factors: soil composition, local climate, thermal amplitude, altitude, relief, solar exposure, wind, humidity, volume and distribution of rainfall, soil drainage;
- human factors: choice of varieties, agricultural techniques utilized, wine elaboration methods, aging – that is to say the local savoir-faire.

Extrapolating on this idea, this concept garnered, little by little, strength among consumers, traders and growers, who began to introduce the concept of state coffee – the farm's coffee – unique product produced in a single farm, given its edaphoclimatic characteristics.

The territory in the Cerrado region in Minas Gerais, where coffee is grown, indeed has singular characteristics that make it stand out among the several producing areas in Brazil. The following can be cited:

- Altitude ranging from 800 to 1,300;
- The annual average temperature of around 22o C;
- The average rainfall of 1,800 mm/year;

13 TERROIR. Acoording Larousse Terroir is: Portions of land exploited by the inhabitants of a village. All the lands of a region, considered from the point of view of their agricultural aptitudes and supplying one or more characteristic products, for example a wine. Province, countryside considered as the refuge of habits, typical tastes rural or regional: A descriptor of the territory . Read more at: http://www.larousse.fr/dictionnaires/francais/terroir/77475#1dCF3O81Abd4IaRG.99

- Dry winter that enables coffee dryness in the harvest, as opposed to other regions that suffer from unexpected rain during the harvest period, which assures flexibility of choosing the dryness method: natural coffee in the sun, mixed drying between the sun and drying machine uses, or drying machine use only;
- Low fertility, high acidity, and well-drained latosols soils;
- Sufficient river basins for irrigation;
- Intense insolation that helps photosynthesis;
- Flat topography relief, which favors mechanization.

All this added to the varieties planted and the practices carried out by man, which give rise to a product bearing the following characteristics:

- Intense nutty and caramel aromas;
- Mild citrus acidity;
- Moderate to full-bodied body;
- Flavor: prevailing sweet chocolate.
- Long aftertaste.

The denomination of origin is a complex process that demands governance, monitoring, and control. Nevertheless, nowadays it is recognized that the DO has more elements to be considered, besides those presented.

Besides the region and the product

The DO, just like registered trademarks, copyright laws, and patents, is a modality of intellectual property and, for no other reason, is under the law that regulates it. According to Chaddad, the DO's:

"are less recognized and utilized as a form of protection for products generated by the innovative activity of private agents. By means of such modality of intellectual property, a collective property right is conveyed to growers or organizations from a delimited region, who can use denominations of origin for products of various kinds originated in that region. "Port wine," "champagne", "Havanna" and "Parma ham" are examples of denominations of origin that are well-known and appreciated worldwide.

The DO Cerrado for coffee from Minas Gerais can enter this list, too. The growers from Cerrado have the opportunity to add and maintain value in their product when it is certified DO. To that intent, they must comply with collectively established rules and norms, in order not to be penalized or suffer discontinuity from the system." The DO is a form of collective protection of property rights, which lays down rules for entry, removal, monitoring, and control of participants.

Innovating

The innovations that occurred in that region in the quality, technology, and denomination of origin areas were determined by the key strategies taken in the pre-organizational steps, as a result of collective actions, which led to the success of the DO achievement through the coordination of such actions. It led to the creation, coordination, and centralization of actions from Cooperatives and Associations, a rare event in the Brazilian agriculture, through a structured Board.

The DO covers 55 cities (Figures 3.7.1, 3.7.2 and3.7.3) and a production area of 200 thousand hectares (Figure 3.7.4). However, the certified area adds up to 105 thousand hectares, relying on 4.5 thousand growers so far. Out of those 105 thousand certified hectares, 68 thousand are irrigated. Five million bags of coffee are produced, with an annual yield of 35 bags/ha. That production corresponds to 12.5% of the national production and 25% of the overall production in the state of Minas Gerais (Figure 3.7.4).

Figure 3.7.1. – Map of the Cerrado Mineiro region

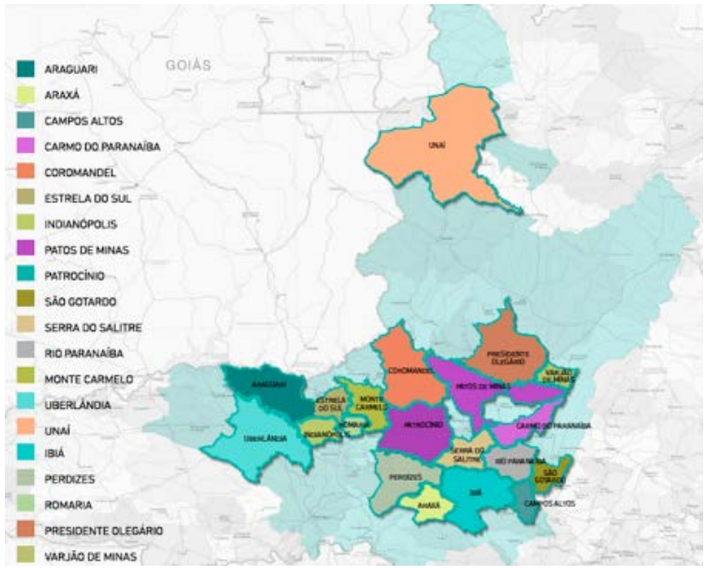


Figure 3.7.2 – Location of the towns from the demarcated region "DO Cerrado Mineiro"

LISTA DOS 55 MUNICÍPIOS DA REGIÃO DEMARCADA DO CERRADO MINEIRO

1. ABADIA DOS DOURADOS
2. ARAGUARI
3. ARAPUÁ
4. ARAXÁ
5. BAMBUÍ
6. BONFINÓPOLIS DE MINAS
7. BURITIS
8. BURITIZEIRO
9. CAMPOS ALTOS
10. CANÁPOLIS
11. CARMO DO PARANAÍBA
12. CASCALHO RICO
13. CONQUISTA
14. COROMANDEL
15. CÓRREGO DANTA
16. CRUZEIRO DA FORTALEZA
17. DOURADOQUARA
18. ESTRELA DO SUL
19. GRUPIARA
20. GUARDA-MÓR
21. GUIMARÂNIA
22. IBIÁ
23. INDIANÓPOLIS
24. IRAÍ DE MINAS
25. JOÃO PINHEIRO
26. LAGAMAR
27. LAGOA FORMOSA
28. MATUTINA
29. MEDEIROS
30. MONTE ALEGRE DE MINAS
31. MONTE CARMELO
32. NOVA PONTE
33. PARACATU
34. PATOS DE MINAS
35. PATROCÍNIO
36. PEDRINÓPOLIS
37. PERDIZES
38. PRATINHA
39. PRESIDENTE OLEGÁRIO
40. RIO PARANAÍBA
41. ROMARIA
42. SACRAMENTO
43. SANTA JULIANA
44. SANTA ROSA DA SERRA
45. SÃO GONÇALO DO ABAETÉ
46. SÃO GOTARDO
47. SERRA DO SALITRE
48. TAPIRA
49. TIROS
50. TUPACIGUARA
51. UBERABA
52. UBERLÂNDIA
53. UNAÍ
54. VARJÃO DE MINAS
55. VAZANTE

Figure 3.7.3. – Cities from the demarcated region of Cerrado Mineiro

Figure 3.7.4 – Data on the demarcated region of Cerrado Mineiro

The average productivity of coffee production in Brazil, presented by CONAB – Brazilian Supply Company, in the period of 2008-2016, is of 22.5 bags/ha and the average for the state of Minas Gerais, for the same period, is of 23.5 bags/ha. It is confirmed that the growers certified DO Cerrado have a higher degree of technification, which allows them to meet the higher average amount of 35 bags/ha. The high-end growers reach average amounts of 60 bags/ha.

Governance in the system of denomination of origin

The denomination of origin from Cerrado Mineiro is administered by the Coffee Growers Federation, which came from CACCER. The Federation is a non-profit entity, comprising eight Cooperatives, eight Associations, and one Foundation – the Foundation of Development of Cerrados Mineiros. The main role fo the federation is to represent growers, control and promote product origin with Denomination of Origin. In better words, they are the guardians of Cerrado coffee.

The grower's Cooperatives comprise the Board of Administration of the Coffee Growers Federation, which is a deliberative organization of internal and strategic decisions of the system. This Board is composed of the Presidents of those Cooperatives. The Associations participate in the General Assembly and in the Institution Committee of the Federation. But the chain of custody cycle for the Program of Origin Certification in the Cerrado Region does not end at the farm gate. Participants also include warehouses, exporters, and roasters.

The burning question for many growers must be:

"How should I proceed to become a DO-certified grower in the Cerrado Mineiro?"

First, he must have his facilities geographically situated in one of the 55 cities in the demarcated region (Figure 3), at 800-meters altitude at the minimum.

He must grow Coffea arabica coffee only. He must be cooperated or associated registered in one of the Cooperatives or Associations affiliated with the Federation of Growers from Cerrado. He must be up-to-date with his annuity[14] of accreditation with the Federation and the agreed Responsibility Term[15]. These two obligations are necessary for effecting the grower's membership.

Having a contract for the Assignment of rights of Image Use of Grower and Property signed. As mentioned before, it is set forth in the governance laws and in the accreditation regulation the grower in the DO Program that, in case he makes inappropriate use of the brand and the denomination of origin, he will be given a time period to bring himself into line. If that does not occur, other penalties may be incurred, such as fines and even discontinuity from the system. Such cases are rare, and there has been no record of its occurrence until today.

What do brings for the region and for the grower

The brand is an important element of identification of region and is tightly connected to the grower. As for the DO's, they involve the territory, the product and the man by definition. Its members can make use of the brand (logo) and its benefit, placing them in the facilities of their rural property, on signs, business cards, general media and administrative documents. Its use is regulated by norms that must be observed.

The registered grower, whose coffee is roasted and DO sealed, offers, by means of "QR-code, history-held coffee. This technological innovation can be defined as a form of information exchange about the product, the characteristics of the coffee lot, as well as the origin and quality certificate. In short footage videos, the grower and his/her family, in his/her property, in introduced to the consumer. It is a customer communication tool, that draws them closer to the production, identifying who makes that product, where and how it is made.

Another advantage of bearing a DO seal on a product is the possibility of tracing it. The traceability control is an important differentiation element that meets the demands either of the roasting industry or the final consumer. Unknown product origin is unacceptable in the food world. There are several companies that buy coffee that does not accept purchasing green coffee that does not have a traceability certificate. Other two factors of immediate impact for the consumer, which are elements of differentiation, are the quality of the product and its sustainable production. The environmental protection, water usage, labor ethics and cares with the human capital involved with the production are decisive factors of access to international markets and draw the attention of domestic consumers.

Such important element for growers, the prices of the DO-sealed products have an average difference of 1% to %% on top of the market return. That variation will depend a lot on the quality of the product. In some cases, it may amount to 10% on top.

And, at last, the DO is the Cerrado coffee gateway to the commercialization of third-wave coffee[16], which is an element that seeks the production of high-quality coffee, considering coffee as a handcrafted element just like wine, and not a standardized product. This involves improvements in all the segments of coffee agribusiness, from the plant to the cup, passing through closer relations among growers, traders, and roasters. An analogical to the micro-breweries, the movement may lead to micro-roasters, which are indeed thriving. The aim of the third

14 The cost for the farmer is calculated according the total area of the farm: up 20 ha = R$ 100.00, from 20.01 to 50ha = R$ 200.00 and above 50,01ha = R$ 300.00 .

15 Responsibility term: Signed document, with a recognized signature, valid for 1 year referring to all the principles and standards and technical recommendations applied to the production, especially regarding the use of agrochemicals, processing, transport of foods, practices oriented to safeguard human health, promotion of better working conditions and protection of environment.

16 The so called First wave of coffee happened when there was a world expansion of the beverage. An improvement in the volume. The second wave was the improvement in the quality of the beverage , the introduction of the espresso coffee, the advancement of the quality. More information about the third wave can be obtained into MSc. Dissertation of Elisa Reis Guimarães from UFLA, 2916, The third wave of coffee: conceptual base and applications. Available at http://repositorio.ufla.br/bitstream/1/10972/1/DISSERTACAO_Terceira%20onda%20do%20caf%C3%A9%3A%20base%20conceitual%20e%20aplica%C3%A7%C3 %B5es.pdf

wave is to take advantage of the coffee subtleties, its varieties, producing regions (terroir-DO) similarly to other food specialties.

The Federation of Growers from Cerrado joins forces with other institutions to promote projects, either of technical matters in partnership with Universities and Research Centers, or managerial/organizational issues (See Annex 1).

There are the projects that promote the visibility and marketing of the region, in all cases with the Cerrado Foundation. The representativeness of the region in several national and international forums inserts and highlights the DO in the world, turning the place global.

This led to the tripod the define the coffee with DO Cerrado Mineiro: Ethics-traceability-Quality, which sums up the philosophy of producing sustainable coffee, or what coffee from Cerrado Mineiro is commonly called: "Attitude coffee."

Micro-lots of exotic high-scoring coffee in sensorial analyses are launched monthly, locally and nationwide, from different growers, standing out from the ones coming from yellow or red fruit.

This has been occurring very often and Expocaccer – Cooperative of Coffee Growers from Cerrado – inaugurated a café in Patrocínio-MG, in December 2014, together with the new administrative headquarters. It is called "Cafeteria Dulcerrado".

Figure 3.7.5 – Façade of Cafeteria Dulcerrado next door to EXPOCACCER's headquarters

Figure 3.7.6 – Modern and pleasant in-door ambience at Cafeteria Dulcerrado

This kind of action is dreamed of by all those who study and teach agro-industrial systems, the approach and direct contact between the grower and the consumer. The Cooperative adopts a vision in which the grower should know and consume their own products. Functioning as a comparison and incentive tool in their circle, they set themselves to the offering, at the café, grower-identified coffee that is roasted, ground, expresso, sifted and, in various ways, as a form of advertising. The café is run by specialized personnel and serviced by highly experienced baristas who are capable of offering cutting-edge service to the client. Besides commercializing coffee from growers and also the branded Dulcerrado, they have a wide range of edible products, some coffee-based, and kettles and accessories for coffee lovers. There's also an e-commerce service available.

The advancement of certification for growers is proven by the rate of growth in the number of sealed bags of green coffee bearing the "SELO DO CERRADO MINEIRO," which has been growing at the annual rate of 62.23% since 2011. In the case of industrialized coffee, the number of 90,748 seals has been achieved thus far.

Problems and difficulties of the system

Albeit offering many advantages for the grower, the DO also presents a whole new level of trading coffee, different from the one that prevailed before. Sales by type and classification, by itself, is not done anymore. At least not DO-framed lots. This coffee requires a much more well-crafted treatment because they are also of-

fered to and searched by very demanding clients. So, as for the forms of commercialization of a new trend in the region, the coffee bearing Denomination of Origin – which adds value to the product – is still grown in a commodity-oriented way.

Old forms of commercialization, in an impersonal way, will give way to relational contracts little by little. This one is made up of the relationship between buyer and seller upon a partnership of trust between the parties, including mutual support for working out problems, among other features. The classificator will need to show a greater deal of dynamism, browsing the region, propping up new projects and aligning the ends between the grower, their product, and the client. Especially the needs and discretion of the client. These will be the contracts that will suit the third-wave coffee, counting on the New Trader image. The new trader will no longer be the bureaucratic seller or buyer. He will have to be acquainted with the grower like the back of his hand. The trader will need to now about coffee lineages, territories, nuances, client's needs and innovative products at the farm. Will also be a partner and a market developer.

Perhaps one of the problems to be sorted out at the moment is the one of the clear perception, from the grower's part, of the advantages of being part of the DO system. According to data from the Federation, today there are 370 properties entitled to using the DO, corresponding to the approximate area of 60,000 hectares. The existing potential is much larger (Figure 4). At the moment, the greater need is to feed the system with more and more growers, amplifying the coffee basis with DO. A forthcoming problem for the next step will be the safeguarding, monitoring, and control of the Cerrado brand. Nowadays, many roasters own coffee brands, informing their clients that the latter is originated from Cerrado Mineiro, and they do not use the DO. Perhaps they hardly know that they are infringing a law protecting the rights of collective property of the growers from Cerrado. Perhaps it is about opportunistic attitudes.

Looking to the future: what are the challenges that have to be overcome?

The growth outlook for the DO in the Cerrado is interesting, but there are challenges to be overcome. The Cerrado Federation is kicking off a program called "Integra Cerrado," whose aim is to send off a visiting technical team to 1,800 properties. The objective is to inform growers about the DO, clear up doubts, clarify and bring new members onboard. Once the communications about the DO in the mainstream media haven't shown progress in raising new memberships, word of mouth was chosen. It is predicted that the potential for new members may reach the double of visited growers, that is to say, 3,600 growers in the medium and long terms.

Another challenge that requires attention is the one regarding the maintenance of one of the most valuable natural resources for agriculture: the water.

One of the most significant concerns in the Cerrado Region is that water remains available for production. There is no point in having other programs if there is no water available. Some cerrado areas like Araguari, Unaí, Monte Carmelo, and Patrocínio rely on irrigation. Shortage of river sources and beds are frequently noticed. The historical average of cerrado rainfall, 1,500/1,600, has dropped over the last few years to 1,300/1,000/year, encompassing the global situation. The Cerrado Water Consortium is built, which is a multi-institutional entity aiming at conducting and proposing studies and conservationist water production measures and recovery of the cerrado landscape.

Along these lines, concerns also focus on the prevention of nematode-contaminated soils, an issue that may preclude many areas suitable for coffee production in the cerrado. Some areas within cerrado properties have started to present this problem punctually.

But perhaps the most significant challenge to be overcome by the Federation is the one of reaching 500,000 sealed bags bearing the DO by 2020. With water and no nematodes.

The saga of Cerrado Mineiro Coffee DO remains. That is likely to bring in many more growers and will shift many more paradigms.

It may bring many local benefits also. It is likely to add a track record, visibility and penetration of this Denomination of Origin in the specialty coffee markets in Brazil and worldwide, building upon a differentiation factor and adding value to the cerrado growers.

Work is underway to this intent. The challenge is big, but Cerrado Mineiro, since its origin, is used to overcoming it.

Teachings from the case

This case shows that collective actions towards results that add more value to a regional product are worthwhile, in spite of all the effort made to achieve this goal. It goes to show these actions need capable and committed leaders to bring this project to pass.

The social communication of projects of collective action is one of the two nerve points to raise associates to an idea, which is the case of DO Cerrado Mineiro. Grower membership does not pop up out of the blue, but always at the cost of much advertising work and word-of-mouth parole. Personal relationships are a key element in this process. An innovation, though abstract, as the idea of the Denomination of Origin, begins to take shape when logos and seals are made

when it morphs from a product that used to be standardized into another one identified. The ripple effect begins to occur when the trading contracts show the grower it is worth belonging to a group that has a well-signalized Denomination of Origin as a common identifier.

Bibliographical references

Chaddad, F.R. UMA APLICAÇÃO DA TEORIA DOS DIREITOS DE PROPRIEDADE: o conceito de denominações de origem controlada ,Informações Econômicas,IEA, SP, v.26, n.12, Dec. 1996.

Saes,M.S.M. "CACCER: Coordenando ações para a valorização do café do cerrado" –PENSA-USP-1997 available at http://pensa.org.br/category/estudos-de-caso/page/2/

Annex 1

CAPAL

Capal – Cooperativa Agropecuária de Araxá
Presidente: Alberto Adhemar do Valle Júnior
Atividade: Café e Leite

COOCACER

Coocacer Araguari - Cooperativa dos Cafeicultores do Cerrado de Araguari
Presidente: Mario Takanobu Watanabe
Atividade: Café

CARPEC

Carpec - Cooperativa Agropecuária de Carmo do Paranaíba
Presidente: Daniel André da Silva
Atividade: Café, Pecuária e Grãos.

