Economic Analysis of Certification in the Brazilian Fruit Chain

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"*Ando devagar porque já tive pressa e levo este sorriso porque já chorei demais*
hoje me sinto mais forte mais feliz quem sabe só levo a certeza,
de que muito pouco eu sei ou que nada sei…"

(Almir Sater)

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Abstract

Producers and exporters of fresh fruits and vegetables from developing countries like Brazil are increasingly required to demonstrate the safety and traceability of their produce up to the consumption stage. In order to access international markets such as the European Union (EU) and the United States (US), fruits producers need to meet the requirements from the buyers and comply increasingly with certification systems. In Brazil, these are specifically the Integrated Fruit Production (PIF), GlobalGAP, Fairtrade and Organic certification schemes. Not clear is the impact these certification schemes have on Brazilian fruit farmers. There is some evidence in the literature, that certification contributes positively to the development of specific export sectors in developing countries. In fact, the Brazilian export market is still relatively underdeveloped, with an export share of only 2.4% of the total produced volume. However, certification may also have the effect of a non-tariff trade barrier, undermining the capability and financial ability of especially small-scale farmers in exporting to international markets. This study, therefore, aims at providing an economic analysis of certification in the Brazilian fruit chain.

A survey of 303 grapes and mango farmers was conducted in 2006 in the Juazeiro/Petrolina region of the Sao Francisco Valley in Brazil. The survey continued interviewing 85 cashew nuts farmers and conducting six case studies with melon growers in the Serra do Mel/Mossoró region in the semi-arid zone of the Northeast of Brazil. Certified and non-certified farmers as well as those in process to obtain certification were included in the sample.

To analyze the primary data, a conceptual framework of the marketing chain and the farmers' adoption decision was first developed. Then, different theoretical and empirical approaches which are relevant for the analysis of certification, were added to the framework. The descriptive analysis has been complemented by some econometric models. The LOGIT model was used three times: first, for identifying the determinants of the adoption of certification and second, for determining the factors relevant for adopting two versus one certification scheme, and third, for testing the main factors that lead farmers to adopt specifically PIF. Several tests were performed to check the robustness of the models.

Comparative analyses between certified and non-certified farmers of grapes, mango, melon and cashew nuts show that certified farmers receive higher net income than non-certified

farmers. The net income of the farmers in process is slightly lower compared to certified farmers. The higher net income partly derives from the price premium paid for the certified fruits. Certified mango and grapes farmers have received an increased price per kg of 58% and 28%, respectively. Cashew nuts farmers receive the highest rates: 82% per kg of nuts and 62% per kg of kernel. Melon producers do not receive a price premium after adopting certification, but certification enables them to remain in the market. Other benefits identified refer particularly to environmental, health and food safety aspects. The costs of certification are found to be of minor importance, especially since financial support is provided by Brazilian governmental organizations like SEBRAE and EMBRAPA. Investments due to certification are partly considerable, but are outweighed by higher productivity and price premia. The price premia of small-scale farmers have been found to be lower compared to those of the medium-scale farmers, but the farmers are still able to compete.

The logistic estimates show that education and the years of experience mostly have a positive and significant effect on the decision to adopt certification. The chances to certify decrease, however, when farmers are dependent on the income from non-agricultural activities, are living in rural villages and not on the farm and trade with an individual buyer using a verbal trust-based arrangement. The estimates on separate grapes and mango models also find the size of the farms and the share of the current irrigated area to negatively contribute to the chances of adoption. The decision of mango and grapes farmers to adopt two instead of only one certificate was found to be influenced by whether the farmer can made use of the packing house from the group, cooperative or association. Variables such as 'years trading with the buyer' and 'living in the city' have negative and significant influence on the decision making.

An analysis of the grapes and mangoes marketing chains reveals that certified producers generally trade with groups, cooperatives or associations, while non-certified farmers trade with individual buyers. Groups, cooperatives and associations generally contribute to upgrade mostly certified farmers. Written contracts are more often found between groups and farmers. Uncertified farmers, however, trade more often with individual buyers based on verbal contracts. Such marketing chains are less vertically integrated and present low asset specificity.