COOCACER

Coocacer Carmo do Paranaíba - Cooperativa dos Cafeicultores do Cerrado de Carmo do Paranaíba
Presidente: Jerry Magno Resende
Atividade: Café

COAGRIL

Coagril - Cooperativa Agrícola de Unaí
Presidente: José Carlos Ferigolo
Atividade: Café e Grãos

COOPA

Coopa - Cooperativa Agropecuária de Patrocínio
Presidente: Renato Nunes dos Santos
Atividade: Café e Leite

monteCCer

monteCCer - Cooperativa dos Cafeicultores do Cerrado Monte Carmelo.
Presidente: Francisco Sérgio de Assis
Atividade: Café

EXPOCACCER

Expocaccer - Cooperativa dos Cafeicultores do Cerrado
Presidente: Lázaro Ribeiro de Oliveira
Atividade: Café

ACA – Associação dos Cafeicultores de Araguari
Presidente: Claudio Morales Garcia
Atividade: Café

AMOCA

AMOCA - Associação dos Cafeicultores de Monte Carmelo Presidente: Carlos Dorna Alvarez
Atividade: Café

ACANOR - Associação dos Cafeicultores do Noroeste Mineiro
Presidente: Everaldo Peres Domingues
Atividade: Café

ASSOCAFÉ

ASSOCAFÉ - Associação dos Cafeicultores da Região de Carmo do Paranaíba
Presidente: Cleber Wilhiam Ribeiro do Amaral
Atividade: Café

ACARPA - Associação dos Cafeicultores da Região de Patrocínio
Presidente: Marcelo Queiroz
Atividade: Café

ASSOGOTARDO - Associação de Apoio aos Produtores Rurais da Região de São Gotardo
Presidente: Naohito Tsuge
Atividade: Café, Grãos, Hortifrútis e Pecuária

APPCER

APPCER - Associação dos Pequenos Produtores

ASSOPATOS

ASSOPATOS - Associação dos Cafeicultores de

FUNDACCER

Fundaccer
Fundação de Desenvolvimento do Cerrado Mineiro
Presidente: Francisco Sérgio de Assis
Atividade: Pesquisa & Desenvolvimento

3.8 Case Study

Sítio Conquista/Venda Nova do Imigrante-Espírito Santo

The Roque family was faced with a dilemma: they wanted to produce high-quality coffee to sell it at a better price.

Introduction

The climate conditions from Sítio Conquista hinder coffee dryness in winter, which can jeopardize the quality of the product. One option to counteract the problem is hulling the coffee, which facilitates and makes the drying process shorter. Before hulling it is necessary to wash the fruits, a water-consuming operation, so the burning question came to the forefront: what to do with the waste water from hulling? The treatment was costly, and the topography of Sítio Conquista did not suit settling ponds.

Solution came after the invitation from extensionist Evaldo de Paula, a technician from the Capixaba Institute of Research, Technical Assistance, and Rural Extension – INCAPER, to doctor professor Aldemar Polonini Moreli, from the Federal Institute of Espírito Santo – IFES, who noticed that the property was suitable for the implementation of a technology developed in a partnership among EMBRAPA, the Company of Agricultural Research of Minas Gerais – EPAMIG and INCAPER, known by that time as SLAR: Cleaning System of Waste Water.

The members of the Roque Silva family were quite skeptical about what the professor promised; they thought that he would not come back to the farm, a preceding fact with other technicians in the past. To their surprise, Aldemar came back with a project elaborated by his team. Once it was implemented, results were much more impacting than they expected.

The property that illustrates this case is Sítio Conquista, located in Venda Nova do Imigrante – ES. The Sítio was acquired in 2000 and has 3.5 bushes. Arabica coffee, banana, avocado, orange, manioc, corn, okra, jiló, beans, spring onion, parsley and "baroa" potato are grown there. The labor force is strictly family-sourced.

The SLAR system was developed with the goal of making water use rational during coffee preparation in small rural properties. It is rumored that water volume reduction through utilization might amount to 90%. The system has been used by coffee growers from the regions of Matas de Minas and Espírito Santo since 2012. Under technical advisory, facilities were built by the owners themselves.

Slap's history

Researcher Sammy Fernandes Soares, from Embrapa Café/EPAMIG, remembers that the issue of waste water from coffee fruit processing in the highland region of Espírito Santo became evident in 2002 when several growers were penalized due to the lack of an adequate disposition for waste water. Coffee growers responded by requesting a solution to political leaders. With this goal, a meeting took place at Centro Serrano/INCAPER that year, located in the town of Domingos Martins, which was attended by around 80 technicians from institutions of the State Secretariat of Agriculture.

In 2003 saw the elaboration of the research project called "Treatment and disposition of residues generated in processing units of coffee fruits," which was approved by the Coffee Research Consortium in 2004, when some options began to be studied. It was verified that the treatment would be unfeasible due to the high cost, and that water reuse in the processing could be the solution. In the following years, a joint effort between researchers and professors from the Federal Institute of Education, Science and Technology of Espírito Santo – IFES, EPAMIG, Federal University of Viçosa – UFV and Embrapa Café developed a water-reusing technology in a closed system. The system was named SLAR (Cleaning System of Waste Water).

The SLAR studies began in 2008. The system was evaluated by professor Aldemar Polonini Moreli in his Master and Doctorate courses concluded in 2010 and 2013 (MORELI, 2010 and MORELI, 2013) respectively. The doctoral thesis assessed the effects of coffee waste water recirculation on water consumption, its physical and chemical characteristics and beverage quality. The study concluded that reuse allowed for the water consumption reduction from 3 to 0.3 L, without affecting beverage quality. Experiments were conducted at INCAPER's Experimental Farm in Venda Nova do Imigrante and several studies were published from them.

As it concentrates nutrients, water can be utilized in the fertilization of coffee plantations and other crops with a cost reduction effect. In 2015 SLAR has renamed SLAP – Cleaning System for Processing Water. The alteration avoided the negative connotation of the phrase "waste water," since this water is rich in nutrients and can be seen as a valuable input and non-pollutant.

Coffee production in venda nova do imigrante – ES

The State of Espírito Santo is known for its commercial port activity. However, agricultural production has always had a leading role. Coffee production began circa 1845 and, in 1853, it surpassed sugar production. Coffee production contributed to the occupation of the countryside of the south, central and then also the northern region of Espírito Santo. These regions were populated as a result of the expansion of the agricultural frontier in Rio de Janeiro and Minas Gerais. Farmers from other states migrated because they were attracted by the high availability of wasteland in the Province of Espírito Santo (BERGAMIM, 2006).

Unlike Minas Gerais, the dominant coffee species cultivated in Espírito Santo is Connilon, also known as Robusta. Espírito Santo is the main producing state of this coffee species and ranks third in the production of Arabica coffee (CONAB, 2016).

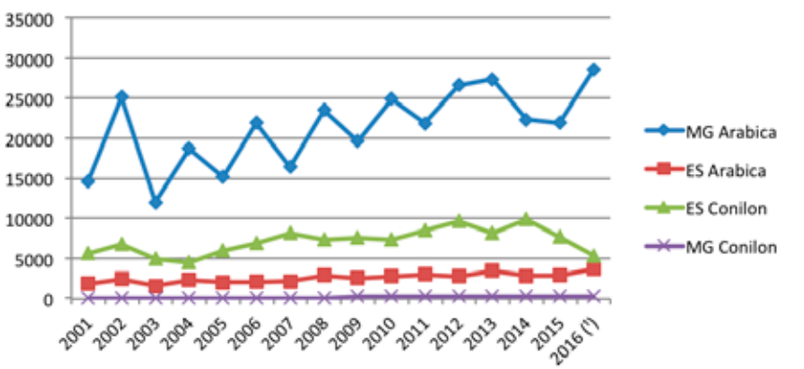


Chart 3.8.1 – Historical series of coffee production (one thousand hulled bags) in Minas Gerais and Espírito Santo

Source: Data from Conab, 2016

Venda Nova do Imigrante is situated in the highland region of Espírito Santo. According to information from the city hall, this town is economically based on agriculture, and its main product is coffee (90% of properties). Another remarkable rural activity is agrotourism, a touristic activity that associates the experience of agricultural routine to leisure and visitation. 70 properties are part of the town's agrotourism program, with 300 families hosting visitors and commercializing crafts and typical products (sausages like social, sweets, jam, liquor, biscuits, etc.). Venda Nova was recognized as the National Capital of agrotourism by Abratur in 1993 (VENDA NOVA DO IMIGRANTE, 2016).

According to IBGE, Venda Nova do Imigrante has 24,615 inhabitants. The Gross Domestic Product (GDP) in 2013 was R$ 384,926, from which 12% (R$ 46,963) referred to agricultural GDP (IBGE, 2013). Unlike the rest of the state, Census 2013 points that 100% of the coffee produced in Venda Nova is arabica (3,550 hectares and 4,260 tons produced).

Figure 3.81: Location Map of Venda Nova do Imigrante

Source: Data from IBGE

The Roque Silva family

Mr. Laerte Silva and Mrs. Maria Lucia Roque Silva worked in a partnership system for coffee production for 30 years[17]. They did not have access to education but always encouraged their children to study and work with them to buy their own rural property. One of the challenges suggested by Aldemar in the implementation of the project was that they learned how to read within two years, which ended up as one more benefit.

The Roque Silva family bought Sítio Conquista in 2000, with 3.5 bushels, and saved up for three years so they could engage in their agricultural activity. In the beginning, seedling plantation occurred only on Sundays, because they worked as colonies in another rural property. They began growing bananas and then came the coffee seedlings. They started with 1,000 seedlings and, in 2016, cultivated 19 thousand trees, and had plans to plant another thousand in order to finally make it to the 20,000 target. As an additional income, the family grows vegetables and fruit to be sold weekly at the municipal fair.

Challenges faced

The city hall of Venda Nova do Imigrante – ES set up, in 2013, an aid program for small growers, granting, through public lending, coffee huskers. The family believed that would be the opportunity they expected to improve the quality of the coffee grown at the farm and, consequently, to make better deals, because due to the high humidity levels in the region and to little room for a patio, they were not able to make high-quality coffee.

The stumbling block in the way concerned the traditional treatment for coffee waste water.

Usually, coffee growers conduct the harvest all at once, by mixing immature, ripe, overripe and dry fruits, and also external elements, like leaves. After the first dry cleaning process, water is used for washing the beans, which is useful in removing several impurities and separate the lighter fruits from, the heavier ones. Water is also used for hulling and for transporting coffee among machines that perform such operations (Soares et al., 2012).

Coffee hulling is the operation for removing the husk from the ripe fruit mechanically. After this, the beans are taken to the patio. According to Matos et al. (2006), in general, the hulling of the coffee from the plantation consumes from 3

17 In the region the term used is "Colonos", colonies in English.

to 5 L of water for each liter of hulled fruit. Wastewater can't be brought back to the environment without proper treatment. The conditions and standards for the release are described in Resolution 430 from CONAMA (BRAZIL, 2011).

As stated by Raggi et al. (2008), the wet process brings advantages like the reduction of the patio-occupied area, as well as the one for the drying machine, due to the decrease of volume and necessary time length for dryness. Nevertheless, coffee growers have been faced with the issue of generation of waste water from the plantation (ARC) in the process. This water is rich in organic material, nutrients, and mineral salts and, if discarded inadequately into the environment, they may present the high polluting potential for soil and water table.

Aldemar, who performs extension work in that region, noticed that, ideally, in Sítio Conquista's case, SLAR should be implemented. He talked to Prof. Juarez Souza e Silva, from the Department of Agricultural Engineering from the Federal University of Viçosa, about the possibility of such move. The professor believed in the family's potential and set up the processing unit project, with closed-system water reuse bundled with a pump, in such a way that growers would be taken through user-friendly installation and equipment assembly. The budget for the construction implementation was set at R$ 16,000.00. The family agreed with the value and also with the challenge proposed by Aldemar, that concerned participating in quality contests as of the second year following the implementation. The perspective was not only to work out the water issue but also to garner a price prize for the quality of the final product.

According to SILVA (2014), the simplest SLAP model, like the one installed at Sítio Conquista, is composed of three 1,000-L decantation boxes, interconnected by PVC pipes, and two sieve filters. The first and the second sieves are built by 1.5 mm and 1.00 mm mesh filters respectively and are disposed in a sequence, at a 30º slant between the water output from the third box and the pumping tank to the reuse box.

Still, according to SILVA (2014), the boxes retain residues that are denser than the water by decantation and the less dense ones by the flotation process. The residues, which can clog the nozzles of the hulling machine cylinder, washed out of the third box, are retained in the sieves (filter) of the SLAP. As soon as the water has been used in four or five recirculations, it goes on to the fertigation process, and the residue from the boxes (decanted and supernatant) is forwarded to the composting process.

The SLAP has 3.0 x 1.0 x 1.0 dimensions (masonry), plus a 500-1,000 reservoir, with overall retention capacity ranging from 2,800 to 3,000 liters of coffee processing water – APC, regardless of the processing capacity (volume of fruits). That means that the same SLAP structure sizing suit different processing unit sizes (UP). What varies is the water circulation time length.

At Sítio Conquista, water circulates in the system for one week for the processing of 8,000 liters of fruits. In a property near Venda Nova do Imigrante, in Itatiba, there is a system that operates on a much larger scale, by processing 60 thousand liters of fruits. In this case, the same water lasts for only two days as not to jeopardize quality.

According to Aldemar, the project designed for Sítio Conquista was aimed at setting up the facilities in the most rational and economic way possible. Even though Roque Silva family did not have a construction background, the construction of the UP and the equipment installation was very fast. The first visit took place in February 2015, and by then the unit had already been built.

Figure 3.8.2: Processing Unit, consisting of a washing tank, a hulling machine/washer and SLAP. Sítio Conquista

Patio time decreased as a result of coffee hulling because there was patio room left because of volume reduction and the coffee could be thoroughly dried within a week.

SLAP provides high reutilization of nutrients that remain in the water during the hulling process. This water is used for the fertirrigation of coffee and banana. The coffee husk, rich with potassium, began to be utilized for fertil-

ization. Hence, one of the three fertilization turns was not necessary, because coffee was balanced with fertigation only. Nitrogen-based fertilization was cut down by around 20%.

According to the owners, banana yield soared from 20 to 30 kg per bunch after the beginning of nutrient intake. Avocado, orange, manioc, corn, okra, jiló, beans, spring onion, parsley and baroa potato are also grown at Sítio Conquista.

The labor force is family-centered, and everyone is involved with the property. For the whole system to be put into commission, responsibilities were assigned by activity. For instance, Mr. Laerte was appointed for raking the coffee in the patio to prevent from fermentation.

Challenges for the future

There are several SLAP-equipped rural properties in the Matas de Minas and Espírito Santo regions. Sítio Conquista, in Venda Nova do Imigrante, was chosen for its model of social and economic transformations. The level of the family's knowledge about the process was improved gradually. Aldemar reports that they had been willing to learn and make progress since the beginning. Nowadays they already discuss management and commercialization strategies, and welcome other coffee growers who are interested in the model.

In 2016, they sent samples out for classification and, on the eve of the case interview, they were called about their coffee being scored high (86) in the SCAA classification (Specialty Coffee Association of America) and that it could be marketed at R$ 700.00 per bag.

Teachings From The Case

This case exemplifies a partnership among teaching, research and extension institutions collaboratively with coffee growers with relevant results. The role of the rural extension of research institutions makes the difference, mainly in small properties. Investments in technologies that improve country life conditions.

This case shows, aside from rational water use, that agribusiness also encompasses small-scale family agriculture. Farmers are entrepreneurs and can make better deals year after year.

Breakthrough innovation can even occur in poorly educated families, provided there is initiative and willingness to observe opportunities.

Bibliographical references

BERGAMIM, Marcia Cristina. A pequena propriedade rural no espírito santo: constituição e crise de uma agricultura familiar. In: CONGRESSO DA SOCIEDADE BRASILEIRA DE ECONOMIA, ADMINISTRAÇÃO E SOCIOLOGIA RURAL, 44., 2006, Fortaleza. Anais... Brasília, DF: SOBER, 2006.

BRASIL. Conselho Nacional do Meio Ambiente. Resolução nº 430, de 13 de maio de 2011. Dispõe sobre as condições e padrões de lançamento de efluentes, complementa e altera a Resolução nº 357, de 17 de março de 2005, do Conselho Nacional do MeioAmbiente – CONAMA. Available at: <http://www.mma.gov.br/port/conama/legiabre. cfm?codlegi=646> Accessed on August 18, 2016.

CONAB. COMPANHIA NACIONAL DE ABASTECIMENTO. Safras. Série histórica de produção de café arábica e conilon. Disponível em: http://www.conab.gov.br/conteudos.php?a=1252&t=2 Accessed in September 2016.

IBGE. Cidades 2013, Venda Nova do Imigrante. Site: http://cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=320506&search=espirito-santo|venda-nova-do-imigrante. Accessed in October 2016.

MATOS, A. T.; CABANELLAS, C. F. G.; BRASIL, M. S. Ensaio de sedimentação em água utilizada no descascamento/despolpa de frutos do cafeeiro. Engenharia na Agricultura, Viçosa, v. 14, n. 3, p. 148-155, 2006.

MORELI, Aldemar Polonini. Avaliação de um sistema de remoção de sólidos para maximização do uso da água no processamento dos frutos do cafeeiro. 2010. 68f. Dissertação (Mestrado em Produção Vegetal) – Centro de Ciências Agrárias, Universidade Federal do Espírito Santo, Alegre, 2010.

MORELI, Aldemar Polonini. Maximização da reutilização da água residuária do processamento dos frutos do cafeeiro: influências em características físico-químicas do efluente e qualidade da bebida do café. Tese (Doutorado em Produção Vegetal) – Universidade Federal do Espírito Santo, Centro de Ciências Agrárias. 2013.

PREFEITURA DE VENDA NOVA DO IMIGRANTE, Histórico do município. Site: http://vendanova.es.gov.br/website/site/Historico.aspx Acessado em outubro, 2016.

RAGGI, Luiz Gustavo de Rezende; Matos, Antonio Teixeira de, Resende, Fátima Aparecida. Avaliação de sistemas de tratamento de águas em recirculação no processamento dos frutos do cafeeiro.COFFEE SCIENCE, Lavras, v. 3, n. 1, p. 19-29, jan./jun. 2008.

SILVA, Juarez de Souza; DONZELES, Sérgio Mauricio Lopes; SOARES, Sammy Fernandes; MORELI, Aldemar Polonini; VITOR, Douglas. Lavadores e Sistema de Reúso da Água no Preparo do Café. Circular Técnica 4. EMBRAPA CAFÉ Brasília-DF, Janeiro, 2014.

SOARES, Sammy Fernandes; MORELI, Aldemar Polonini; DONZELES, Sérgio Mauricio Lopes; PREZOTTI, Luiz Carlos. Reuso da Água na Produção de Café Cereja Descascado. Circular Técnica 1. EMBRAPA CAFÉ Brasília-DF, Janeiro, 2012

3.9 Case Study

Educampo/Manuaçu – Matas de Minas Gerais

In 2001, the coffee price stood as the best in seven years. Sérgio D'Alessandro was looking at his highland coffee and began to wonder how to make ends meet.

Introduction

Coffee growers from the Matas de Minas region are based in a beautiful highland region. High altitudes provide excellent coffee bearing a multiplicity of flavors and aromas. However, the region also brings challenges, such as rainfall during the harvest period, which can cause undesirable fermentation to the final product and also high labor cost.

Nowadays quality contests show the other way around, but up until relatively recently coffee growers and specialists believed that it would be impossible to produce quality coffee in the region. In spite of the difficulty, this was the dream of a small group of growers, and in believing in that possibility, created SCAMG – Association of Specialty Coffee in Minas Gerais in 2001, in the city of Manhuaçu.

This same group was seeking out alternatives for the low prices operated in the domestic and international markets that year. Quality investment in previous years had raised costs, and they could not make ends meet. They needed to make better selling deals or cut costs down.

These growers found out that they could push costs down by exchanging experiences, but with that intent, they needed to have the same basis of comparison. That was the spark for the implementation of the Educampo Coffee in the Matas de Minas region project, together with SEBRAE some years later.

This makes a case for innovative collective action that impacts participants positively, by means of cost cutbacks, increase of competitiveness, price and sales method improvements.

The D'Alessandro family

Sérgio is the son of an Italian immigrant. His father, Mario D'Alessandro, came to Brazil after the war. In 1966, he got married and, as a wedding gift, the couple was given the lands for kicking off coffee production. Mr. Mario was innovative in the production. He made level curves to prevent erosion and began to harvest coffee on a canvas and not on the ground, which was widely practiced by that time. Mr. Mario warned that the secret to having profit was to sell better. Sérgio worked along with his father in coffee production since he was very young. At 14, he already drove a Ford F 75 truck, and his Agronomic Engineering degree was the outworking of his passion for coffee.

When Mr. Mario passed away in 1989, Sérgio was still attending Agronomy school, in Viçosa, but already took over the farm administration and worked in the facilities every weekend.

The SCAMG

Up until the 90's, the Matas de Minas region was not recognized for the quality of its coffee. A landmark for the region was when Mr. Renan Werner, a grower from Manhuaçu, was ranked among the finalists from "Illy Quality Prize for Espresso," in 1996. Later on, in 1998, another grower from the region, Mr. Mauro Garcia, was ranked among the finalists. Completing this particular setting, grower Mrs. Ceci Maria de Faria was ranked first in the Cup of Excellence contest from BSCA[18], in 2000.

These awards stimulated a small group of coffee growers to seek out more information on preparation techniques of quality coffee, mainly hulling. From 1999 onwards, Illycaffè began to source natural pulped coffee, which represented a significant incentive, once the preparation of natural coffee in the region had its quality harmed by high air humidity levels.

That group of growers determined to make quality coffee began to strengthen with the exchange of information on the wet process, popularly known was coffee hulling. Hulling machines did not work correctly and the leading manufacturer did not meet the technical assistance demands. Therefore, there was an exchange of experiences in a joint learning process that strengthened the bonds,

18 BSCA means Brazil Specialty Coffee Association. Since 2000, BSCA has been holding the "Cup of Excellence" Gourmet Coffee Competition of Brazil.

prompting the creation of the Association of Specialty Coffee from Minas Gerais (SCAMG) on April 11th, 2011, presided by Sérgio Cotrim D'Alessandro.

Sebrae partnership and "Coffee from Matas de Minas" project

SCAMIG was faced with hardship due to skepticism and lack of cooperative culture in the region. An alternative that was proven stimulating for collective creation was the partnership with SEBRAE, which generated a quick response with the support from several courses and lectures on quality, production management and techniques, leading up to the brand project for "Região Matas de Minas" and further geographical indication "Café das Matas de Minas".

THE GEOGRAPHICAL IDENTIFICATION OF MATAS DE MINAS was launched in September 2014 and establish that growers who grow coffee scoring 80 points or above in the cup tasting will be entitled to market the beans by utilizing the "Região das Matas de Minas" brand. The aim of the project is to advertise and differentiate the coffee from the region, as well as stimulate growers to invest in quality improvement (Matas de Minas, 2016).

The Brazilian Institute of Statistic Geography (IBGE) divides Minas Gerais into 12 mesoregions: Noroeste de Minas, Norte de Minas, Jequitinhonha, Vale do Mucuri, Triângulo Mineiro and Alto Paranaíba, Central Mineira, Metropolitana de Belo Horizonte, Vale do Rio Doce, Oeste de Minas, Sul e Sudoeste de Minas, Campos das Vertentes e Zona da Mata, as it is shown in the map as follows (Minas Gerais, 2016).

The production of the area for specialty coffee of the geographical indication designated Matas de Minas is in the Zona da Mata mesoregion, and part of it is in Vale do Rio Doce. It comprehends 63 cities and covers 275 thousand hectares. It has 36 thousand growers, of whom 80% have less than 20 hectares of planted area. In total 75 thousand direct jobs and 156 indirect jobs are generated (Matas de Minas, 2016).

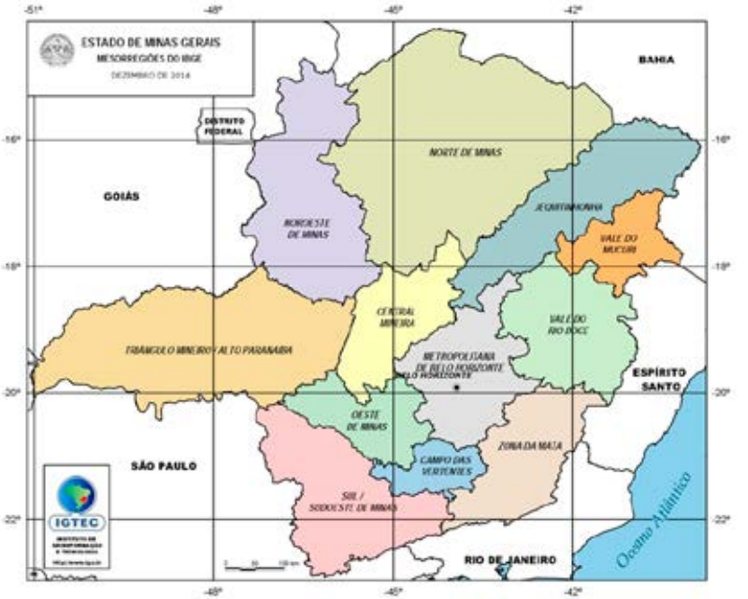


Figure 3.9.1. – Mesoregions from Minas Gerais

Figure 3.9.2 – Detail of the Zona da Mata region

Among the project themes discussed in the SCAMG-SEBRAE partnership, the possibility of certification of the region's growers was contemplated. When analyzing the three fundamental certification pillars (environmental, social and economic), it was rapidly confirmed that the economic component was the one that most needed support. The subsequent action resulted in the Educampo project.

The Educampo Coffee in Matas de Minas

One of the concerns that SCAMG's growers had was about production management and costs. All of them owned information about their costs, but each one of them had their own incomparable methodology. Labor cost in the region amounts to 80%. Therefore, cost control and management are paramount to the profitability of the activity.

This group of growers hired, in 2001, a technician who developed a dynamic Excel spreadsheet, which allowed everyone to look at costs in the same way. It was sold to growers just to cover the technician's costs.

In 2004, a company was hired to develop the "Manager of Farms" system, more sophisticated, which considered expenses and income. One of the group's objectives was to build a database that permitted comparisons and improvements made out of them. This software is still used by some growers alongside Educampo.

In 2007, SEBRAE introduced Educampo to SCAMG, a management program for rural properties that would bring procedures together, facilitating comparisons and background exchange. So Educampo was created.

Educampo was initially created in 1997 for milk production. SEBRAE and partners had the goal of unifying technical assistance, business management and cost control in rural properties. Later on, it was expanded to coffee and fruit productions, always in partnership with SEBRAE with a Cooperative, Association or agribusiness. In 2016, the overall number of groups totals 83, from which 53 of milk, 27 of coffee, 2 from fruit farming and one from pork production, all in Minas Gerais.

In Matas de Minas partnership was entered with SCAMG in order to equalize queue growers' financial sustainability.

The functioning of Educampo mainly relies on the following factors:

- Adequate collaboration from the grower. It is necessary to take accurate records of all expenses so that they can be passed on to the technician once a month.
- The technician from Educampo, a key element in the project, should keep up a good relationship with growers, SEBRAE and the Educampo Board.
- The Board of Educampo/SEBRAE, which is supposed to make the necessary adjustments to the program, as well as keep track of and monitor groups.
- Project local coordinators: Ari de Oliveira Filho and João Luís Carneiro Viana, who make the interface between the Association and SEBRAE. When problems are identified, it is their duty to contact SEBRAE for solving them.

The Educampo group from Matas de Minas from Manhuaçu has 11 growers, 24 properties and the overall number of 1,200 hectares of coffee. The full list of growers participating in this group is in Annex 1.

The current technician from the Matas de Minas group is agronomist Flávio Borella Pena. Flávio is an agronomist who is experienced with coffee and, as part of his work in Educampo, he also provides agronomic technical assistance to most growers from the group. The way of hiring is chosen by each owner, and the technician can perform tech assistance and/or take care of costs only.

Regardless of the way of hiring, Flávio goes to each and every farm once a month, and the visit begins with the plantation. He walks through all the property, preferably together with the coffee grower or his/her manager. Afterward, they go to the office for launching costs in the previously defined model. Time consumption in each property depends on its size. At the end of the visit, the grower receives a financial report and agronomic recommendations, in case the technician is also made responsible for the agronomic follow-up in the property. The cost for each group participant will derive from the time spent in the property, its distance from Manhuaçu and whether or not the agronomist was hired for technical assistance or only as an Educampo technician.

The monthly report received by the growers breaks down the closed production cost for the referred month and its ranking position among the group members so that he/she keeps track of their monthly data evolution in comparison with the others.

The ranking availability online is estimated, especially the average of the other groups from Educampo. The opportunity of cost comparison signals room for improvement. For quite some time the members of Matas de Minas group no longer use identification codes just as a way to exchange experiences.

The model resembles the CREA groups (Regional Consortium of Agricultural Experimentation) from Uruguay. The CREA method is based upon the joint work of rural growers by means of exchange of information among its members on problems faced by them, in order to reach personal and collective development.

"The CREA group members can get to know, observe and analyze how other companies work. This way, members can draw conclusions about production systems and techniques employed, as well as business strategies and commercial agreements that their peers accomplish." (free translation – FUNCREA, 2016)

There is a monthly meeting among CREA members so that they can address their needs and find common solutions.

Educampo from Matas de Minas has this remarkable feature of information exchange among members. Among the activities, meetings are called for in-group and group-to-group interactions. They have at least three meetings a year in order to improve their critical points.

Challenges faced

When Educampo was implemented in Matas de Minas, there had been groups of growers in Cerrado and South of Minas, but as the profile of the regions is quite different, and the program is the same, there was a difficulty during the implementation. Regions were distinguishable for their relief and, consequently, for their harvest type. In Matas de Minas, the harvest is nearly all-manual, whereas mechanization prevails in other regions.

The group came up with the program evolution through several improvement tips submitted to SEBRAE, mainly those regarding releasing ways about the manual harvest.

The group also conceptually questioned the set of activities, like those that compose post-harvest, as an example.

Another challenge was set by the technician. Flávio is the fifth Educampo technician in the region. He began work in February 2014 and brought about his agronomist and grower backgrounds. Among technicians, he is the one who mostly provides farms with agronomic assistance. Former technicians headed straight to the office and did not get involved in assistance. As Flávio roams through all the farms, he offers tips on production ways or more cost-efficient products.

Another important challenge was about the cost. In other regions, the SEBRAE partnerships are cooperatives, and they covered costs partly, but Manhuaçu does not have a cooperative, so the cost is covered in its entirety by growers. Perhaps that may be one of the reasons for its success.

The following challenges were also taken into account: little effort from some group members and reluctance to accept the technician as an agronomist since most growers had an agronomist of their own and did not intend to let go of them.

Another hindrance was the fact that most group members had a college degree and insisted on using their own concept of production costs.

Particularities

Growers pondered that all the period prior to 2010 was a real learning experience and nowadays the group is in the spotlight. Data shows that Educampo has helped them reduce costs, boost competitiveness and also make better sales deals since now they can see production costs more clearly.

The group from Matas de Minas has welcomed visitors from other regions, as a way to check how they have gotten good results.

Group members emphasized that harmony among members is essential for the result.

The success of the program relies on the following variables:

- Grower's commitment;
- Involvement of the coordination;
- The Board of Educampo;
- SEBRAE
- The technician in charge.

Here are some of the results:

- Reduction of effective operational costs (COE) by hectare, of 8.95%, which is equivalent to a 2.23% biennial COE reduction, as well as a 10.4% reduction in the overall cost (CT) by hectare, within the same period.
- Permanent cost reduction as of 2011, down to 10.4%.
- In recent years, a water deficit in high-demand seasons in Matas de Minas was observed, and it is a fact responsible for the sheer yield reduction in 2013/2015 biennium.
- The overall cost (CT) by bag presented a 4% reduction during the 2013/2015 biennium, in comparison to 2010/2012, even with yield decrease of 7%.
- The same analysis disregarding the last biennium, which was uncommon due to climate conditions, a 16% overall cost reduction by bag was verified for 2012/2014 in comparison to 2010/2012 and a yield increase by 22%.

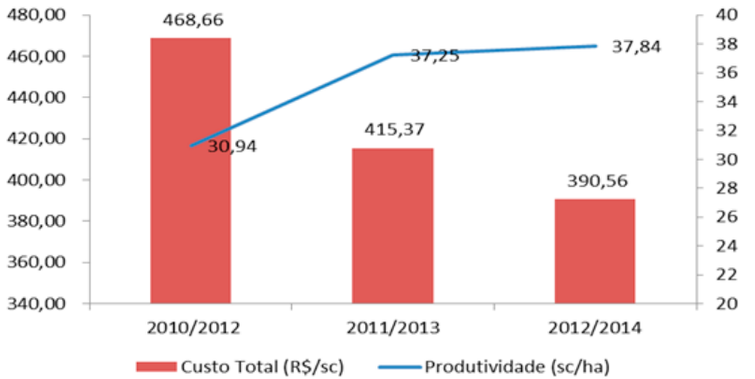


Figure 3.9.3 – Chart with overall cost evolution by the bag and with yield for the biennia 2010/2012 to 2012/2014

These are the reasons why Matas de Minas stood out among other groups:

- Improvement of product quality, a benchmark with the post-harvest work;
- The growth of the average selling price and of commercialization tools such as future sales, locks, etc., deriving from knowledge about production cost and long-term cash flow forecast;
- Improvement of the productivity of the SCAMG group in comparison to other Educampo groups. Labor cost makes up 60% of the overall cost. Hence productivity is essential for the activity to be economically feasible.

Looking to the future

The future challenges for the Educampo project are:

- Constant improvements in the program;
- Educampo expansion in the region;
- Sharing data with other growers;
- Performance of field work, aided by actions that can improve background exchange, aiming at cost improvement from all members.

Teachings from the case

Usually, production cost, when known, is hidden behind seven keys. This case is worthy of attention because growers, when not competing among themselves, tend to benefit from information sharing on utilized practices and costs.

Information sharing based upon a common-ground methodology of production cost elaboration makes it possible to elaborate the average amount of costs that participants have. It is also useful as a comparison parameter so that they can check whether they are operating under or above the group's average, and they can take management measures to adjust their performance.

This case also highlights the importance of efficient cost management.

Bibliographical references

FUNCREA. CREA. Institucional. Los princípios Metodo CREA. Website: http://www.fucrea.org/informacion/index.php?TypeId=12&ClassId=26 Acessado em: outubro/2016

MASSON, THIAGO SIQUEIRA. A desconfiança dos cafeicultores da zona da mata mineira no gerenciamento de cooperativas agrícolas (subsídios para a nova economia institucional). DISSERTAÇÃO DE MESTRADO EM AGRONEGÓCIOS. PROGRAMA DE PÓS-GRADUAÇÃO EM AGRONEGÓCIOS. UNIVERSIDADE DE BRASÍLIA. FACULDADE DE AGRONOMIA E MEDICINA VETERINÁRIA. 2010.

MATAS DE MINAS. Região das Matas de Minas. Website: http://www.matasdeminas.org.br/ Acessado em outubro/2016

MINAS GERAIS, 2016. Portal Governo de Minas Gerais. Meso e microregiões. Website: https://www.mg.gov.br/governomg/portal/c/governomg/conheca-minas/geografia/5669-localizacao-geografica/69547-mesorregioes-e-microrregioes-ibge/5146/5044 Acessado em outubro/2016.

ANNEX 1 – Full list of participants from Educampo Matas de Minas group (August 2016)

1. Angela dos Santos Raeli
2. Ari de Oliveira Filho
3. Edinilson Alves Dutra / Walter César Dutra
4. Elizabeth Werner de Freitas
5. Euler de Moura Soares Filho
6. João Luiz Carneiro Viana
7. José Antonio Pena
8. Mauro Garcia Correa / Marcelo Garcia Correa
9. Mauro Luiz Heringer
10. Sergio Cotrin D'Alessandro
11. Wallace Ferreira Pedrosa

3.10 Case Study

Retiro Farm /Manhuaçu – Matas de Minas Gerais

Mr. Cornélio Emerick de Paula was a visionary in 1975, anticipating great trends that future held. He looked at his coffee at Retiro Farm and was sure that it needed a resting period for quality improvement.

Introduction

As it was reported about the existence of coffee hulling machines in 1979, Mr. Cornélio Emerick de Paula got motivated and became one of the earliest growers in the region to purchase the piece of equipment. The first attempt did not bear fruit because yield fell short. That was the motivation to understand how the equipment worked. Mr. Cornélio saw potential in it. He rolled up his sleeves and went down to work on improving the hulling machine. His effort resulted in a whole new machine, whose functioning was so good that patenting was encouraged, as well as the beginning of scale production, giving rise to the Máquinas Realeza factory.

A routine of innovations

At Fazenda Retiro, it is a commonplace to develop, adapt or enhance equipment that can improve coffee preparation. The farm pioneered floater coffee hulling in the region. The creator and executor of this type of hulling machine were Mr. Cornélio himself. Mr. Ivan Januário Lage, Cornélio's son-in-law, learned the art of producing coffee and shared his father-in-law's spirit of innovation. For many years he has been sharing his innovations with those who walk up to him. In his wife's words, Ângela Maria de Paula Lage, "the family is always attentive to possible innovations."

Fazenda Retiro

Fazenda Retiro is situated in the District of São Pedro do Havaí, in the city of Manhuaçu, Minas Gerais, part of a region known as Matas de Minas, a geographical indication that is in the Zona da Mata mesoregion. The Matas de Minas region is made up of 63 cities in the East of the State of Minas Gerais and 36 thousand growers. The map that shows the location of the region is presented in Figure 3.10.2 and data of coffee production in the city of Manhuaçu are in Table 3.10.1.

Figure 3.10.1 – Map of Zona da Mata Region

Source: MASSON, 2010

Table 3.10.1. Coffee production in the region

Coffee data in beans (2014)	Manhuaçu	Minas Gerais	Brazil
Establishments – over 50 Arábica coffee trees (units**	3.166	104.939	199.492
Establishments – over 50 Canephora coffee trees (units)**	12	8.488	87.350
Arábica Coffee – Amount Produced (tons)	16.320	1.346.517	2.012.172
Arabica Coffee – Production Value (thousand reais)	111.492	9.301.169	12.726.052
Arabica Coffee – Planted Area (hectars)	17.000	995.621	1.550.112
Arabica Coffee – Average Yeald (kg/hec)	960	1.352	1.298

**** Data available only for the year of 2006 and provided by Agricultural Census. Source: Municipal Agricultural Production. IBGE.**

Mr. Cornélio began with arabica coffee production in the 1960's, always with quality in mind. 2016's production stood at 2.900 bags of coffee. According to reports from growers in the region, Mr. Cornélio had a free mind and the fact that he was poorly educated did not stop him from creating and enhancing coffee hulling machines. It is reported that, whenever he caught sight of a faulty machine, he worked on it until he could fix it.

As an outcome of the development of innovations, Mr. Cornélio created the "CEP Máquinas Realeza" for the manufacturing of machines and other equipment suited for coffee processing and hulling. The original name was CEP INDUSTRY AND COMMERCE LTDA. In the 1990's the company shifted focus to metallurgy, and it was renamed to CEP METALLURGY LTDA. After Mr. Cornélio's passing, his sons Marcos Emerick de Paula and Sergio Emerick took over the company administration.

Back to Fazenda Retiro, when Mr. Cornélio's daughter got married, the family gained a new partner, Mr. Ivan, a metalworking technician that moved to Manhuaçu to help his father-in-law and Mrs. Ângela grow coffee. Always looking forward to quality improvement, in 2006 they hulled from 70 to 80% of all the coffee produced on the farm. In 1998, while commemorations on the sale of the first lot to Illycaffè, Mr. Cornélio passed away. His search for innovation was not broken, as we will show thereafter.

Innovations developed at the farm

The hulling machine for floater coffee

The main innovation developed by the family was the hulling machine for floater coffee in 1983/84, an important piece of equipment for high-rainfall regions in the harvest phase. Work begins in the washer, that separates cherries from floaters and immature ones. The floater is separated in the washer, but Mr. Cornélio observed that a large number of sticks was not separated from the beans. In order to sort out the problem, he developed a rotative cylinder with slotted holes that separate small floaters from large ones (overripe coffee) and also from sticks. Thus, when floaters are placed into the washer, the bean floats, goes through the cylinder and flows into the floater hulling machine. This way,

the overripe coffee is hulled solely, which results in the improvement of the quality process.

The floater is a hulling machine, just like the revamped cherry hulling machine, is equipped with a calibration system with a rubber system that allows for hulling without hurting coffee. The system requires calibration and daily cleanliness of the rubber, depending on the type of coffee. This is the only procedure that leads to adequate hulling.