Keywords: fruits, certification, logit model, marketing chain, Brazil

Kurzfassung

Von Produzenten und Exporteuren von frischem Obst und Gemüse aus Entwicklungsländern wie Brasilien wird zunehmend verlangt, die Sicherheit und Rückverfolgbarkeit ihrer Erzeugnisse bis zur Stufe des Konsums nachzuweisen. Um Zugang zu den internationalen Märkten wie der Europäischen Union (EU) und den Vereinigten Staaten (US) zu erhalten, müssen Fruchtproduzenten den Anforderungen von Abnehmern gerecht werden und Zertifizierungssystemen in zunehmendem Maße nachkommen. Diese umfassen in Brasilien die ‚Integrierte Frucht-Produktion' (PIF), ‚GlobalGAP', ‚Fairtrade' und die Zertifizierung des organischen Anbaus. Nicht geklärt sind die Auswirkungen der Zertifizierungsanforderungen auf brasilianische Obstanbauer. In der Literatur gibt es Anhaltspunkte, dass Zertifizierung positiv zur Entwicklung entsprechender Exportsektoren in Entwicklungsländern beiträgt. Tatsächlich ist der brasilianische Exportmarkt bezüglich des Obsts mit einem Exportanteil von nur 2,4% am produzierten Gesamtvolumen verhältnismäßig schwach entwickelt. Zertifizierung kann jedoch auch den Effekt einer nicht tarifären Handelsbeschränkung haben und das Leistungsvermögen sowie die finanzielle Leistungsfähigkeit besonders von Kleinbauern beim Exportieren in Weltmärkte schwächen. Vor diesem Hintergrund strebt die vorliegende Arbeit eine ökonomische Analyse der Zertifizierung in der brasilianischen Wertschöpfungskette von Früchten an.

Dazu wurde im Jahre 2006 eine Befragung von 303 Trauben- und Mangoproduzenten in der Region Juazeiro/Petrolina innerhalb des Sao Francisco Tals in Brasilien durchgeführt. Zudem wurden 85 Produzenten von Cashewnüssen befragt und 6 Fallstudien mit Anbauern von Melonen aus der Region Serra do Mel/Mossoró durchgeführt, einer semi-ariden Zone im Nordosten Brasiliens. In der Stichprobe befanden sich zertifizierte und nicht zertifizierte Produzenten sowie solche, die sich noch im Zertifizierungsprozess befinden.

Um die Primärdaten zu analysieren, wurde zuerst ein konzeptioneller Rahmen der Vermarktungsbeziehungen und der Zertifizierungsentscheidung der Produzenten entwickelt. Dann wurden verschiedene theoretische und empirische Ansätze, die für die Analyse der Zertifizierung relevant sind, dem konzeptionellen Rahmen hinzugefügt. Die deskriptive Analyse wurde durch verschiedene ökonometrische Modelle ergänzt. Drei LOGIT-Modelle wurden durchgeführt: Zuerst zur Prüfung der Determinanten in Bezug auf die Entscheidung für die Annahme der Zertifizierung; zweitens, ein Modell zur Bestimmung der relevanten Faktoren für die Annahme zweier oder lediglich eines Zertifizierungssystems, und drittens,

die Prüfung der Hauptfaktoren, welche die Produzenten dazu veranlasst, sich nach PIF zertifizieren zu lassen. Verschiedene Tests wurden zur Überprüfung der Modellrobustheit durchgeführt.

Vergleichende Analysen zwischen den zertifizierten und nicht zertifizierten Anbauern von Trauben, Mangofrüchten, Melonen und Cashewnüssen haben gezeigt, dass zertifizierte Produzenten ein höheres Nettoeinkommen im Vergleich zu nicht zertifizierten Farmern erzielen. Das Netteinkommen der Produzenten, die sich noch im Zertifizierungsprozess befinden, fällt etwas geringer aus im Vergleich zu zertifizierten. Das höhere Nettoeinkommen lässt sich teilweise von dem Preisaufschlag für zertifizierte Früchte ableiten. Zertifizierte Anbauer von Mangofrüchten und Trauben haben eine Preissteigerung von 58% respektive 28% pro kg zu verzeichnen. Anbauer von Cashewnüssen erzielen die höchsten Anstiegsraten: 82% pro kg Nüsse und 62% pro kg der Kerne. Produzenten von Melonen erhalten keinen Preisaufschlag nach Zertifizierung; sie ermöglicht es ihnen aber, im Markt zu bleiben. Weitere Vorteile schließen Umweltaspekte, Gesundheit und Aspekte der Nahrungsmittelsicherheit mit ein. Die Kosten der Zertifizierung sind von geringerer Bedeutung, besonders, da finanzielle Unterstützung durch brasilianische Regierungsorganisationen wie SEBRAE und EMBRAPA gewährt wird. Die für die Zertifizierung notwendigen Investitionen sind zwar teils beträchtlich, werden aber durch höhere Produktivitäts- und Preisaufschläge wieder übertroffen. Ergebnisse zeigen, dass Kleinbauern geringere Preisaufschläge erhalten verglichen mit größeren Betrieben, dass die Produzenten aber noch in der Lage sind, auf dem Markt zu konkurrieren.