Figure 3.10.2 – Cylinder for separation of overripe floaters

Figure 3.10.3 – Floater hulling machine developed by Mr. Cornélio

Figure 3.10.4 – Detail of rubber system in the hulling

Figure 3.10.5 – Nipple cylinder

Wet-process hulling roller for coffee

After the success of the coffee wet hulling process, Mr. Cornélio and Ivan stumbled on another problem: the quality of the dry hulling, commonly called "limpa de café." The existing hulling machines by that time operated the "Madeira conventional" ("conventional leaker"), which performed well with natural coffee, but with natural-pulped coffee (CD) it generated broken beans, low yield and also detectable coffee parchment in the hulled coffee. In the 1990's, Mr. Cornélio began to study a hulling system to work out these problems, which would be drawn upon a pressing system. He then conceived the wet-process hulling roller, which is a cylinder with blades, where coffee is hulled by pressure without causing physical damage to the bean, resulting in high-quality coffee. In 1990, Mr. Cornélio built the earliest hulling machine bundled with this wet-process hulling roller, which is on demand at Fazenda Retiro until today.

This hulling system has two types of blades: plain for natural coffee and cogged for natural-pulped coffee. It also has a worm screw for rotation control of the hulling operation.

Figure 3.10.6 – Wet-process hulling roller and classification row

Figure 3.10.7 – Detail of the hulling roller

Figure 3.10.8 – Upper view of the hulling roller (open cover)

Figure 3.10.9 – Detail of the inner part of the hulling roller

Enhancement of the classification machine

Along with the improvement of the dry-process hulling machine and, consequently, the increase of productivity (hulled bags per hour), came the need for improving classification capacity. This occurred potentializing the "ventilation column." An air column performs the separation of normal beans from broken ones, and also performs the pre-sifting process of the beans by density. The heavier beans, that is to say, the ones of better quality, remain at the bottom. The equipment can be viewed in Figure 3.10.6.

The bag "sariador"

The "sariador" (lifter) of bags was another innovation benchmarked by Mr. Cornélio, with the goal of facilitating the operator's work, because it enables a person to carry a bag of coffee on top of his/her head and then pile it up on the lot.

Figure.3.10.10 – The bag "sariador"

Vibrating Sieve

When the coffee is passed through the washer/hulling machine, it gets wet. Good post-harvest practices indicate that water should not be taken to the patio, nor wet coffee, because it makes dryness longer, leading to high risk of undesired fermentation. Big properties use a centrifuge that removes water content after the washing process. However, it is an expensive piece of equipment for small growers. Concerned about this issue, Mr. Cornélio developed a vibrating sieve. It consists of a vibrating sieve that removes water surplus before coffee is taken to the patio. The sieve was placed in all coffee outputs and works nearly as efficiently as the centrifuge.

Figure.3.10.11 – Vibrating Sieve

Vertical Dryer

In the 1990's the dryers available in the region did not cater to hulled coffee because they could physically harm the beans. Mr. Cornélio modified a dryer so it could be fitted to the dryness of natural-pulped coffee. Modifications included:

- Rotation and cup elevator adaptations;
- Changes to the coffee discharge inclination ("tombo do café");
- Distribution and adjustment of drying air flow;
- Adaptation of the inner distance and inclination of the drying chamber.

Such changes considerably reduced physical harm and the dryer began to be fit for drying lots of natural-pulped coffee. The first dryer that was built in 1994, still works at Fazenda Retiro.

Figure 3.10.12 – Vertical dryer

Main difficulties encountered

The goal of growers from Fazenda Ribeiro has always been the production of high-quality coffee. What encouraged them to develop and adapt equipment was the early inexistence of equipment that could meet quality demands. The functioning of existing equipment was not satisfactory, either due to harming the bean quality or by producing poor yields. The solution found by Mr. Cornélio and Mr. Ivan was to develop their own equipment from scratch until functioning was fully optimized.

Challenges for the future

Mr. Ivan and Mrs. Ângela Maria intend to keep on making quality coffee sustainably and efficiently. The main challenge for the future is to meet that target and, to that intent, they intend to continually improve equipment and farming operations, in order to reduce damage done to coffee quality, as well as produce it cost-efficiently.

Teachings from the case

This case makes it evident that not always are technical solutions complicated to be worked out. It stands to reason that talent for improving equipment shown by Mr. Cornélio, and Mr. Ivan is not an easily found asset, but when the grower sets himself to look into the functioning of the machines or of operation at the farm, he can find the solution to the problem, frequently at low cost.

The management of an enterprise requires dedication to the activity and attentive presence of the owner throughout the operations, in order to be acquainted with everything that happens around. Kowing a problem well increases the chances of finding a solution.

Formal education is not always a passport to creativity. Will and motivation can be useful as a mainspring in many processes, as this case shows abundantly.

References

IBGE. Produção Agrícola Municipal (2014). Disponível em: http://www.ibge.gov.br/home/estatistica/economia/pam/2014/ Accessed in October 2016.

MASSON, THIAGO SIQUEIRA. A desconfiança dos cafeicultores da zona da mata mineira no gerenciamento de cooperativas agrícolas (subsídios para a nova economia institucional). DISSERTAÇÃO DE MESTRADO EM AGRONEGÓCIOS. PROGRAMA DE PÓS-GRADUAÇÃO EM AGRONEGÓCIOS. UNIVERSIDADE DE BRASÍLIA. FACULDADE DE AGRONOMIA E MEDICINA VETERINÁRIA. 2010.

MATAS DE MINAS. Região das Matas de Minas. Website: http://www.matasdeminas.org.br/ Accessed in October 2016.

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4. Strategic supply contracts for high quality coffee

Decio Zylbersztajn • Samuel Ribeiro Giordano
Christiane Leles Rezende de Vita • Gustavo Oliveira

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 chapter tis structured in seven 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 Management, 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).

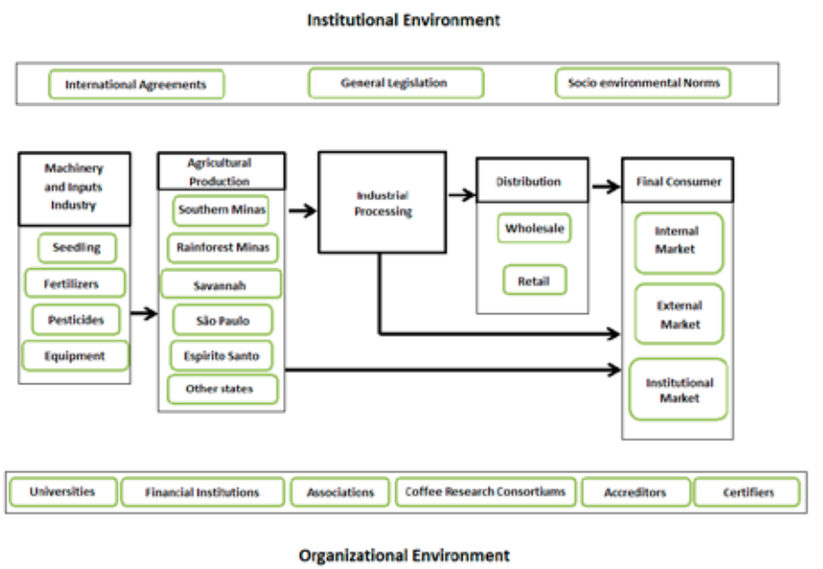
The PENSA method of analyzing the Agribusiness System is based on the economic theory of the New Economics, and the Transaction Cost Economics (TCE), as well as the Industrial Organization. This technique is worried in adopting a mesoanalytical view, which considers the institutional environment and 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 4.1 – 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.

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.

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.

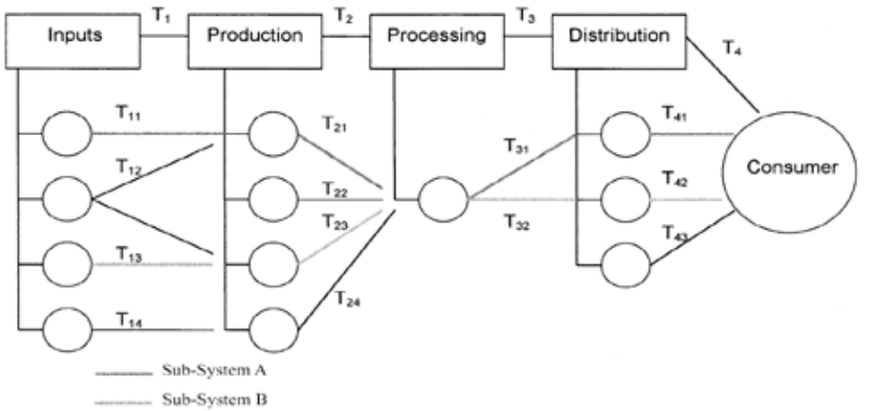


Figure 4.2 – Business Model via strictly coordinated system

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 Item 4.6 about 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 item 4.2 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. 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.

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

Chart 4.1 – Decision to hire mechanized services

Source: Elaborated by the authors

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: 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 the topic of producers subcontracting equipment in the courses at the University and day fields of the Club Illy.
- The importance of exploring the theme of producer's micro-innovations, such as those who design and build their own equipment.
- The theme of human resource management, because of the temporary labor in the sector.
- 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 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.

4.5.1.8 References

CALEMAN, Silvia M. de Queiroz, 2015. Contratos e Coordenação. In: ZYLBERSZTAJN, Decio; EVES; Marcos Fava; CALEMAN, Silvia. Gestão de Sistemas de Agronegócios, Atlas, 2015.

da Silva, C.A. and Rankin,M. Contract Farming for Inclusive Market Access. FAO. Rome 2013.

FAO. Legal Guide on Contract Farming. UNIDROIT-FAO-IFAD. Rome, 2015.

KLEIN, Benjamin. Contracts and incentives: The Role of Contracts Terms in Assuring Performance. In: WERIN, L and WIJKANDER, R. Contract Economics. Oxford, Blackwell, 1992.

KLEIN, Benjamin; CRAWFORD, Robert; ANCHIAN, Armen. Vertical Integration, Appropriable Rents and The competitive Contracting Process. Journal of Law and Economics. Chicago, v. 21, p.297-326. October, 1978.

NEVES; Marcos Fava; CALEMAN, Silvia M. de Queiroz, 2015. Metodologia de Análise de Sistemas Agroindustriais. In: ZYLBERSZTAJN, Decio; EVES; Marcos Fava; CALEMAN, Silvia. Gestão de Sistemas de Agronegócios, Atlas, 2015.

NORTH, Douglass. Institutions, Institutional Change and Economic Performance. Cambridge: Cambridge University Press, 1990.

REZENDE, Christiane Leles; ZYLBERSZTAJN, Decio. 2011. Quebras contratuais e dispersão de sentenças. Revista Direito GV 13. Vol 7 N.1 Jan-jun 2011.

SILVA, Carlos Arthur da. The growing role of contract farming in agri-food systems development: drivers, theory and practice. FAO – Agricultural Management, Marketing and Finance Service. Rome, July, 2005.

WILLIAMSON, Oliver. The Mechanisms of Governance. Oxford, New York: Oxford University, 1996.

ZYLBERSZTAJN, Decio. 2005. Papel dos Contratos na Coordenação Agro-Industrial: um olhar além dos mercados. RER, Rio de Janeiro, vol. 43, nº 03, p. 385-420, julho/set 2005.

ZYLBERSZTAJN, Decio. Estruturas de governança e Coordenação do Agribusiness: uma aplicação da Nova Economia das Instituições. 1995. Tese (Livre Docência em Administração) – Programa de Pós-Graduação em Administração, Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo.

ZYLBERSZTAJN, Decio; FARINA, Elizabeth Maria Mercier Querido. Strictly Coordinated Food Systems: exploring the limits of the coasian firm. International Food and Agribusiness Management Review, New York, v.2, p. 249-265, 1999.

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 readi-

ly 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.

4.5.2.3 REFERENCES

Saes, M.S.M. Cadernos da Universidade illy do café. V1 / editado por Samuel Ribeiro Giordano e Christiane Leles Rezende. São Paulo: Universidade illy do café/PENSA-FIA-FEA-USP pp 26-50.

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 learn-

ing; 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: Coffee
   Number of Hectares_____ Number of bags produced_____
   Percentage in rural income (%)_____
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.
   If you are: what's the name of the cooperative or association? _____
   How long have you been a member? _____years.
10. Do you participate in coffee producer seminars? ( ) Yes ( ) No.
   If you do: Which? _____
   For how many years? _____ years.

B) CHARACTERISTICS OF THE PRODUCTION

11. In Cultivation and harvest labor is: (percentage of each modality):
   % ( ) Own Mechanization
   % ( ) Outsourced Mechanization
   % ( ) Shared Mechanization
   % ( ) Family Manual labor
   % ( ) Hired Manual labor
12. Classify the PREDOMINANT type of labor used in cultivation and harvest on your property:
   ( ) Mechanized
   ( ) Semi mechanized
   ( ) Manual
13. 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
14. 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
15. 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
16. Do you hire any post harvest service from a company? ( ) Yes ( ) No.
17. 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
18. Do you hire mechanization services from a company? ( ) Yes ( ) No.
19. If you do, what kind of contract do you have?
   ( ) Formal contract per harvest
   ( ) Exchange of services
   ( ) Other: _____
   ( ) I do not hire these services
20. How do you pay the services above?
   ( ) Product
   ( ) Cash
   ( ) Other ways (exchanges)
   ( ) I do not hire these services
21. If you hire mechanization services from a company, what are the characteristics of the company?
   City/State:_____/____
   Years of relationship:_____
   Recommended by :_____
22. 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

23. Have you already had any legal problems hiring mechanized services in your region?
( ) Yes ( ) No.
If so, what was the reason? _____

24. How many workers do you have on your property?
Hired _____
Temporary (hired at peak seasons) _____

25. Do you contract temporary professional you have already hired previously?
( ) Yes ( ) No.
If so, what is the number of times you re-hired someone? _____

26. Where do these temporary workers come from? (What state) _____

27. 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

28. Are the above benefits extended to the temporary workers?
( ) Yes ( ) No ( ) I do not have temporary workers

29. 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

30. 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$ _____

31. 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): _____ %

32. Have you had any legal problems in hiring?
( ) Yes ( ) No.
If so, what was the reason? _____

C) COMMERCIAL ASPECTS

33. What product do you commercialize? (% in the total production of the coffee farm):
% ( ) Dried natural coffee
% ( ) Pulped
% ( ) Other, which: _____

34. 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: _____

35. What % of your total production is commercialized with each of the commercialization channels?
% ( ) Exporter broker
% ( ) Industry
% ( ) Cooperative
% ( ) Internal market broker
% ( ) Others, which: _____,

36. How do you sell coffee?
% ( ) Spot sale
% ( ) Formal contract per harvest
% ( ) Formal long term contract
% ( ) Intention sale term
% ( ) Barter
% ( ) Others

37. 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.
38. What percentage of your coffee is commercialized before the harvest? ____ %
39. In your sales contract is price set?
    ( ) Yes ( ) No. ( ) I do not have a contract
40. Have you faced a disparity in prices where it was difficult to maintain the contract?
    ( ) Yes ( ) No.
    If this happened, what did you do?
    ( ) Maintained the contract
    ( ) Renegotiated the contract
    ( ) Broke the contract
41. Is there any form of anticipated payment? ( ) Yes ( ) No.
42. Do you receive premium price for quality? ( ) Yes ( ) No.
43. Does your commercialization channel promote any event to recognize it suppliers that have top quality? ( )Yes ( )No.
44. 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
45. Does your channel of commercialization promote seminars and exhibits to exchange experiences among coffee producers ? ( ) Yes ( ) No.
46. Does your channel of commercialization incentivize innovation in your production?
    ( ) Yes ( ) No.
    If so, how is this done? _____

47. 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
48. Do you receive any sort of contact form the channels in the harvest time? ( ) Yes ( ) No.
49. 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

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%
Itamogl	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%

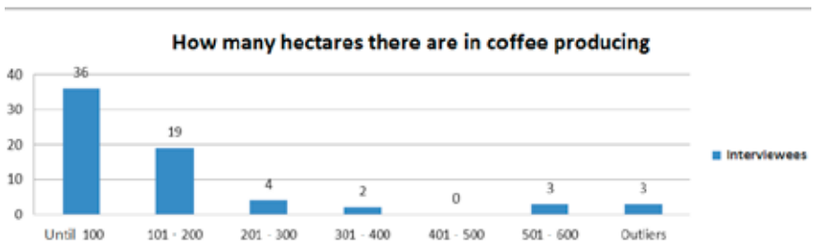
Question 1.1		
Where property is located (state)		
UF	Quantity	%
ES	1	1,5%
Região das Matas (MG)	16	24%
Cerrado Mineiro (MG)	24	36%
Sul de Minas (MG)	21	31%
RJ	1	1%
SP	4	6,0%
Total	67	100,00%

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	100,00%

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 6.1		
What percentage is coffee in family income?		
Percentage	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 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		
Are you a member of a cooperative or association?		
	Quantity	%
No	7	10,4%
Yes	60	89,6%
Total	67	100,0%

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 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?	Não	Sim
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?	
Years	
Maximum	40
Minimum	2
Average	11,43589744

Question 11	
Cultivation and harvest	
	% (Average)
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 (harversters, 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	%
Yes	27	40,3%
No	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	8,23

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	6,33

Question 24.3	
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 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 26		
Where were the hired workers from (state)?		
State	Quantity	%
-	12	17,9%
BA (Bahia)	3	4,5%
ES (Espirito 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 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$	3.000,00	0,00	1.930,73
Temporary worker: R$	4.800,00	0,00	1.930,73
Hired worker with family: R$	3.500,00	0,00	1.213,13
Temporary worker with family: R$	3.000,00	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?

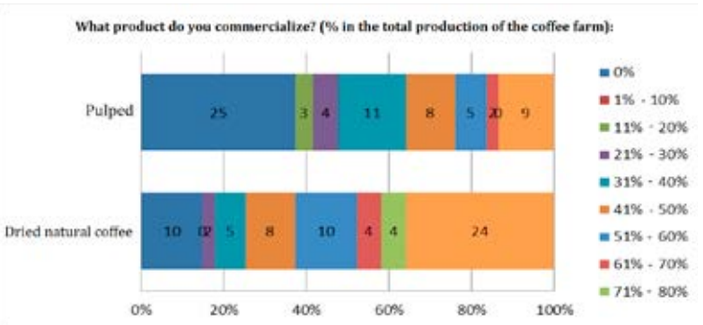
	Quantity	%
No	37	55,2%
Yes	22	32,8%
Did not answer	8	11,9%
Total	67	100,00%

Question 32.1

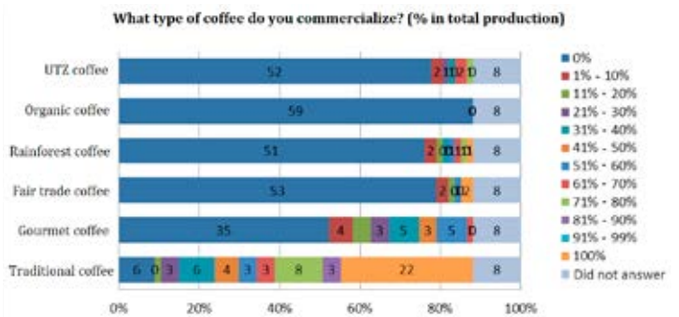
If you have, what was the reason?

	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	100,00%

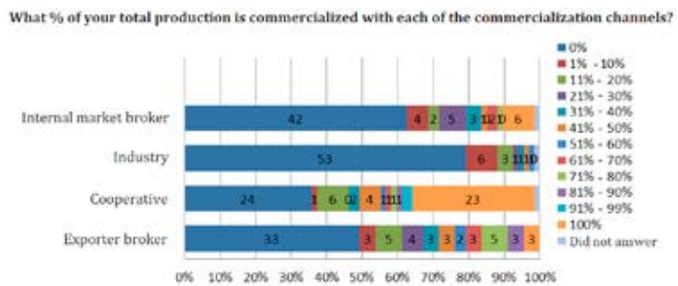
Question 33



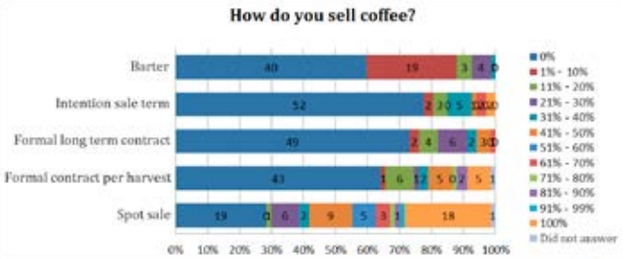
Question 34



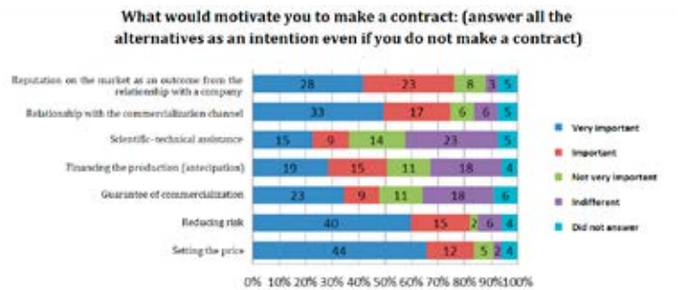
Question 35



Question 36



Question 37



Question 38

What is the percentage of coffee commercialized before the harvest?

Percentage	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%

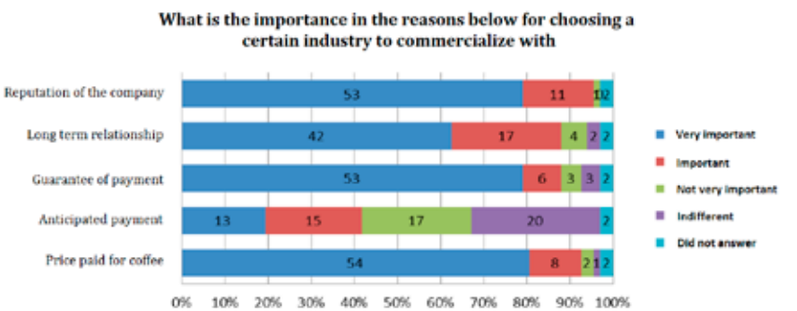
Question 40.1		
If you did, what did you do?		
	Quantity	%
Maintained the contract	20	29,9%
Renegotiated the contract	6	9,0%
Broke the contract	1	1,5%
Did not answer	40	59,7%
Total	67	100,00%

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%

5. Drivers of change in the coffee production: past, present and future challenges – 2014

Luciana Florêncio de Almeida • Decio Zylbersztajn
Samuel Ribeiro Giordano • Christiane Leles Rezende de Vita

5.1 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 chapter 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.

5.2 Research stages and conceptual maps

Below are the three stages of the research:

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.

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?)

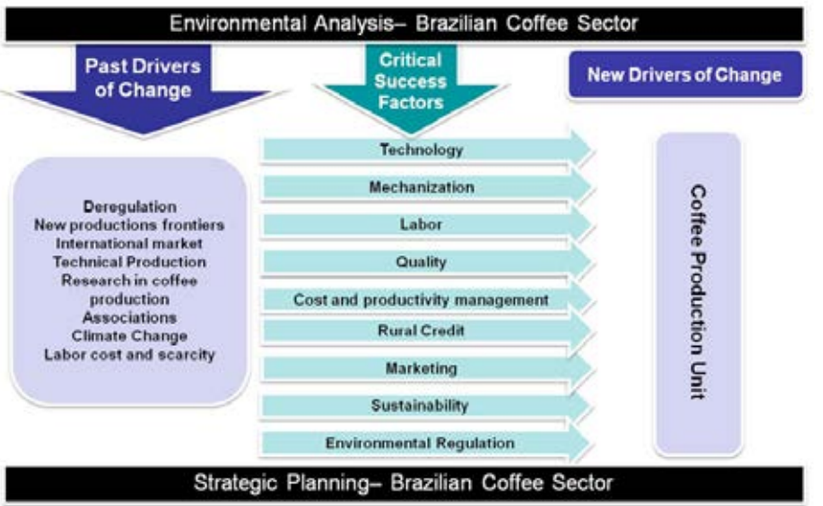


Figure 5.1. Conceptual Map of the research

Source: Elaborated by the authors

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.

5.3 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 prin-

cipally, 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.

5.3.1 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)

5.3.2 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.

"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)

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.

5.3.3 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.

5.3.4 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 compet-

itive 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.

5.3.5 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."

5.3.6 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 agri-industrial 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.

5.4 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:

5.4.1 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 con-

sumer 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:

- 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.
- Lack of representativeness at the federal level for the coffee business, with few many organizations that do not communicate with each other.
- Obsolete research centers.
- 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.

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

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

- 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;
- 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;
- 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;
- 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:

- Increase in the consumption of robusta in the world, to facilitate the entrance in countries with emerging consumption, favoring buying coffee from Indochina;
- Renovation of the plantations in competitive countries increasing the productivity of these markets
- The market will demand more and more exotic coffees, of extreme quality with the presentation of the history of the property and traceability;
- The need of more coordination between producers and owners of roasting companies with potential virtualization;
- 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."

5.4.2 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, environ-

mental 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.

5.4.3 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.

5.5 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 5.5.1 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 5.1. 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 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

5.6 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

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.

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.

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.

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.

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.

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.

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.

5.7 References

ABIC, 2014. Indicadores da indústria. Available in http://www.abic.com.br/publique/cgi/cgilua.exe/sys/start.htm?sid=61. Retrieved in Augusta, 2014.

CECAFE. Edição tudo sobre a safra 2011-2012. Documento interno. 2013.

ICO. Renewed Concerns Over Brazil Crop Cause Price Jump. Available in http://icocoffeeorg.tumblr.com/post/94443030175/renewed-concerns-over-brazil-crop-cause-price-jump. Retrieved in August, 2014.

SCAA. Consumer understanding. Available in : http://www.scaasymposium.org/tracy-ging-speaks-at-symposium-2012-on-consumer-understanding/. Retrieved in August, 2014.

EMBRAPA, UNICAMP. Aquecimento Global e a nova Geografia da produção agrícola no Brasil. 2009

MARTINS, A.L. A história do café. 2º Ed. São Paulo: Contexto, 2012.

RURALBR, 2014. Números de agricultores familiares deve-se reduzir em 50 anos no Brasil. Available in http://expointer.ruralbr.com.br/noticia/2014/09/numero-de-agricultores-familiares-deve-se-reduzir-em-50-anos-no-brasil-4589891.html?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+RuralBR+%28Notícias+-+RuralBR%29. Retrieved in August, 2014.

SAES M.S.M.; NAKAZONE D. Estudo de competitividade de cadeias integradas no Brasil: Impactos da zona de livre de comércio. Campinas,Unicamp: 2002.

SAES, M.S.M: A Racionalidade econômica da regulamentação no mercado Brasileiro de café. São Paulo: USP/FEA, 1995. 163p. (Thesis – Phd in Economics)

6. Risk assessment for pesticide contamination of coffee – 2014

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6.1 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.

6.1.1 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.

6.1.2 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.

6.2 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.

6.2.1 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).

6.2.1.1 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 6.1)

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

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).

6.2.1.2 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).

6.2.1.3 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:

- 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 ;
- 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.
- 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 Coordi-

nation 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).

6.2.2 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.

6.2.2.1 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).

6.2.2.2 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).

6.2.2.3 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).

6.2.2.4 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.

6.3 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.

6.3.1 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.

6.3.1.1 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).

6.3.1.2 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).

6.3.1.3 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).

6.3.1.4 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).

6.3.1.5 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.

6.3.2 Agrochemical Contaminations Risks for Coffee

6.3.2.1 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.

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 6.5):

- 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).

6.3.2.2 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).

6.3.2.3 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 cyan-

traniliprole 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).

6.4 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.

6.4.1 Institutional Environment for Agrochemicals

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

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.

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.

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.

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.

6.4.2 Technological Environment for Agrochemicals

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.

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

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

6.5 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.

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.

6.6 References

Almeida, S.R. & Matiello, J.B. (2010). A ferrugem do cafeeiro continua grave e com novas raças. *Pro Café Online, Clube de Tecnologia Cafeeira*, Folha Técnica 070. Disponível em <http://www.fundacaoprocafe.com.br>. Acesso em 02 mar 2014.

ANVISA – Agência Nacional de Vigilância Sanitária (2013a). *Perguntas e respostas do Programa de Análise de Resíduos de Agrotóxicos em alimentos (PARA)*. Brasília: ANVISA, Gerência Geral de Toxicologia. Disponível em <www.portal.anvisa.gov.br> Acesso em 02 abr 2014.

ANVISA – Agência Nacional de Vigilância Sanitária (2013b). *Programa de Análise de Resíduos de Agrotóxicos em alimentos (PARA):* Relatório de atividades de 2011 e 2012. Brasília: ANVISA, Gerência Geral de Toxicologia. Disponível em <www.portal.anvisa.gov.br> Acesso em 02 abr 2014.

Araújo, M. (2013). *As implicações técnico-econômicas da utilização de agrotóxicos na cafeicultura pelos cooperados da Cooxupé*. Monografia (Curso de Pós-Graduação). Fundação Instituto de Administração (FIA), Centro de Conhecimento em Agronegócios (PENSA), Universidade do Café Brasil. São Paulo: FIA, PENSA, 32p.

Batista, F. (2014). Uso indevido de agrotóxicos afeta 20% de grãos e frutas. *Valor Econômico*, Agronegócios, 26 abr. Disponível em <http://valor.com.br>. Acesso em 30 abr 2014.

Brasil, Ministério da Agricultura, Pecuária e Abastecimento (2008). *Instrução Normativa SDA N.º 42, de 31 de dezembro de 2008*. Institui o Plano Nacional de Controle de Resíduos e Contaminantes de Produtos de Origem Vegetal – PNCRC/Vegetal. Disponível em http://www.agricultura.gov.br/arq_editor/IN%2042_2008%20-%20PNCRC%20Vegetal.pdf. Acesso em 05 abr 2014.

Brasil, Ministério da Agricultura, Pecuária e Abastecimento (2014). *Codex Alimentarius*. Disponível em <http://www.agricultura.gov.br/internacional/negociacoes/ multilaterais/codex-alimentarius>. Acesso em 03 mar 2014.

Brasil, Ministério das Relações Exteriores, Divisão de Inteligência Comercial (2013). *Como exportar*: Bélgica. Brasília: MRE, 106p.

Brasil, Presidência da República, Casa Civil (2002). *Decreto No. 4.074, 04 de Janeiro de 2002*. Regulamenta a Lei no 7.802, de 11 de julho de 1989, que dispõe sobre a pesquisa, a experimentação, a produção, a embalagem e rotulagem, o transporte, o armazenamento, a comercialização, a propaganda comercial, a utilização, a importação, a exportação, o destino final dos resíduos e embalagens, o registro, a classificação, o controle, a inspeção e a fiscalização de agrotóxicos, seus componentes e afins, e dá outras providências. Disponível em <http://www.planalto.gov.br/ ccivil_03/decreto/2002/D4074.htm>. Acesso em 04 abr 2014.

Caetano, M. (2014a). Basf amplia produção em São Paulo. *Valor Econômico*, Agronegócios, 13 jun. Disponível em <http://valor.com.br>. Acesso em 30 jun 2014.

Caetano, M. (2014b). Recorde, venda de defensivo no país em 2013 atingiu US$ 11,5 bi. *Valor Econômico*, Agronegócios, 26 abr. Disponível em <http://valor.com.br>. Acesso em 30 abr 2014.

Café Seguro (2012). *Garantia de acesso da produção em todos os mercados*. São Paulo: 2012. Disponível em <http:www.cafeseguro.com.br. Acesso em 15 mar 2014.

CEPICAFE (2013). Manejo fitosanitario en el cultivo de café. Proyecto "Mejoramiento de la productividad del cultivo de café de las organizaciones socias de CEPICAFE, en la sierra de Piura". CEPICAFE – Central Piurana de Cafetaleros. Disponível em <http:www.cepicafe.com.pe>. Acesso em 15 mar 2014.

EU – European Union, European Parliament and Council (2005). *Regulation (EC) nº 396/2005 of the European Parliament and of the Council of 23 February 2005, on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC*. Brussel: European Union. Disponivel em <http://ec.europa.eu/food/plant/protection/pesticides/index_en.htm>. Acesso em 04 abr 2014.

FDA – Food and Drug Administration (2011). Pesticide Monitoring Program – 2011 Pesticide report. Washington, 45 p. Disponivel em <http://www.fda.gov/Food/FoodborneIllness Contaminants/Pesticides/default.htm>. Acesso em 15 abr 2014.

Ferreira, C. (2014). Broca volta a ameaçar cultivo de café no país. *Valor Economico*, Agronegócios, 26 ago 2014. Disponível em <http://www.valor.com.br/noticia/ 3246236/agro/3246236/broca-volta-a-ameaçar-cultivo-de-cafe-no-pais>. Acesso em 30 ago 2014.

FFCR – The Japan Food Chemical Research Foundation (2014). The japanese positive list system for agricultural chemical residues in foods. Disponível em <http://www.ffcr.or.jp/zaidan/FFCRHOME.nsf/pages/MRLs-p>. Acesso em 15 set 2014.

Garcia, A.L.A. (2012). Alerta sobre a presença e disseminação do nematóide *meloidogyne paranaensis* em Minas Gerais. *Pro Café Online*, *Clube de Tecnologia Cafeeira*, Folha Técnica 001. Disponível em <http://www.fundacaoprocafe.com.br>. Acesso em 02 mar 2014.

Izaguirre, M. (2014). Autorizada importação de agrotóxico para combate à broca do café. *Valor Econômico*, Agronegócios, 18 jul 2014. Disponível em < http://www.valor.com.br/agro/3618988/autorizada-importação-de-agrotóxico-para-combate-à-broca-do-café>. Acesso em 30 ago 2014.

JETRO – Japan External Trade Organization (2011). *Specifications and standards for foods, food additives, etc. under the Food Sanitation Act (Abstract) 2010*. Disponível em <https://www.jetro.go.jp/en/reports/regulations/pdf/foodext2010e.pdf>. Acesso em 25 ago 2014.

Krohling, C.A. & Matiello, J.B. (2014). Programas de proteção contra Phoma podem ter efeito complementar contra outras doenças no cafeeiro. *Pro Café Online*, *Clube de Tecnologia Cafeeira*, Folha Técnica 124. Disponível em <http://www.fundacaoprocafe. com.br>. Acesso em 02 mar 2014.

Matiello, J.B. & Almeida R.S. (2007). Ataque da bacteriose mancha aureolada (*pseudomonas seryngae pv garcae*) se espalha nas lavouras cafeeiras. *Pro Café Online*, *Clube de Tecnologia Cafeeira*, Folha Técnica 001. Disponível em <http://www.fundacaoprocafe.com.br>. Acesso em 02 mar 2014.

Matiello, J.B. & Almeida R.S. (2013a). Cuidado com aplicações de glifosato em cafeeiros jovens. *Pro Café Online*, *Clube de Tecnologia Cafeeira*, CT 134. Disponível em <http://www.fundacaoprocafe.com.br>. Acesso em 02 mar 2014.

Matiello, J.B. & Almeida R.S. (2013b). Aplicação concentrada ou sequencial de triazóis sistêmicos, em altas doses via pulverização, em cafeeiros para controle da ferrugem. *Pro Café Online*, *Clube de Tecnologia Cafeeira*, CT 134. Disponível em <http://www.fundacaoprocafe.com.br>. Acesso em 02 mar 2014.

Matiello, J.B. & Almeida R.S. (2014a). Fusariose – uma doença pouco conhecida em cafeeiros. *Pro Café Online*, *Clube de Tecnologia Cafeeira*, CT 134. Disponível em <http://www.fundacaoprocafe.com.br>. Acesso em 02 mar 2014.

Matiello, J.B. & Almeida R.S. (2014b). Toxidez de triazóis em altas doses, via solo, em cafeeiros. *Pro Café Online*, *Clube de Tecnologia Cafeeira*, CT 175. Disponível em <http://www.fundacaoprocafe.com.br>. Acesso em 02 mar 2014.

Matiello, J.B., Mendonça, S. M. & Leite Filho, S. (2008). Uso de herbicida gliphosate não reduz produção de cafeeiros. *Pro Café Online*, *Clube de Tecnologia Cafeeira*, CT 003. Disponível em <http://www.fundacaoprocafe.com.br>. Acesso em 02 mar 2014.

Morya, G.K.K. (2013). *Risk assessment of the agro chemicals contamination on coffee*. Dissertation (Master Degree). Università degli Studi di Udine, Master in Coffee Economics and Science – Ernesto Illy. Trieste, 121p.

Shi, M. (2013). Japanese safety standards of imported foods: focus on pesticide residues and organic products residues. University of Tsukuba. Disponível em <http://info.worldbank.org/etools/docs/library/55383/china_efa2/china_efa2/pdf/ppt_MinjunShi.pdf>. Acesso em 03 jun 2014.

Soler, W.R., Centurion, L., Alves, R.C.P., Ferreira, A.L.S., Miranda, W.L., Meireles, E.J.L., Carvalho L.G. de, Volpato, M.M.L. & Moreira, R.V. (2013). Evolução das principais doenças em lavouras de cafeeiros no município de Lavras, MG, nos anos agrícolas 2011-2012 e 2012-2013 – projeto SIMAFF. *VIII Simpósio de Pesquisa dos Cafés do Brasil*. Disponível em <http://ainfo.cnptia.embrapa.br/digital/bitstream/item/ 94894/1/ Evolucao-das-principais-doencas.pdf>. Acesso em 14 abr 2014.

WHO – Word Health Organization – Joint FAO/WHO Consultation, (2005). *Dietary Exposure assessment of chemicals in food*. Maryland. Disponível em: <http://whqlibdoc.who.int/ publications/2008/9789241597470_eng.pdf>. Acesso em: 5 mar 2014.

WHO – Word Health Organization / Global Environment Monitoring System – Food Contamination Monitoring and Assessment Programme (GEMS/Food); Codex Committee on Pesticide Residues (1997). *Guidelines for predicting dietary intake of pesticides residues*. WHO Press. Disponível em: <http://www.who.int/ foodsafety/publications/chem/en/ pesticide_en.pdf>. Acesso em: 13 mar 2014.

Table 6.1 – Maximum residue limits (MRL) in mg/kg coffee grains for Brazil, Japan, Codex Alimentarius, European Union, and the USA.