Die Schätzung der logistischen Regression zeigt, dass Ausbildung und Erfahrung meist einen positiven signifikanten Effekt auf die Entscheidung haben, sich zertifizieren zu lassen. Die Wahrscheinlichkeit der Zertifizierung nimmt jedoch ab, wenn die Produzenten von Einkommen aus nicht-landwirtschaftlicher Tätigkeit abhängig sind, in Dörfern und damit nicht auf dem landwirtschaftlichen Hof leben und mit einzelnen Kunden handeln, mit denen auf Vertrauen basierte verbale Abmachungen bestehen. Die Schätzungen separater Modelle für Trauben und Mangofrüchte zeigen, dass sich zusätzlich die Größe der Höfe und der Anteil der bewässerten landwirtschaftlichen Fläche negativ auf die Wahrscheinlichkeit der Annahme einer Zertifizierung auswirken. Die Entscheidung der Mango- und Traubenproduzenten, zwei Zertifizierungssysteme anstatt eines anzunehmen, wird davon beeinflusst, ob der Produzent eine Kühllagerung einer Kooperativen nutzen kann. Variablen wie „die Anzahl der Jahre, die

mit dem Abnehmer zusammengearbeitet wird“ sowie dem „Leben in einer Stadt“ haben einen negativen signifikanten Einfluss auf die Entscheidung.

Die Analyse der Wertschöpfungsketten von Trauben und Mangofrüchte zeigt, dass zertifizierte Produzenten im Allgemeinen mit Kooperativen Handel betreiben, während nicht zertifizierte Produzenten mit einzelnen Kunden handeln. Zudem tragen Kooperativen im Allgemeinen dazu bei, dass sich zertifizierte Produzenten innerhalb der Wertschöpfungskette meistens verbessern können. Schriftliche Verträge werden häufig zwischen Gruppen und Produzenten geschlossen. Nicht zertifizierte Produzenten handeln hingegen häufig mit einzelnen Kunden, wobei der Handel auf mündlichen Verträgen basiert. Solche Vermarktungsbeziehungen sind weniger vertikal integriert und weisen eine geringere Produktspezifität auf.

Schlüsselwörter: Früchte, Zertifizierung, LOGIT Modell, Vermarktungsbeziehungen, Brasilien

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List of Abbreviations

ACR	Arm's Length Contractual Relation
AGAPOMI	Associacao Gaúcha dos Produtores de Maçã
APEX	Trade and Investment Promotion Agency
APHIS	United States Department of Agriculture, Animal and Plant Health Inspection Service
BRC	British Retail Consortium
BSE	Bovine Spongiform Encephalopathy
CEO	Conformity Evaluation Organization
CNPAT	EMBRAPA Tropical Agro industry
CNPQ	National Council for Scientific and Technological Development
CPATSA	EMBRAPA Semi-Arid
CODEVASF	Sao Francisco River Valley Development Agency
COEX	Comitê Executivo de Fitossanidade do Rio Grande do Norte
COOPERCAJU	Cooperativa dos Beneficiadores Artesanais de Castanha de Caju do Rio Grande do Norte
DAAD	German Academic Exchange Service
EC	European Communities
EMATER	Institute of Technical Assistance and Rural Extension of Rio Grande do Norte
EMBRAPA	Brazilian Agricultural Research Corporation
ESAM	Federal School of Agronomy in Mossoró
EUREP	Euro-Retailer Produce Working Group
EU	European Union
FAO	Food and Agriculture Organizations of the United Nations
FLO	Fairtrade Labeling Organizations International
FOB	Free on Board
GAP	Good Agricultural Practices
GCC	Global Commodity Chain
GFSI	Global Food Safety Initiative
GLOBALGAP	Global Partnership for Good Agricultural Practice
GMO	Genetically Modified Organisms
GMP	Good Manufecturing Practices
GVC	Global Value Chain

Ha	hectare
HACCP	Hazard Analysis Critical Control Points
IBD	Institute of Biodynamic Certification Association
IBGE	Brazilian Institute of Geography and Statistics
IBRAF	Brazilian Fruit Institute
INMETRO	National Institute of Metrology, Standardization and Industrial Quality
IFOAM	International Federation of Organic Agriculture Movements
ILO	International Labor Organization
IPM	Integrated Pest Management
ISO	International Organization for Standardization
Kg	kilogram
MAPA	Ministry of Agriculture, Food Supply and Livestock
MDIC	Ministry of Development Industry and Foreign Trade
MRL	Maximum Residue Level
NIE	New Institutional Economics
OCR	Obligation Contractual Relations
OGS	Organic Guarantee System
PIF	Integrated Fruit Production
PNSQV	National Plan of Security and Product Quality of Vegetal Origin
RN	Rio Grande do Norte state
SEBRAE	Support Agency for Small and Medium-sized Firms
SFV	Sao Francisco Valley
TBT	Technical Barriers to Trade
TCE	Transaction Cost Economics
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
US	United States of America
USDA	United States Department of Agriculture
SPS	Sanitary and Phytosanitary Measures
VALEXPORT	Producers and Exporters Association of the São Francisco River Valley
WTO	World Trade Organization
ZEF	Center for Development Research

1 Introduction

This thesis aims at providing a comprehensive economic analysis of certification in the main fruit chains in the region of Petrolina/Juazeiro in Pernambuco and Bahia states, and the Mossoró/Serra do Mel region in Rio Grande do Norte state in Brazil. These two regions are mainly responsible for the country's total exports to the European Union (EU) and the United States (US). This chapter presents the background, states the research problem, discusses the objectives and finally, outlines the structure of the thesis.