Nº	Active Ingredient (Portuguese)	Active Ingredient (English)	Brasil	Japão	Codex	UE	EUA
1	Abamectina	Abamectin	0,002	0,008		0,02	
2	Acetamipridо	Acetamiprid	0,2	0,01		0,1	
3	Acetocloro	Acetochlor	0,2	0,01		0,01	
4	Ácido Giberélico	Gibberellic Acid	SR	SR		5	
5	Ácido 4-Indol-3-Ilbutírico	4-Indol-3-Ylbutyric Acid	SR	SR			
6	Alacloro	Alachlor	0,05	0,01		0,05	
7	Aldicarbe	Aldicarb	0,1	0,1	0,1	0,1	0,1
8	Alfa-Cipermetrina	Alpha-Cypermethrin	0,01	0,05	0,05		
9	Ametrina	Ametryn	0,05	0,01			
10	Azadiractina	Azadirachtin	SR	SR		0,01	
11	Azoxistrobina	Azoxystrobin	0,05	0,05		0,1	
12	Bacillus Thuringiensis	Bacillus Thuringiensis	SR	SR			
13	Beta-Ciflutrina	Beta-Cyfluthrin	0,05	0,02			
14	Beta-Cipermetrina	Cypermethrin	0,30	0,05		0,1	
15	Boscalida	Boscalid	0,05	0,05	0,05	0,5	
16	Brometo De Metila	Methyl Bromide	50	60		70	75
17	Cadusafós	Cadusafos	0,05	0,01			
18	Carbofurano	Carbofuran	0,1	1	1	0,05	0,1
19	Carfentrazona-Etílica	Carfentrazone-Ethyl	0,05	0,1		0,02	0,1
20	Casugamicina	Kasugamycin		0,01			
21	Ciflutrina	Cyfluthrin	0,01	0,02		0,1	
22	Cinetina	Kinetin	SR	SR			
23	Cipermetrina	Cypermethrin	0,05	0,05	0,05	0,1	
24	Ciproconazol	Cyproconazole	0,1	0,01		0,1	0,1
25	Cletodim	Clethodim	0,5	0,01		0,1	
26	Clorantraniliprole	Chlorantraniprole	0,03	0,01		0,02	
27	Cloreto De Benzalcônio	Benzalkonium Chloride	1	0,01			
28	Cloridrato De Cartape	Cartap Hydrochloride	0,1	0,01			
29	Clorotalonil	Chlorothalonil	0,2	0,2		0,1	0,2
30	Clorpirifós	Chlorpyrifos	0,05	0,05	0,05	0,2	
31	Cresoxim-Metílico	Kresoxim-Methyl	0,05	0,01		0,1	
32	Deltametrina	Deltamethrin	1	2		2	
33	Dibrometo De Diquate	Diquat Dibromide	0,1	0,05		0,1	0,05
34	Dicloreto De Paraquate	Paraquat Dichloride	0,05	0,05		0,05	0,05
35	Difenoconazol	Difenoconazole	0,5	0,01		0,05	
36	Dissulfotom	Disulfoton	0,1	0,2	0,2	0,05	
37	Diurom	Diuron	1	0,02		0,1	
38	Endossulfam	Endosulfan	0,05	0,1	0,2	0,1	
Nº	Ingrediente Ativo (Português)	Ingrediente Ativo (Inglês)	Brasil	Japão	Codex	UE	EUA
39	Enxofre	Sulfur	SR	SR		5	
40	Epoxiconazol	Epoxiconazole	0,1	0,01		0,05	0,05
41	Esfenvalerato	Esfenvalerate	0,05	0,01		0,05	
42	Espinosade	Spinosad	0,2	0,01		0,02	
43	Espirodiclofeno	Spirodiclofen	0,03	0,01	0,03	0,05	
44	Etanol	Ethanol	SR	SR			
45	Etefom	Ethephon	1	0,1		0,1	0,5
46	Fenamifós	Fenamiphos	0,1	0,01		0,05	
47	Fenpiroximato	Fenpyroximate	0,05	0,02		0,1	
48	Fenpropatrina	Fenpropathrin	0,5	0,01		0,02	
49	Fentiona	Fenthion	0,1	0,01		0,05	
50	Flazassulfurom	Flazasulfuron	0,03	0,02		0,02	
51	Fluazifope-P-Butílico	Fluazifop-P-Butyl	0,03	0,1		0,1	0,1
52	Flumioxazina	Flumioxazin	0,05	0,01		0,1	
53	Fluquinconazol	Fluquinconazole	0,07	0,01		0,05	
54	Flutriafol	Flutriafol	0,05	0,01		0,05	
55	Forato	Phorate	0,05	0,02	0,05	0,1	0,02
56	Fosetil	Fosetyl	0,05	0,5		5	
57	Fosfeto De Alumínio	Aluminium Phosphide	0,1	0,01		0,05	0,1
58	Fosfeto De Magnésio	Magnesium Phosphide	0,1	0,01		0,05	0,1
59	Fostiazato	Fosthiazate	0,1	0,01		0,05	
60	Gama-Cialotrina	Gamma-Cyhalothrin	0,05	0,01			
61	Glifosato	Glyphosate	1,0	1		0,1	1
62	Glufosinato – Sal De Amônio	Glufosinate-Ammonium	0,05	0,01		0,1	
63	Hexitiazoxi	Hexythiazox	0,1	0,01		0,05	
64	Hidróxido de Cobre	Cooper Hidroxide	SR	SR		50	
65	Imidacloprido	Imidacloprid	0,07	0,7	1	1	0,8
66	Iminoctadina Tris(Albesilato)	Iminoctadine Tris(Albesilate)	0,1	0,02			

67	Iprodiona	Iprodione	2	0,05		0,1	
68	Lambda-Cialotrina	Lambda-Cyhalothrin	0,05	0,01		0,05	
69	Lufenurom	Lufenorun	0,05	0,01		0,02	
70	Mancozebe	Mancozeb	0,3**	5**	0,1 **	0,1	
71	Metanol	Methanol	SR	SR			
72	Metconazol	Metconazole	0,2	0,01		0,02	
73	Metribuzim	Metribuzin	0,1	0,01		0,1	
74	Metsulfurom-Metílico	Metsulfuron-Methyl	0,02	0,01		0,1	
75	Miclobutanil	Myclobutanil	0,1	0,01		0,05	
76	Msma	Msma	0,07	0,01			
77	Novalurom	Novaluron	0,50	0,01		0,01	
Nº	Ingrediente Ativo (Português)	Ingrediente Ativo (Inglês)	Brasil	Japão	Codex	UE	EUA
78	Óleo Mineral	Mineral Oil	SR	SR			
79	Oxicloreto De Cobre	Copper Oxychloride	SR	SR		50	
80	Óxido Cuproso	Cuprous Oxide	SR	SR		50	
81	Oxifluorfem	Oxyfluorfen	0,05	0,05		0,05	0,05
82	Pencicurom	Pencycuron		0,01		0,05	
83	Pendimetalina	Pendimethalin	0,1	0,01		0,1	
84	Permetrina	Permethrin	0,01	0,05	0,05	0,1	
85	Picoxistrobina	Picoxystrobin	0,01	0,01		0,1	
86	Piraclostrobina	Pyraclostrobin	0,5	0,3	0,3	0,2	
87	Piridafentiona	Pyridaphenthion	0,5	0,01			
88	Piriproxifem	Pyriproxyfen	0,1	0,01		0,05	0,1
89	Profenofós	Profenofos	0,03	0,01		0,1	
90	Propargito	Propargite	0,3	0,01		0,02	
91	Propiconazol	Propiconazole	0,05	0,1	0,02	0,1	
92	Simazina	Simazine	0,02	0,01		0,05	
93	Sulfato de Cobre	Copper Sulfate	SR	SR		50	
94	Sulfentrazona	Sulfentrazone	0,5	0,05			
95	Tebuconazol	Tebuconazole	0,2	0,2	0,1	0,1	0,3
96	Teflubenzurom	Teflubenzuron	0,5	0,02		0,05	
97	Terbufós	Terbufos	0,05	0,05	0,05	0,01	0,05
98	Tetraconazol	Tetraconazole	0,08	0,01		0,02	
99	Tiametoxam	Thiamethoxan	0,02	0,05	0,2	0,05	0,05
100	Tifluzamida	Thifluzamide	0,05	0,01			
101	Tiofanato-Metílico	Thiophanate-Methyl	0,03**	5**	0,1 **	0,1	
102	Triadimenol	Triadimenol	0,5	0,1	0,5	0,2	
103	Triazofós	Triazophos	0,01	ND		0,02	
104	Trifloxistrobina	Trifloxystrobin	0,05	0,05		0,05	
105	Zeta-Cipermetrina	Zeta-Cypermethrin	0,05	0,05	0,05	0,1	
106	2,4-D	2,4-D	0,1	0,01		0,1	
107	5,9-Dimetilpentadecano	5,9-Dimethylpentadecane	SR	SR			

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 6.2 – 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 6.3 – 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)	Year 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 contyaining 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-TGSO2) or methyl esters thereof, calculated in total as cycloxydim	0.05*	5/6/2014
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 hexachlorociclohexane (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 propamocarb)	0.2*	10/2/2014
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 quintozene)	0.1*	26/4/2013
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 thiamethoxam)	0.2	5/6/2013
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 6.4 – 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 6.5 – Maximum residue limits (MRL) of the active ingredientes sold by the Coxupé Cooperative from 2009 to 2012 for the coffee crops.

N°	Active ingredient	Maximum Residue Limit (mg/kg)				
		Brazil	Japan	Codex	UE	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	gibberellic 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	
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 6.6 – Active Ingredients with restrictions abroad sold by the Coxupé Coopeartive from 2009 to 2012 for coffee.

N°	Active Ingredient (Portuguese)	Active Ingredient (English)	USA[1]	EU[2]	PAN Dirty Dozen[3]
1	acetato de fentina	fentin acetate		X	
2	alacloro	alachlor		X	
3	aldicarbe	aldicarb			X
4	cadusafós	cadusafos		X	
5	carbofurano	carbofuran	X	X	
6	dicloreto de paraquate	paraquat dichloride			X
7	endossulfam	endosulfan	X	X	
8	fentiona	fenthion		X	
9	permetrina	permethrin		X	
10	simazina	simazine		X	
11	triazofós	triazophos		X	
12	triclorfom	trichlorphon		X	

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

Table 6.7 – 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
Glifosato	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 6.8 – Agrochemicals applied to soil (fungicides, insecticides e nematicides) sold by Coxupé Cooperative from 2009 to 2012 for coffee crops.

Comercial Product	Active Ingredients	# 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
Did not use		11		

Source: Adapted from Araújo (2013)

Table 6.9 – 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		

7. The possibilities in the differentiation in the coffee production and the consumers' behavior

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7.1 Introduction

Illycaffè 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 has been fully used by organizations in their communication strategies nor has 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.

7.2 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 major-

ity 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.

7.3 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.

7.3.1 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.

7.3.2 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.

7.3.2.1 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.

7.3.2.2 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.

7.3.3 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 Coun-

cil; 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.

7.3.3.1 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).

7.3.2.2 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.

7.3.4 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).

7.4 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:

- Presentation of the research and method
- Distribution of the form with one question at a time so all participants could respond individually in 15 minutes
- Presentation of the individual answers and plenary discussion on the questions coordinated by a mediator for 15 minutes

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.

7.4.1 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.

7.4.2 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).

7.4.3 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.

7.4.4 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.

7.4.5 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

7.5 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.

7.5.1 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 7.1.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 7.2 presents this stratification.

Table 7.2. Stratification of the population of Campinas

Gender	Nº of people	Age	Nº of people	Income (in Minimum salaries)	Nº 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

7.5.2 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.

7.5.3 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.

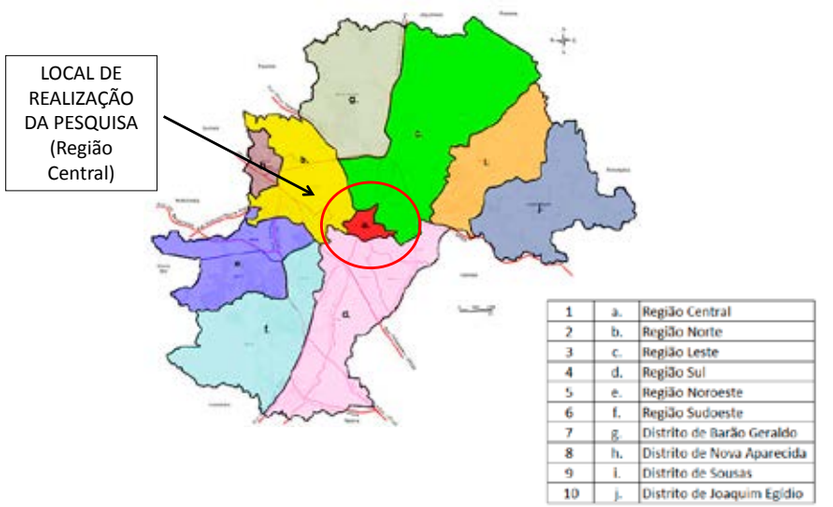


Figure 7.1. Map of Campinas and the Region where research was conducted.

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 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.

7.5.4 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 7.3, 7.4, 7.5 and 7.6.

Table 7.3. 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 7.4. 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 7.5. 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 7.6. 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

7.5.5 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 7.7. 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 7.8) , 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 7.8. 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 7.9. 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 7.10), 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 7.10. 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 7.11. 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 7.12. 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.	1º.	2º.	3º.	1º.	2º.	3º.
Flavor and aroma	134	85	95	32,2	20,4	22,8	32,1	21,0	23,3
Feel good	86	82	75	20,7	19,7	18,0	20,6	20,2	18,4
Stop to rest	68	104	89	16,3	25,0	21,4	16,3	25,7	21,9
Other	54	41	35	13,0	9,9	8,4	12,9	10,1	8,6
Being amongst friends	52	60	65	12,5	14,4	15,6	12,4	14,8	16,0
For a moment of reflection	24	33	48	5,8	7,9	11,5	5,7	8,1	11,8

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 7.13)

Table 7.13. 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 7.14 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 7.14. 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 7.15)

Table 7.15. 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 illycaffè brand was the least know brand (Table 7.16). 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 7.16. 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

7.5.6 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 7.17). The majority (89,2%) , had already bought or buys coffee. Therefore, they were apt to answer the two following questions.

Table 7.17. 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 7.18. 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 7.19), 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 7.19. 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

7.5.7 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 7.20, 7.21, 7.22 and 7.23 that follow, summarize the initial results, which refer to the specific part on differentiation and innovation.

Table 7.20. 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

The safety issue is the item of greatest importance (8,45) (Table 7.20). Attributes related to flavor like aroma (8,43) e taste (7,86) was also considered important. Nutrition was the least valued.

Table 7.21. Results with reference to the dimension "certification attributes" (n=104)

Attribute	Importance (1-10)	Variance	Interest (1-10)	How much + pay (%)
Sustainable Coffee	8,63	0,87	7,25	6,47
ABIC	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	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 7.22. Results with reference to the "social- environmental attributes" (n=110)

Attribute	Importance (1-10)	Variance	Interest (1-10)	How much + 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 7.22). 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 7.23. 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 (Table 7.23).

7.5.8 Importance, Interest and Propensity to Pay for Differentiating Aspects

After individually analyzing each differentiation dimension, Tables 7.24, 7.25 and 7.26 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 7.24 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 7.24. 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 7.25) 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 7.25. 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 7.26, 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 7.26. 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

7.5.9 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 7.27). 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 7.27. 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 7.28. The KMO was 0,714.

Table 7.28. 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.

7.5.10 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.

7.5.11 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 7.29. 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)			
“aroma” (11)	“quality” (52)		“place of production” (18)
“good coffee” (6)	“flavor” (8)	“quality” (18)	“farm” (16)
“strong coffee” (5)	“approval” (8)	“environment” (17)	“plantation” (16)
“quality” (5)	“validity” (5)	“production” (16)	“quality” (12)
“a moment to reflect” (4)	“price” (4)	“sustainability” (14)	“flavor” (11)
“purity” (3)	“reliability” (4)	“preservation” (12)	“aroma” (8)
“origin” (3)	“guarantee” (4)	“health” (8)	“brand” (4)
“brand” (2)	“aroma” (3)	“pollution” (5)	“packaging” (3)
“reliability” (2)	“brand” (2)	“social” (2)	“cigarette” (2)
“habit” (2)	“origin” (2)	“cost-benefit” (2)	“slavery” (2)
“morning” (2)	“honesty” (2)		“environment” (2)
“process” (2).			

Source: Elaborated by the authors

When compared to the difference in gender for the 4 dimensions (Table 7.30), it is more significant when the dimensions are compared.

Table 7.30. 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 7.31 represent the identification of the attribute, the consequence and the value found.

Table 7.31. 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 7.32):

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 7.32. 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

Open to change	Hedonismo	Hedonism	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

Searching improvement	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

7.5.11 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.

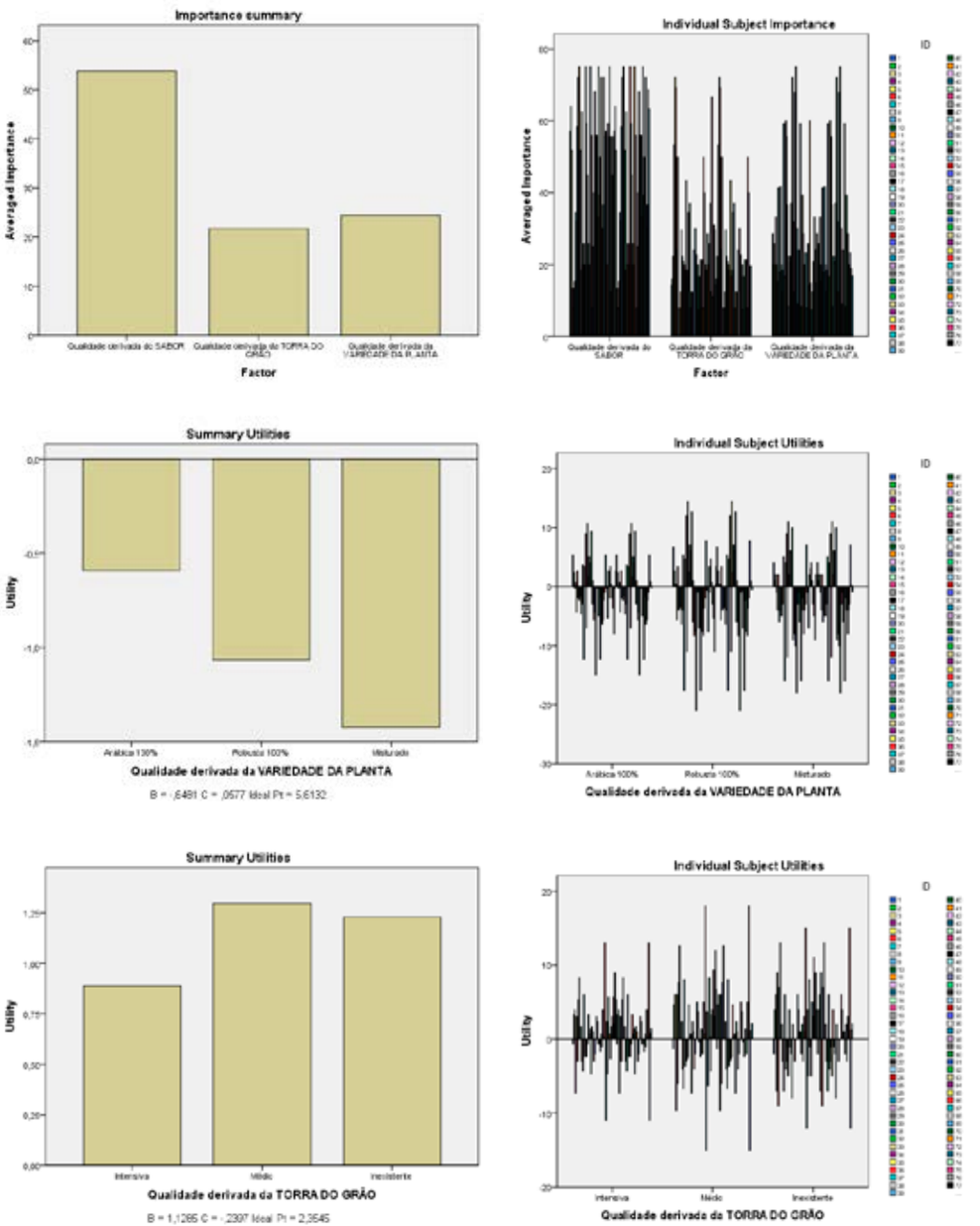
In relation to the quality, the most important item of the selected attributes was flavor (53,81%), followed by variety (24,46%), and roast (21,72%) with very similar levels (Table 7.33). The column utility defines the preference for each level of atribute.

Table 7.33. 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 7.2 illustrates the importance and preference by each individual.

Aggregated Preference *Individual Preference*



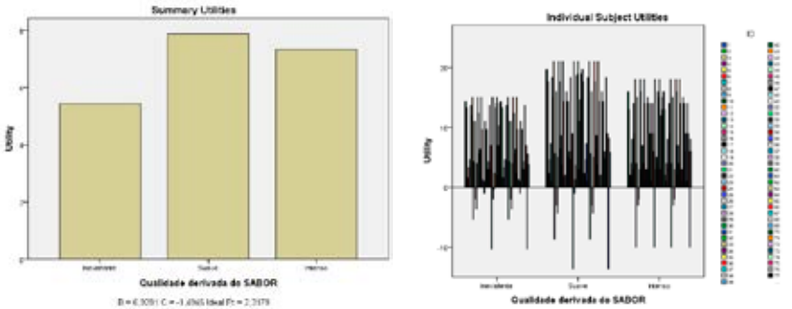


Figure 7.2. Joint Analysis in relation to the attributes in the differentiation of quality.

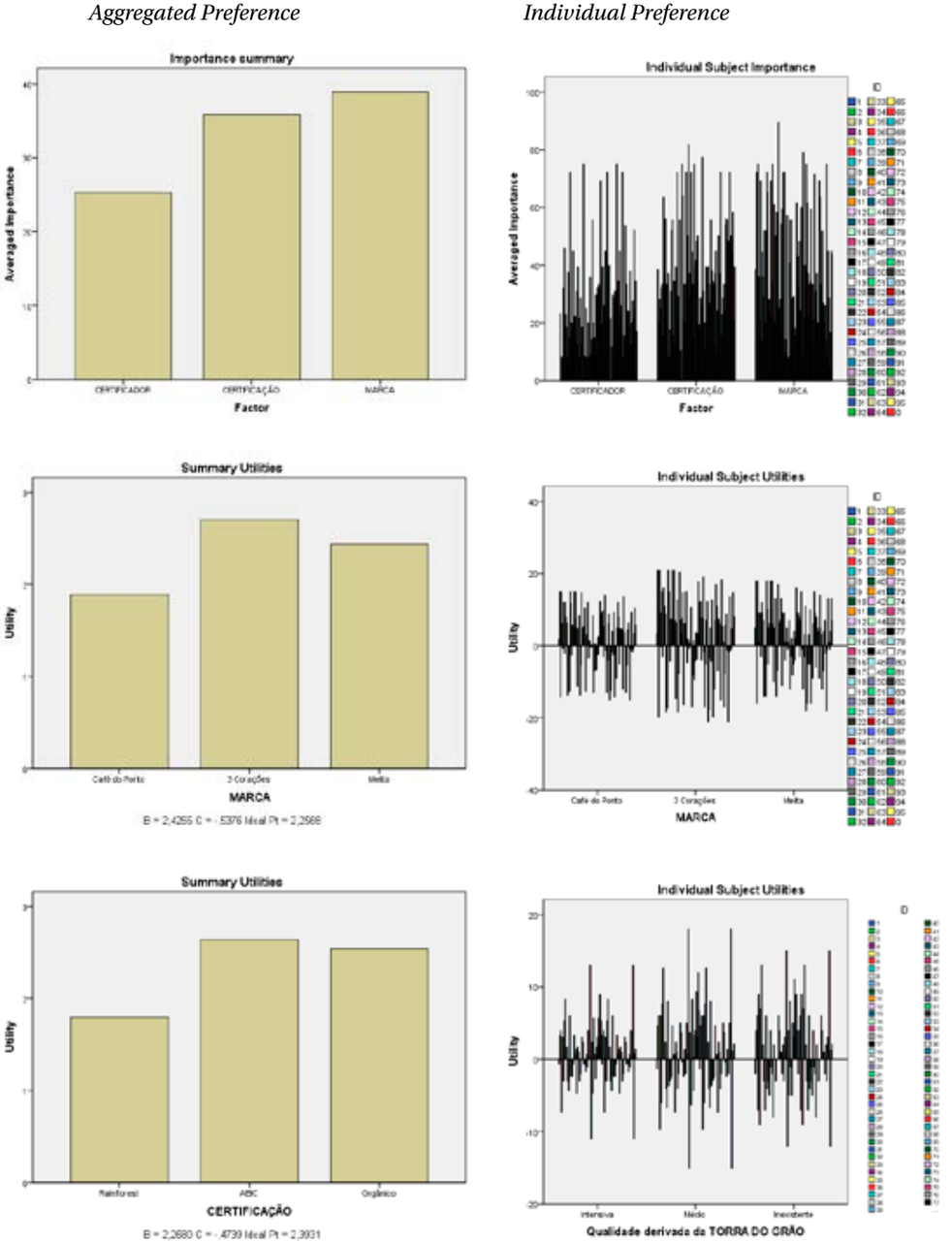
For the certification dimension (Table 7.34), the most important attribute was brand (38,87%), followed by certification (35,85%) and last of all the certifier (25,27%)

Table 7.34. 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. The favorite certifier was the Association. Figure 7.3 illustrates the importance and preference of each individual.



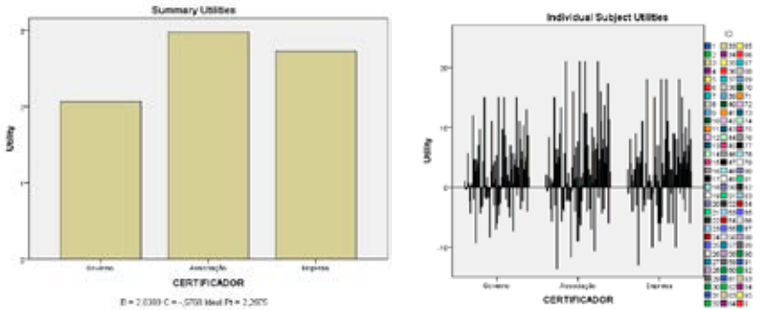


Figure 7.3. Joint analysis in relation to the attributes of in the differentiation in certification.

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%).

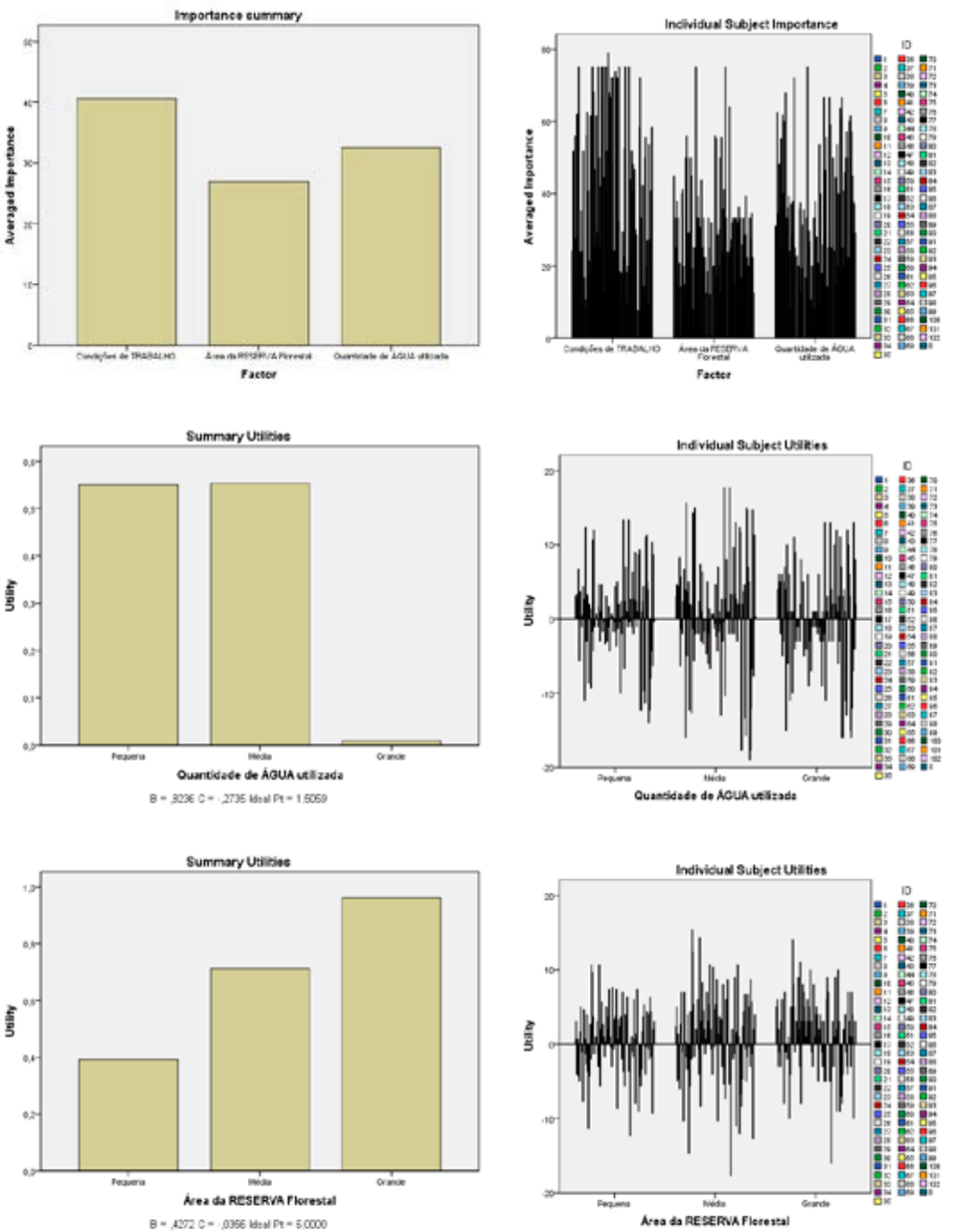
Table 7.35. Joint analysis in relation to the attributes in the differentiation for sustainability.

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

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 7.4 illustrates the importance for each individual.

Aggregated Preference *Individual Preference*



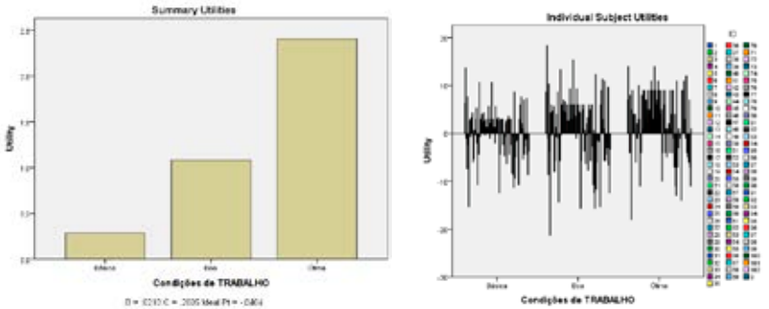


Figure 7.4. Joint analysis in relation to the attributes in the differentiation of sustainability.

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%).

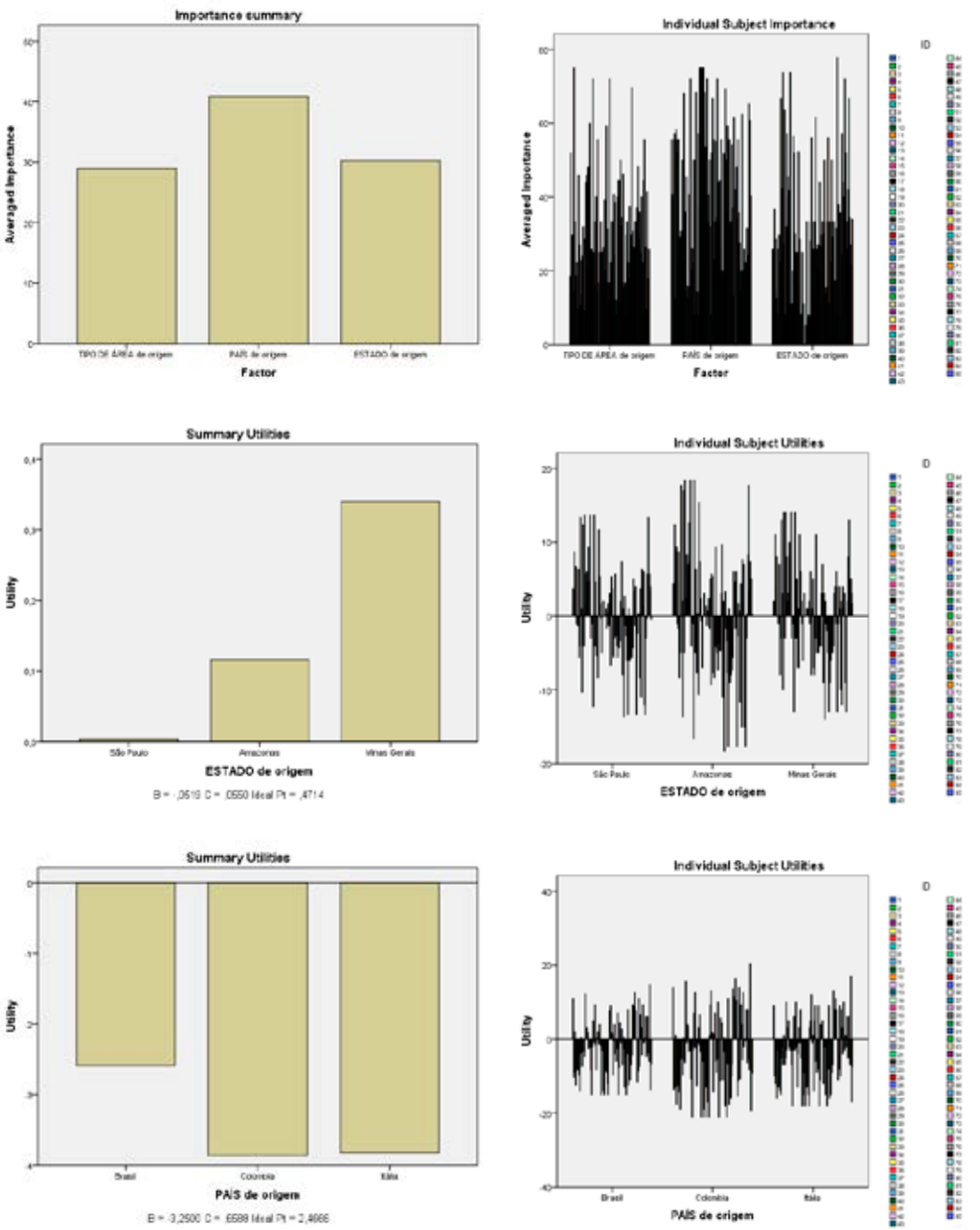
Table 7.36. Joint analysis in relation to the attributes in the differentiation of origin

Attributes and Levels		Utility
AREA (28,94%)	Atlantic Forest	1,050
	Mountain	1,597
	Savannah	1,642
COUNTRY (40,82%)	Brazil	-2,591
	Colombia	-3,865
	Italy	-3,821
STATE (30,23%)	São Paulo	0,003
	Amazonas	0,116
	Minas Gerais	0,340

Source: Elaborated by the authors

For the consumer, The Savannah of Minas Geris was the prevalent area for traditional coffee growing. Figure 7.5 illustrated the importance and preference for each individual.

Aggregated Preference *Individual Preference*



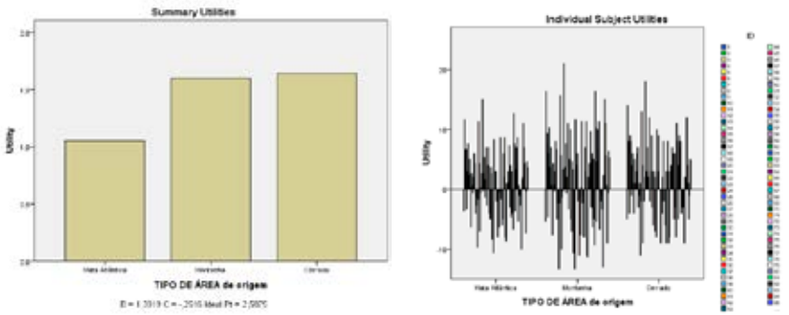


Figure 7.5. Joint analysis in relation to the attributes in the differentiation of origin

7.6 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 7.37).

Table 7.37. 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 7.38 summarizes the main attributes based on the final consumers' perception.

Table 7.38 – 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 price.	The three aspects added up represent almost 85% of the attribute package.
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

7.7. References

Aprile, M.C. & Gallina, G. (2008). Quality perception using signals on food labels: an analysis on italian consumers. *Anais do 2008 Annual World Symposium*. Monterrey: International Food and Agribusiness Management Association – IFAMA, junho. Disponível em <https://www.ifama.org/events/conferences/2008/Symposium.aspx.>. Acesso 15 abr 2013.

Ayala, L., Senesi, S.I., Palau, H. & Vilella, F. (2008). Organizations in agrifood chains and their strategies for sector competitiveness: the Colombian coffee model. *Anais do 2008 Annual World Symposium*. Monterrey: International Food and Agribusiness Management Association – IFAMA, junho. Disponível em <https://www.ifama.org/ events/conferences/2008/Symposium.aspx.>. Acesso 15 abr 2013

Bravo, C.P., Spiller, A. & Villalobo, P. (2012). Are organic growers satisfied with the certification system? A causal analysis of farmers' perceptions in Chile. *International Food and Agribusiness Management Review*, 15(4), 115-136.

Cunha, C.F, Saes, M.S.M. & Spers, E.E. (2011). Different institutional environments in organic: the difference in organic certification laws between Brazil and the U.S.A. *Anais do 2011 Annual World Symposium*. Frankfurt: International Food and Agribusiness Management Association – IFAMA. Disponível em <https://www.ifama.org/events/ conferences/2011/Symposium.aspx>. Acesso 15 abr 2013.

Cunha, C.F. & Spers, E.E. (2011). The perception of consumers about origin, sustainability and food safety attributes in a retailer in Brazil. *Anais do 2011 Annual World Symposium.* Frankfurt: International Food and Agribusiness Management Association – IFAMA. Disponível em <https://www.ifama.org/events/conferences/2011/ Symposium.aspx>. Acesso 15 abr 2013.

Drucker, P. (1998) [1985]. The discipline of innovation. *Harvard Business Review*, Reprint Number: 1-8.

Ewing, R. & Bartholomew, K. (2009). Comparing land use forecasting methods: Expert panel versus spatial interaction model. *Journal of the American Planning Association*, 75(3), 343-357.

Firat, A.K.; Woon, W.L. & Madnick, S. (2008). Technological forecasting – A review. Working Paper CISL# 2008-15. Composite Information Systems Laboratory (CISL), Sloan School of Management, Massachusetts Institute of Technology.

Fritz, M. & Schiefer, G. (2009). Sustainability in food networks: A framework for research. *Anais do 2009 Annual World Symposium*. Budapest: International Food and Agribusiness Management Association – IFAMA, junho. Disponível em <https://www.ifama.org/ events/conferences/ 2009/Symposium.aspx.>. Acesso 15 abr 2013.

Fritz, M., Schiefer, G. (2010). Food chain management for sustainable food system development. *Anais do 2010 Annual World Symposium.* Boston: International Food and Agribusiness Management Association – IFAMA, junho. Disponível em <https://www.ifama.org/ events/conferences /2010/Symposium.aspx.>. Acesso 15 abr 2013.

Giordano, S.R. (2009). The importance of socioenvironmental certifications in agri-chains. In Zylbersztajn, Decio & Omta, Onno (Eds.). *Advances in supply chain analysis in agri-food systems*. São Paulo: Singular, 364p.

Gomes, C.M.P. & Neves, M.F. (2011). Alternatives to overcome the main difficulties in the Fairtrade certification process: a multi-cases study of organizations of small producers in Brazil. *Anais do 2011 Annual World Symposium*. Frankfurt: International Food and Agribusiness Management Association – IFAMA. Disponível em <https://www.ifama.org/events/ conferences/2011/Symposium.aspx>. Acesso 15 abr 2013.

Haghiri, M. (2011). Advances in traceability system: Consumer attitudes toward development of an integration method and quality control systems for the farmed Atlantic salmon. *Anais do 2011 Annual World Symposium*. Frankfurt: International Food and Agribusiness Management Association – IFAMA. Disponível em <https://www.ifama.org/events/conferences/2011/Symposium.aspx>. Acesso 15 abr 2013.

Krishnakumar, J. & Chan-Halbrendt, C. (2010). Consumer preferences for imported Kona coffee in south India: A latent class analysis. *Anais do 2010 Annual World Symposium*. Boston: International Food and Agribusiness Management Association – IFAMA, junho. Disponível em <https://www.ifama.org/events/conferences /2010/Symposium.aspx.>. Acesso 15 abr 2013.

Marks, N. & Cuthbertson, B. (2008). Beyond credence: Emerging trends in global consumer food preferences. *Anais do 2008 Annual World Symposium*. Monterrey: International Food and Agribusiness Management Association – IFAMA, junho. Disponível em <https://www.ifama.org/events/conferences/2008/ Symposium.aspx.>. Acesso 15 abr 2013

Pascucci, S., Royer, A. & Bijman, J. (2012). "To make or to buy", is this the question? Testing making or buying decisions to explain innovation-sourcing strategies in the food sector. *Anais do 2012 Annual World Symposium*. Xangai: International Food and Agribusiness Management Association – IFAMA, junho. Disponível em <https://www.ifama.org/events/ conferences/2012/Symposium. aspx.>. Acesso 15 abr 2013.

Porter, M.E. (1989) [1985]. *Vantagem competitiva: Criando e sustentando um desempenho superior*. Rio de Janeiro: Campus.

Roncan-Kane, M., Gray, A.W & Boehlje, M. (2011). The innovation process: practices in food and agribusiness companies. *Anais do 2011 Annual World Symposium*. Frankfurt: International Food and Agribusiness Management Association – IFAMA. Disponível em <https://www.ifama.org/events/conferences/2011/Symposium.aspx>. Acesso 15 abr 2013.