1.1 Background and statement of the problem

Several crises and scandals like the one on Bovine Spongiform Encephalopathy (BSE) have shaken the European food sector over the last decades. Despite public regulations and government control, most of the BSE cases were not detected immediately, consequently leading to a decline in the consumer's confidence in the safety and quality of many food products. As a result, the private sector in many European Union countries developed consumers' protection strategies such as new quality labels based on control throughout the whole value chain (Caswell & Modjuska, 1996).

The European retail chains have assumed a leading role in the formulation of food safety and quality standards. Their international supplier base, especially in developing countries, needs to adapt and comply, if they wish to continue trading with major retailers (FAO, 2007). It is widely recognized that quality and safety standards play an important role for developing countries, especially for their agricultural sectors. There is a growing concern that standards will undermine the competitive progress already made by some developing countries and present insurmountable barriers to new entrants in the high-value food trade (Jaffee et al., 2005). Henson & Loader (2001) find that Sanitary and Phytosanitary Measures (SPS) are the greatest impediment to developing countries' exports to the EU, surpassing transport and other direct export costs, tariffs or quantitative restrictions.

Nevertheless, food safety standards can also have positive implications for developing countries. These countries may gain and maintain access to markets of high-value agricultural and food products, especially in industrialized countries (Henson & Jaffee, 2007). From this standards-as-catalyst angle, the challenge inherent in compliance with food safety and agricultural health standards may well provide a powerful incentive for the modernization of developing countries export supply chains and give greater clarity to the necessary and appropriate management

functions. Further, via increased attention to the spread and adoption of good practices in agriculture and food manufacture, there may be spillovers into domestic food safety and agricultural health to the benefit of the local population and domestic producers. Hence, part of the costs of compliance could be considered as investments into the national economy.

Rather than degrading the comparative advantage of developing countries, enhancement of capacities to meet stricter standards could potentially create new forms of competitive advantage. Hence, the process of standards compliance could conceivably provide the basis for a more sustainable and profitable trade over the long term, albeit with some particular winners and losers (Jaffee & Henson, 2004).

Fresh fruits are an example of a traditional agricultural export crop and they illustrate the potential for agricultural diversification and production of high-value crops. Brazil is the third largest producer of fruits among developing countries, after China and India. Its total production was 43.8 million tons in 2004, representing 3.2 % of the production of all developing countries. However, it is estimated that only around 2% of the country fruit production (in terms of volume) is exported generating US$370 million (Brazilian Fruit Institute (IBRAF), 2004).

Grapes and mango exports have been the most successful cases, with around 260,000 tons and 550,000 tons each being cultivated. The region of Petrolina/Juazeiro, which is part of the Sao Francisco river basin, is responsible for this export performance. This region produced 99% and 88% of the country's grapes and mango exports (IBRAF, 2004). VALEXPORT (2006) estimates that the sector generates a total of 240,000 jobs directly and 960,000 jobs indirectly in the region.

The states of Rio Grande do Norte, covering the Mossró/Serra do Mel, and Ceará is considered the second biggest irrigated tropical fruits region in Brazil with about 20,000 hectares (ha) (Costa et al., 2007). These two states are responsible for 98% of the country's total exports of melons in 2005 when almost 99% of the fruit is designated to the European Union. Rio Grande do Norte State is also responsible for its exports of 23% of the total Brazilian shelled cashew nuts in 2005 (Aliceweb, 2007). Aiming at accessing international markets such as the European Union and the United States, farmers of mango, grape, cashew nut, and melon need to meet the requirements from the buyers and comply with different certification systems.

Given the trend towards tighter food safety requirements in international markets, in 1999 Brazil started to develop the Integrated Fruit Production (PIF) scheme, a national quality assurance

program. The Ministry of Agriculture, Food Supply and Livestock (MAPA) requested the Brazilian Agricultural Research Company (EMBRAPA) to further develop the scheme for implementation. The pilot projects involved apples, grapes, mangoes and citrus. As part of the Fruit Production Development Program (PROFRUTA), this system contributed to strengthen the ties between the public and private sectors, to aim at improving quality, competitiveness and share of national fruits at the international level (Andrigueto et al., 2002).

Nevertheless, besides the effort of the Brazilian government in developing and implementing a national certification scheme, the acceptance at both national and international levels was below the expectation. Indeed, as Vitti & Cintra (2003) highlight, supermarkets in the European Union started to require the Global Partnership for Good Agricultural Practice (GlobalGAP) certification, instead of PIF, from Brazilian fruit exporters at the end of 2003.