Spers, E.E., Saes, M.S.M. & Souza, C.M. (2004). Análise das preferências do consumidor brasileiro de café: um estudo exploratório dos mercados de São Paulo e Belo Horizonte. *Revista de Administração (RAUSP)*, 39(1): 53-61.

Waack, R.S., Cardoso, F., Giordano, S.R. & Bartholomeu, D.B. (2007). *Sustentabilidade no agronegócio brasileiro: uma análise exploratória qualitativa* São Paulo: Instituto para o Agronegócio Responsável – ARES, 241p.

8. Dryness of natural and natural-pulped coffee, with and without raking, and its effects on the espresso beverage – 2017

Aldir Alves Teixeira • Regina Teixeira
Alan Monteiro • Marcio Reis

8.1 Introduction

It is widely known that the beverage quality derives from the combination of a handful of factors, including species, botanic variety, climate conditions for farming, altitude, farming practices, types of harvest, processing conditions, dryness methods, roasting of the beans, grinding and the preparation method for the beverage.

Camargo e Queiroz Telles Jr. states: "it is known that only in the cherry stage (on the tree) that coffee represents, in any area and climate, the peculiar natural condition to be transformed into a fine product, able to satisfy the most demanding taste".

The distinctive taste of coffee comes from the presence of several volatile chemical components, among which we can mention the acids, aldehydes, ketones, sugars, proteins, amino acids, fatty acids, phenolic compounds, among others, as well as the action of enzymes, which some of these components will form.

However, despite the enormous diversity of factors cited above, it is known that microbial contamination of the fruit and its proliferation intensity in the key processing and drying steps in natural or artificial conditions are vital elements for the final quality of the beverage. Such bean contamination is widely diversified and complex, involving the role of bacteria, moulds and yeasts, with a predominance of some groups only, depending on the step of the process and environmental conditions. There is an association of pathogenic microorganisms for plants, which contaminate the surface of the fruit and is commonly found on the ground and in the pulp juice. Microbial ecology is quite complex and involves

the successive growth of some fungal species (*Aspergillus, Penicillium* and *Fusarium*), yeasts, lactic bacteria (*Leuconostoc* and *Lactobacillus*) and pectolitic bacteria (*Erwinia, Bacillus*). Studies have shown that several moulds can be found on the coffee tree fruit in the patio, accelerating the fermentation process of the fruit (Carvalho *et al.,* 1997).

Preparation may also be crucial for coffee quality. There are two coffee preparation types: dry and wet processes. In the dry-process preparation (natural), coffee is harvested and the whole fruits are scattered in patios and submitted to natural sun dryness until most of its humidity content is eliminated. The fruit that should be used is overripe or dry (both on the tree), because it contains less water and can lead to obtaining fine and reputed coffee. However, achieving such quality might be faced with boundaries of preparation management, ecological zones and climate change.

The wet-process preparation (pulped and semi-pulped) requires the careful harvesting of the ripe fruit because, once it is removed from its stem, environment-laden microorganisms invade it and fermentation is immediately triggered. That is the reason why the pulping of the coffee, which separates the parchment-covered bean from the husk and part of the mucilage, should be effected within 24 hours after the harvest at maximum. The removal of the remainging mucilage covering the parchment may or may not be performed prior to dryness. The pulping process may be performed as follows: mechanically, by fermentation or by means of chemicals. Through fermentation (or biological), the sugars and pectins (AMSTEL) are fully fermented, releasing the mucilage from the parchment. Coffee is then washed in running water so that loosened mucilage can be removed, thus deriving washed or pulped coffee. LILIENFELD-TOAL isolated, from the mucilage fermentation waste water, a large amount of microorganisms, among which some did not influence core coffee features, but others, such as "*L.* Agestre", "*B. Coli Putrificans*", etc. transmit unpleasant smells and flavors to the coffee.

Water distribution in the ripe cherry fruit is of approximately 20-25% in the husk, 76-90% in the mucilage and 48-49% in the bean covered by parchment and silverskin. Therefore, when the husk and part of the mucilage are removed before dryness, water content is fairly reduced, enabling dryness and decreasing the risk of undesirable fermentation.

One of the practices that has been increasingly adopted by Brazilian growers is the dryness of the coffee with part of the mucilage (natural-pulped). This practice has shown excellent results, giving rise to a beverage that is rich with body, sweetness and aromas.

Currently some recommend the dryness of the coffee cherry (ripe fruit) in the patio. However, this practice may be harmful to quality. Because of its histological structure, the husk (epicardium) preserves the fruit from desiccation, whitch extends drying time. In the meantime, the sweet pulp prompts an "ideal" habitat for the development of a wide range of microorganisms, bacteria, yeasts, moulds, among others. The metabolic products from such microorganisms (alcohols, acids like the lactic and butyric ones, amines etc) penetrate in the coffee bean, modifying its aroma and the distinctive flavor of coffee. Some of those metabolites may transmit a pleasant "bouquet" to the coffee. Others, nonetheless, are damaging to the organoleptic characters of the latter, which may give rise to riado, "rio", fermented and "stinker" coffees.

Analysis methodology for *espresso* coffee is different from other known methodologies in Brazil and overseas, such as: Brazilian cup tasting, filter coffee (or infusion) and the SCAA methodology. In the methodology employed for *espresso* coffee, medium roasting (chocolate) is used, which is the same one offered to the final consumer. The beverage should be prepared with 13g of coffee powder (double shot), in 50ml of water, at 30-second percolation time and at 9-atmosphere pressure. The Brazilian cup tasting utilizes very light roasting color, a very thick grinding level and has the following classifications: strictly soft cup, soft cup, just soft for drink, hard, riado and "rio". In the filter coffee (infusion), medium roast is used and 10g of coffee powder for 100ml of water. Yet in the SCAA methodology, analysis protocol created in the United States (Specialty Coffee Association of America), the roasting color used is lighter and in a more diluted infusion (8,25g of coffee powder for 150ml of water). Therefore, there are evaluation differences between the methodologies. In the *espresso* methodology, which holds the substances in the bean, very pleasant characteristics of positive aromas and flavors may be perceived, however, very unpleasant aromas and flavors might be detected also, like the ones arising from strong fermentations. Yet in other evaluation or brewing methodologies, these unpleasant characteristics are not perceived.

On the basis of all aforementioned steps and influences, the aim of this study is to assess the effects of natural coffee (ripe cherry) and natural-pulped coffee (NP) dryness on the quality of the *espresso* beverage when handled in a concreted patio, with and without raking.

8.2 Materials and methods

The coffee used in the preparation of samples (2016/17 crop) was grown in field "22" from "Rio Brilhante Café" farm, in Coromandel, Minas Gerais, and belongs to Red Catuai 144 variety. The fruits were harvested mechanically by a combine harvester (Jacto K3) on July 21st 2016. After being harvested, the coffee went through the washer for specific weight separation of the fruits. The fraction

of cherries was divided into two samples: one remained in the husk and the other was hulled mechanically. These two groups (natural and natural-pulped) were submitted to the different drying treatments until reaching 11% moisture content in the bean. The samples were manually prepared and defects were eliminated. Then, they were tasted in *espresso*.

8.3 Treatments

TS1: Mechanically hulled coffee, conducted still wet to the cemented drying patio and distributed in a thin layer (8 l/m² corresponding to 2 cm thickness). Dryness was carried out in full sun and with constant raking (every 30 minutes) every day. The coffee remained scattered in the patio in the late afternoon and at night. The final dryness time until reaching 11% moisture content in the bean was of 145h (corresponding to 6 days). That procedure was repeated three times, giving rise to the three samples.

TS2: Mechanically hulled coffee, conducted still wet to the cemented drying patio. Dryness was carried out as follows: the coffee was taken to the patio and distributed in a thin layer (8 l/m² corresponding to 2cm thickness) and raked until drying up the outer water, which took approximately 1h30min. After thorough elimination of the outer water, raking was not performed. On the first day, the coffee remained in a thin layer (8 l/m²). On the second day, still without raking, the layer was doubled in the late afternoon (16 l/m²). On the fourth day in the morning, the coffee was covered with Sombrite canvas (50%) and left unraked until it reached 11% final moisture. The final dryness time was of 167h (corresponding to 7 days). That procedure was repeated three times, giving rise to the three samples.

TS3: Cherry coffee (ripe) was conducted to the cemented drying patio and distributed in a thin layer (8 l/m² corresponding to 2cm thickness). Dryness was carried out in full sun and **with** constant raking (every 30 minutes) every day. The coffee always remained scattered in the patio in the late afternoon and at night. The final dryness time length until reaching 11% moisture content in the bean was of 365h (corresponding to 15 days). That procedure was repeated three times, giving rise to the three samples.

TS4: Cherry coffee (ripe) was conducted to the cemented drying patio. Dryness was carried out as follows: the coffee was taken to the patio and distributed in a thin layer (8 l/m² corresponding to 2cm thickness) and remained unraked until the late afternoon of the third day, when the layer was doubled (16 l/m²). In the late afternoon of the sixth day, the layer was doubled once again (32 l/m²). In the late afternoon of the ninth day, the layer was doubled once more (64 l/m²) and the coffee was covered with Sombrite canvas (50%), and it remained unraked until reaching 11% final moisture. The final dryness time length was of 420h (corresponding to 17 days). That procedure was repeated three times, giving rise to the three samples.

Figure 8.1 Peeled cherry coffee driven to the drying terreiro

Figure 8.2 Cherry coffee led directly to the drying terreiro

8.4 Results

8.4.1 Physical and sensorial analysis

At the end of the field test, all samples from the treated coffee that were dried to 11% final moisture were prepared in sieve 16 and above and their visible defects removed by handpicking. Each treatment was repeated three times. The samples, properly numbered and codified, were sent for physical and sensorial analysis at Experimental Agrícola do Brasil Quality Control Laboratory in November 2016. The samples were evaluated by means of type, aspect, sieve and moisture content classification analyses. The moisture content of each sample was measured through "G600" device (range 9 to 25) – Gehaka.

After the physical analysis, 100g samples were roasted at 220ºC for 5-6 minutes – in the Probat roaster. The color of each roasted sample was measured in the Probat coloring system for ground coffee (Colorette), ranging from 94 to 99, which corresponds to medium roast. This roasting degree is the same one utilized for the final product, the one aimed at the consumer.

For quality evaluation of the beverage, infuse, diluted of *espresso* and *espresso* sensorial analysis methods were used. For this analysis a 1 through 10 scoring criteria was used. Beverage evaluation was performed by a team consisting of six *espresso* specialists, all of them titled *Senior Tasters*. This way, each sample stemmed 24 results (infuse, diluted of *espresso* and *espresso* multiplied by six tasters) and the final evaluation was based upon an average of the individual grades given by each taster.

Initially, 10g of thick-grinding coffee were used and each taster smelled the dry powder from each sample, which was placed into porcelain cups. After this procedure, 100ml of water at 90ºC were poured into the cups with the ground coffee for infusion. After a 3-minute cooking process, the coffee was sifted and tasting was initiated. The infuse analyses were individual and each taster took records in their own technical report. After infuse analysis, the second sensorial analysis began: the *espresso* test. Two *espresso* cups were prepared for each sample to be analyzed with shots of 13g of coffee powder and a 50ml volume, at 30-second percolation time. The device that was utilized for *espresso* preparation was a professional "La Marzocco", calibrated for brewing at 9 atm and 90ºC water temperature. During cup tasting, espresso beverages were tasted and each specialist performed their own evaluation. The final result was composed by the average of the six tasters. In this sensorial analysis step, aroma (positive and negative), body intensity, sweetness, acidity, bitterness and astringency were evaluated.

Climate

Throughout the experiment, climate was very auspicious for coffee dryness, with sunny days and moderate winds, and no rainfall. Figure 1 shows the monitoring status of temperature, air relative humidity and dew point, captured by OM-EL-USB-2 – Omega data collector.

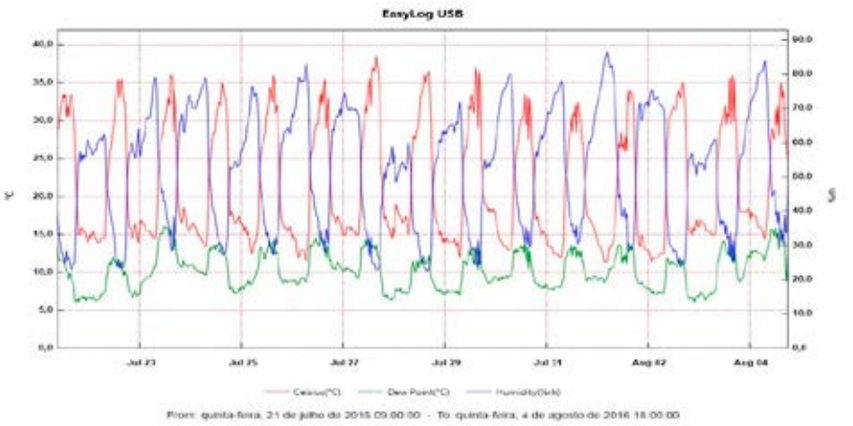


Figure 8.1: Temperature, relative and dew point monitoring

Table 8.1 shows maximum, medium and minimum variations in temperature, relative humidity and dew point throughout the treatments, as well as standard deviation.

Table 8.1. Temperature, relative humidity and dew point variations

	Maximum	Minimum	Average	Std.
Temperature °C	38.5	11.5	21.6	7.8
Air relative humidity %	86.5	22.5	52.3	17.3
Dew point °C	16.1	6.1	10.3	2.4

Table 8.2 shows, in hours, the necessary time length for coffee dryness in the different treatments.

Table 8.2. Time length for coffee dryness

	With raking (hours)	Without raking (hours)
Natural-pulped	145	167
Natural	365	420

8.4.2 Sensorial analysis of the samples

Table 8.3. Sensorial analysis of samples of espresso beverage.

Treatment	Moisture Content (%)1	Score2	Comments on the espresso beverage analysis
TS – 1 – A	11.2	8	caramel, chocolate, honey and sweet.
TS – 1 – B	11.1	8	caramel, chocolate, honey, almond and sweet.
TS – 1 – C	11.2	8	caramel, chocolate, honey and sweet.
TS – 2 – A	11.4	8	caramel, chocolate, honey and sweet.
TS – 2 – B	11.2	7	caramel, chocolate and mild astringency.
TS – 2 – C	11.0	7	caramel, chocolate and mild astringency.
TS – 3 – A	11.0	1	Strongly fermented and stinker.
TS – 3 – B	11.3	1	Strongly fermented and stinker.
TS – 3 – C	11.0	1	Strongly fermented and stinker.
TS – 4 – A	11.5	1	Strongly fermented and stinker.
TS – 4 – B	11.5	1	Strongly fermented.
TS – 4 – C	11.2	1	Strongly fermented.

1- Moisture content was measured in the "G600" (ranges 9 to 25) – Gehaka device.

2- Espresso beverage evaluation (Scoring system): 10 – rare and unique (specialty); 9 – outstanding (specialty); 8 – excellent (specialty); 7 – very good (specialty); 6 – good (specialty); 5 – regular (not specialty); 4 – inferior (not specialty); 3 – mild defect (not specialty); 2- medium defect (not specialty); 1.0 – strong defect (not specialty).

Samples of natural-pulped coffee, dried with constant raking (TS1- A, B and C), were evaluated positively in the *espresso* beverage, characterised by sweetness and flavors like caramel, chocolate and honey.

Samples of natural-pulped coffee, dried without raking (TS2-A, B and C) were evaluated positively in the *espresso* beverage, characterised by flavors like caramel, chocolate and mild astringency.

Samples of natural coffee (whole fruit), dried with constant raking (TS3-A, B and C) were evaluated negatively in the *espresso* beverage, characterised by a strongly fermented taste and "stinker".

Samples of natural coffee (whole fruit) dried without raking (TS4-A, B and C) were evaluated negatively in the *espresso* beverage, characterised by a strongly fermented flavor and "stinker".

8.5 Conclusions

Samples of natural coffee (ripe fruit), conducted directly for dryness in the cemented patio, with and without raking, were evaluated negatively in *espresso* for presenting a strongly fermented flavor and "stinker";

Samples of natural-pulped coffee, conducted directly for dryness in the cemented patio, with and without raking, were evaluated positively in *espresso* for presenting sweetness and caramel, chocolate and honey flavors;

The overall time length for coffee dryness (natural and natural-pulped), without raking, was 15% longer than the one for coffee dryness (natural and natural-pulped) with raking;

Natural coffee (whole ripe fruit), when scattered to be dried in the patio, required a longer time length for dryness due to surplus water content in the fruit. This surplus, along with sugars from the pulp, triggered an environment prone to undesirable microorganism proliferation, which led to strong fermentation. Hence, a very unpleasant strongly fermented flavor was perceived in the beverage prepared for *expresso*;

Research findings show that the dryness of natural-pulped coffee performed in thin layers (8l/m^2 corresponding to 2 cm thickness) – of a good variety, in auspicious climate conditions, **with and without** raking – led to a high-scoring specialty *espresso* beverage, bearing pleasant aromas and flavors. This shows that, when husk and part of the mucilage are removed, a large amount of water content is also eliminated, shortening dryness time length and reducing environmental conditions prone to micoorganism proliferation undesirable for quality. Nonetheless, as to prove the positive outcome obtained in the *espresso* beverage for the handling of coffee **without** raking in the patio, new large-scale field tests ought to be accomplished, within differing climate conditions and geographical situations. Only this way – in case the relation between beverage quality and such handling is proven – that practice could feasibly be validated and recommended.

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8.7 Bibliographical references

SPECIALTY COFFEE ASSOCIATION OF AMERICA. **Metodologia SCAA de avaliação de cafés especiais:** guia rápido. Long Beach: Specialty Coffee Association of America, 2009. 7 p. Available at: <http://www.scaa.org>.

SILVA, J. S.; AFONSO, A. D. L.; GUIMARÃES, A. G. Estudos dos métodos de secagem. In: SILVA, J. S. **Pré-processamento de produtos agrícolas**. Juiz de Fora: Instituto Maria, 1995. p. 105-143.

SILVA, J. de S.; BERBERT, P. A. **Colheita, secagem e armazenagem de café**. Viçosa: Aprenda Fácil, 1999. 146 p.

SAATH, R. et al. Alterações na composição química e sensorial de café (*Coffeaarabica*L.) nos processos pós-colheita. **Revista Energia na Agricultura**, Botucatu, v. 27, n. 2, p. 96-112, Apr./Jun. 2012.

SALVA, T. de J. G. A composição química dos grãos e a qualidade da bebida de café, em consequência do método de preparo e da cultivar. In: SALVA, T. de J. G. et al. (Ed.). **Cafés de qualidade:** aspectos tecnológicos, científicos e comerciais. Campinas: Instituto Agrônomico, 2007. p. 255-280.

TAVEIRA, J. H. S. **Aspectos fisiológicos e bioquímicos associados à qualidade da bebida de café submetido a diferentes métodos de processamento e secagem**. 2009. 67 p. Dissertação (Mestrado em Ciência dos Alimentos) – Universidade Federal de Lavras, Lavras, 2009.

PIMENTA, C. J.; COSTA, L.; CHAGAS, S. J. de R. Peso, acidez, sólidos solúveis, açúcares e compostos fenólicos em café (*Coffeaarabica* L.*)* colhidos em diferentes estágios de maturação. **Brazilian Journal of Storage**, Viçosa, n. 1, v. 25, p. 23-30, 2000. PIMENTA, C.

BARBOSA, L.F.; TEIXEIRA A. A.; PARREIRA P.; CASTILHO A. Um novo desmucilador do café despolpado.

CAMARGO E QUEIROZ TELLES JR, A. – 1953: O Café no Brasil, Vol. 11:445.

Illy, A. & Viani, R. 1995. *Espresso* Coffee: The Chemistry of Quality. San Diego: Academic Press, 253p.

Carvalho, V.D.; Chagas, S.J.R. & Souza, S.M.C. 1997. Fatores que afetam a qualidade do café. **Inf. Agrop., 18:** 5-20.

AMSTEL, I.E. – 1923 – Der Tropenpflazer, 26:59.

LILIENFELD-TOAL, O.A. – 1931: Fermentação do Café (Agriculture Secretariat, São Paulo).

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