Thus, certification has become increasingly relevant as a marketing signal for agribusiness especially in the fruit sector over the past few years. Substantial parts of many value chains are by now certified by standards as GlobalGAP, Fair Trade, Integrated Fruit Production and Organic. However, it has hardly been researched how these approaches impact on the trade with different products, on various sizes of producers, and how they can actually ensure a high quality control. FAO (2004) also highlights that there are no systematic studies available which assess the impact of certification programs over a wide range of farms, crops and locations. However, a growing number of case studies have analyzed their impacts on various costs and profitability aspects.

While there is a great deal of literature on the role of certification in the international fruit export market, only a few studies have concentrated on certification in the Brazilian fruit production. Among them, Cintra et al. (2002) focus on the impact of certification adoption by mango and grape farmers in the Sao Francisco Valley. The results show that certified producers have preference when buyers and traders are selected as potential exporters. In this line, Cavichiolli et al. (2005) argue that for Brazilian fruit producers, certification is considered a vital mechanism to comply in order to access international markets.

Fruit and vegetable sectors are seen as sectors where small producers are able to participate due to their low demand on land and their high labor requirements. However, the concern is that small producers' participation in the international fruit and vegetable trade could be diminishing as a result of the increasing prevalence of food quality standards in the sector (Gibbon & Ponte, 2005). Implementing certification and entering certified markets have complex impacts on the economic

performance of a farm. Production costs, yields and producer prices may each be affected positively or negatively by certification and have to be analyzed together. Furthermore, initial investment costs are likely to be very farm-specific (FAO, 2004).

USAID (2005) argues that for some producers, standards may open new opportunities as they permit access to particular market segments. At the same time, the process of (re)distributing market shares is accompanied by marginalization and exclusion, as standards may impose prohibitively high barriers on certain producers in terms of short-run and long-run efforts needed for production under certification. This is particularly relevant since certification with private standards has become a major requirement for participation in the fruit and vegetable markets worldwide.

Since fruits are perishable, disastrous quality losses can occur at any stage in the marketing chain from grower to consumer and the total value of the product may be lost. Hence, every activity in the production and marketing chain of fruits must be precisely timed (Jensen & Rorabaugh, 2007). The White Paper on Food Safety of the EU (2000) highlights that food safety needs to be organized in a more coordinated and integrated way, i.e. along the chain (farm to table), across all food sectors, within and beyond the frontiers of the EU.

1.2 Objectives of the study

This thesis aims at providing an economic analysis of certification in the Brazilian fruit chain with particular focus on four sectors: mangoes and grapes in the Petrolina/Juazeiro region, and cashew nuts and melons in the Serra do Mel/Mossoró region. It directs attention to the role certification plays in these sectors to assess the differences and the similarities between certified and non-certified farmers. It also looks at the characteristics of the producers to determine the probability of adopting a certification scheme on a wider scale and conducts a comparative analysis of different certification schemes and land sizes. Identifying the type of global value chain governance and providing a theoretical explanation for the reasons that arise are important to generate a better understanding of different forms of inter-firm coordination and to provide tools for policy.

More specifically, the objectives of the study are:

- To assess the differences and similarities between certified and non-certified farmers;
- To understand the functioning of the marketing chain of the four selected sectors;

- To identify the determinants which lead producers to adopt certification or not;
- To assess the impact of certification on producers differing by size;
- To assess the importance, the role and the differences of certification schemes (PIF, GlobalGAP, Organic and Fairtrade).

1.3 Structure of the thesis

The thesis is divided into eight chapters. Chapter 1 presents the introduction of this study. Chapter 2 describes relevant theories associated with empirical and theoretical evidence on the economic importance of certification. Chapter 3 provides the basic conceptual framework and describes the methodology of the thesis used for analyzing the decision to certify and for analyzing the marketing chain. Chapter 4 presents details of the data collection in the grapes, mangoes, melons and cashew nuts sectors as well as background information. Chapter 5 shows major trends regarding fruit production and certification in Brazil. The descriptive and analytical statistics of the survey and the comparative analyses are presented in chapter 6 and chapter 7, respectively. Chapter 8 closes the thesis by presenting the summary and policy recommendations.

2 Certification: Literature Review

This chapter reviews the literature which takes a critical look at the existing research on certification. It provides insights about the originality of this research and establishes the importance of certification for the development of the Brazilian fruit chain. Section 2.1 presents the definition of certification, types of standards and issues related to asymmetric information and monitoring. Section 2.2 describes the theoretical and empirical evidence of certification available in the literature. Section 2.3 briefly summarizes the chapter.

2.1 Certification

2.1.1 Definition and purposes

Certification is a procedure by which a third party gives written assurance that a product, process or service is in conformity with certain standards. Thus, certification can be seen as a form of communication along the supply chain while the certificate demonstrates to the buyer that the supplier complies with certain standards (International Organization for Standardization ISO, 1996). Similarly, "certification is the (voluntary) assessment and approval by an (accredited) party on an (accredited) standard" (Meuwissen et al., 2003:54). Schiefer (2003:4) mentions that "sustainable and effective certification must allow clearly identifiable segmentation through, e.g. branding of products from clearly specified supply chains".

In the agricultural and food industry sector, certification refers to all kinds of food products (juices, cereals and grain incl. rice, and even alcoholic beverages (wine etc.), sugar, meat, dairy products or eggs) which have been produced based on organic or bio-dynamic farming technologies or on Integrated Pest Management (IPM). Other non-food agricultural products like animal feeds (for production of organic meat, dairy products and eggs), grain seeds, natural pesticides and insecticides, cosmetics and textiles (cotton, leather and leather goods) may also be certified if they meet certain environmental criteria (Basu et al., 2004).

According to El-Tawil (2002), certification is the process by which buyers assess the compliance with defined standards and is typically undertaken by a third party agency that the buyer recognizes as competent. A crucial issue for low and middle-income countries is the establishment of certification capacity and parallel institutions through which certification bodies are accredited.

The purpose of certification is to reach a defined performance and to make this perceptible to stakeholders. Stakeholders may include consumers, other customers, governments, risk-financing parties such as banks and insurance companies, or society as a whole. Also the company itself can be a stakeholder, since certification of food safety and traceability systems gives organizations a tangible approval of good practice and a tool for due-diligence defence in case of product safety (Henson & Holt, 2000). For stakeholders to regard certification as a valuable tool, they must trust the certification scheme as well as the certifying party. Also, there should be regular tests or audits (usually specified in the certification scheme) to verify whether the certified party still reaches the agreed performance level.

On the one hand, implementing food safety standards can increase costs for firms. On the other hand, firms have incentives to protect their reputation, and so might implement state-of-the-art food safety practices without any prodding from the government. Additionally, as consumers might be willing to pay more for food that they perceive as safer, firms have another incentive to implement stricter food safety regimes. The higher prices consumers are willing to pay could compensate firms for the costs of food safety provision. A firm will adopt more stringent food safety practices if the cost is smaller than the resulting benefit to the firm in the form of reduced risk of losses, reduced liability, and higher consumer willingness to pay for the safer food (Mitchell, 2003).

Certification can act to impede exports either because explicit bans are placed on imports of particular products or the cost of compliance with requirements diminishes export competitiveness. Standards can therefore be a source of competitive advantage for the developing countries if they upgrade capacity and make the necessary adjustments in the structure and operation of their supply chains. For many high-value foods, including fruits and vegetables, the challenges of international competitiveness have moved beyond price and basic quality parameters to greater emphasis on food safety. Indeed, rising food safety standards serve to accentuate supply chain strengths and weaknesses and thus, affect the competitive positions of countries and distinct market participants (Henson & Jaffee, 2004).

2.1.2 Different types of standards

Setting international standards has proven difficult due to the variety of circumstances that exist around the world. This is especially true for agricultural products, which have to respond to differences in climate, soils and ecosystems and are an integral part of cultural diversity.

Environmental and social standards are hence, often normative standards, i.e. generic standards or guidelines used as a framework by local standard-setting or certification bodies to formulate more specific standards. Nevertheless, standards developed in one particular country or geographical area may discriminate against producers of other countries or areas if they do not take into account different local conditions (FAO, 2003).

The most widely-applied general standards systems are the Hazard Analysis Critical Control Points (HACCP) and ISO 9000 required by the food industry. The HACCP system identifies specific hazards and establishes control systems that focus on prevention rather than on end-product testing. In contrast, ISO standards are specific to a particular product, material or process. ISO 9000 examines if regulations for items are met. Thus, HACCP is a food safety meta-system and ISO 9000 is a quality management system. Both systems are applied by the processing food industries (Lee, 2006).

Hobbs, Fearne & Spriggs (2002) compare the incentive structures in the food safety legislation and business strategies in the private sector in the United Kingdom (UK), Canada and Australia. The comparisons highlight the importance of incentives for changes in determining the respective roles of public policy and private sector responses to food safety issues.

Henson (2006) distinguishes between standards as being mandatory, voluntary and *de facto*. Mandatory or regulatory standards, named technical regulations by the Technical Barriers to Trade (TBT) Agreement, are standards set by public institutions whose compliance is obligatory in the legal sense. Voluntary consensus standards arise from a formal coordinated process involving participants in a market with or without the participation of the government. Finally, *de facto* standards arise from an uncoordinated process of market-based competition of private firms. These standards refer to a set of specifications to gain market share through authority or influence.

According to Schulze et al. (2006), there are public and private certification systems. Governmental certification systems, for instance, serve the consumer's protection purposes by providing quality labels to improve market transparency (e.g. organic farming). Public certification systems help to prevent mislabeling through laws and fines enforced by public authorities. However, most certification schemes are privately organized. Certification procedures tend to be different depending on the purposes: either for consumer marketing or to meet the demands of institutional buyers.

Likewise, the World Trade Organization (WTO, 2005) has also divided standards into private or public. The distinction between them matters when considering whose interests on standards are set for. It is assumed that interests of all actors in society are considered in the case of public standards, while the private standards are chosen to maximize firms' profits. Thus, private standards are by definition voluntary, but public ones can be either voluntary or mandatory[1].

2.1.3 Information asymmetries

Information asymmetries occur when producers have information about the characteristics of the goods they produce which the consumers do not possess. Buyers are in a disadvantageous position compared to sellers, because the latter are well-informed about the goods or services as opposed to the buyers. Therefore, standards can increase welfare by removing information asymmetries in markets (WTO, 2005). Thus, the existence of asymmetric information increases the transaction costs on the one hand, and on the other, generates private incentives to decrease them. Moreover, food quality and safety standards are voluntarily accepted and applied by the firms to improve their competitiveness. This motivation guides the firms towards quality assurance systems (Holleran et al., 1999).

The idea behind certification systems is to reduce existing information asymmetries, especially in the case of goods including credence attributes such as food safety, organic production and animal welfare. In the supply chain, consumers and suppliers are confronted with information uncertainty. Consumers are not able to detect opportunistic behavior. In order to reduce consumers' and suppliers' uncertainty, retailers and brand manufacturers tend to increasingly monitor their suppliers' production process themselves via second party audits (Caswell et al., 1998).

An analysis of a certification system focusing on its functioning reveals that certification systems include tendencies towards opportunistic behavior. Taking into consideration the great number of customers demanding certificates from their suppliers, producers are constantly under pressure to certify (Schulze et al., 2006). Moreover, Beck & Walgenbach (2003) emphasize that suppliers perceive certification schemes as externally imposed obligations instead of intrinsically motivated quality management systems.

[1]In WTO terminology mandatory standards are referred to as technical regulations under the Agreement on Technical Barriers to Trade and also sanitary or phytosanitary measures under the Agreement on the Application of Sanitary and Phytosanitary Measures.

Jahn, Schramm & Spiller (2005:56) denote that "certification systems and labeling imply multifaceted problems to which the parties involved have paid little attention so far: the central task of certification and the reduction of information asymmetry within the market can be fulfilled only if the institutions in charge succeed in assuring certification quality and thus, the validity of the audit signal". However, the reliability of the quality labels and their effectiveness strongly depend on the type of external audits and their implementation. Usually the control process is carried out by independent certifiers who, in turn, have to meet criteria settled by agencies. Only if the certifiers succeed in revealing critical aspects and opportunistic behavior, quality assurance concepts will be able to build up the reputation necessary to serve as a reliable quality signal (Jahn, Schramm & Spiller, 2005).

Depending on the information about the safety of the goods that is available to consumers, goods are classified into three categories. First, there are search goods. The consumer is able to obtain information about the safety of the good through inspection – consumers have nearly perfect information. The second category relates to experience goods. Consumers can get information on safety through repeated purchases or through reputations established by others. The third is credence goods. In this case, consumers cannot discern information on product safety, even after repeated purchases (Antle, 2001). Marette, Crespi & Schiavina (1999) observe that agricultural markets are working imperfectly due to asymmetric information, since the consumers lack perfect information about the product quality.

Jahn, Schramm & Spiller (2004a) seek to investigate the audit quality of certification systems within the food sector, based on financial auditing. They assume that suppliers are not interested in the highest possible standard of inspection, but in acquiring a certificate as easily as possible. Since the risk of free rider behavior occurs, a strict inspection lowers the probability of successful certification. Therefore, suppliers have an incentive to select an auditor known to employ low inspection standards. Thus, certification systems offer a variety of incentives for inadequate inspections. The conclusion highlights that standards tend to be weak without a public regulation inspection. The authors also mention the factors influencing the audit quality. These are: effects on reputation (if there is no reputation, suppliers search for a certifier with low control efforts and inspection prices); protecting quasi-rents (the dependence of certification is diminished); intensifying liability (the quality of the certifier inspection increases) and improvement of inspection technology (certifiers can have varying levels of success with the same costs due to having different levels of know-how).

Deaton (2004) points out that third-party certifiers play an important role in the global food system. Third-party certifiers are external institutions that assess, evaluate and certify quality claims. The framework used by him highlights five concepts: uncertainty; information asymmetries; opportunistic behavior; divergences between private and social returns and signaling institutions. The benefits of third-party institutions result from their capacity to provide market signals. Indeed, the costs of receiving independent third-party certification are inversely related to a firm's product quality.

2.2 Theoretical and empirical evidences

This section reviews the literature and outlines different approaches which have been used to examine relationships between certification and value chains. Both issues are closely related since certification may drive integration in the value chain. Special emphasis will be put on empirical examples from the food sector, in particular related to horticultural products.

2.2.1 Cost-benefit approach

A cost and benefit approach using qualitative variables from the food industry and the consumer's perspective of different systems: food safety, hygiene, traceability and certification has been presented by Meuwissen et al. (2003). The discussion is around three aspects: (i) the positive effect on trade: all systems are an indicator of the quality and product background. Thus, certification facilitates the communication about it; (ii) enhancing license to produce: the use of types of systems and schemes depends on upgraded markets and introduction of new requirements, and (iii) price premium: uncertainty involves the consumer's willingness to pay for food safety systems and certification schemes. They conclude that, in general, more attention has been paid to technical issues of traceability and certification than to economic ones. They recommend that future studies should focus more on economic analyses than on technical aspects.

Carambas (2007) conducts a cost-benefit analysis comparing certified organic and conventional rice producers in Thailand. The net returns for farmers of eco-labeled products were estimated and compared with those of conventional farmers. The difference in incomes per unit of eco-labeled and conventional products depends on the magnitude of the price premium. The costs involved in producing eco-labeled products relate to capital costs due to adjustments to new technologies, additional costs of production and processing and increase in labor requirements, additional cost of raw material, cost of testing and certification. However, financial, environmental and health

benefits also accrue to producers of labeled organic rice. Financial net benefits depend largely on the presence of a price premium.

Gogoe (2003) evaluates the costs for small-scale producers of pineapples to implement the EurepGAP protocol in Ghana. The results indicate that there are considerable fixed costs associated with the upgrading of facilities and production procedures in order to comply with the protocol and that these can be a significant constraints for the small-scale farmers. However, once implemented, EurepGAP significantly reduced variable costs of production due in particular to more selective use of agrochemicals. Although there were no appreciable changes in yields as a result of the changes in production practices, both profits from pineapple production and overall farm incomes increased. Producers benefited from improvements in the overall management of production, more secure and longer-term relations with their major buyer, and continued participation in potentially lucrative export markets. There were also wider benefits, for example through better knowledge of the handling of agrochemicals and hygiene.

Unnevehr & Jensen (2001) measure social costs and benefits of food safety regulations. The social benefits of improved food safety include restrictions in risks of morbidity and mortality associated with consuming contaminated food. The costs that result from regulations include four types: (i) compliance costs (costs incurred by firms which must change production processes to meet new standards – fixed cost or variable), (ii) government regulatory costs (cost to administer, as well as for plant monitoring and testing), (iii) social-welfare losses (from higher consumer prices) and (iv) transitional social costs (possible firm closings due to the firms' inability to competitively meet standards).

2.2.2 Global value chain approach

Value chain analysis is one of the most prominent approaches to analyze changing market structures and to develop suitable strategies for private sector development in developing countries. Several studies based on Global Value Chain (GVC) theory have been developed. In the 1990s the concept of value added chains emerged as an approach to analyze and explain new forms of international trade. Certification schemes are used to ensure marketing claims for unobservable quality attributes and under asymmetric information, to guarantee process-oriented quality characteristics.

Cook (2000) analyzes the implications of drivers on fresh fruit and vegetables value chain in the US market. She concludes that the fresh producing industry is clearly leading to a greater vertical

coordination of the distribution system via more supply chain oriented procurement models, despite the fact that conventional retailers are lagging mass merchandisers in this regard. The explosive growth of the Supercenter format is a compelling force that will continue to move conventional retailers in this direction.

Schipmann (2006) aims at comparing international and national value chains with regard to potential benefits for smallholders and existing entry barriers to their integration in the chilli sector of Ghana. Her results have shown that international value chain integration may offer additional benefits compared to national value chains. In this manner, smallholders have the ability to improve their production skills and become integrated into higher value chains through appropriate incentives. Besides, the author finds that the integration promotion of the poorer population (e.g. smallholders) into the value chain is a useful instrument to promote large-scale pro-poor growth.

Dolan, Humphrey & Pascal (1999) argue that the requirements of the UK supermarkets act as an effective barrier to participation of African small exporters in the chain. The authors argue that, on the one hand, relations which arise in the Obligatory Contracting environment are those capable of promoting quality. On the other hand, Arm's-length Contracting is seen as a price type of relation, where there is little space for quality management discussions. Table 2.1 shows the distinction between Arm's length Contractual Relations (ACR) and Obligatory Contractual Relations (OCR) used in the literature on buyer-supplier relations.

Table 2.1: Arm's length and obligatory contracting

	Arm's Length Contractual Relation (ACR)	Obligatory Contractual Relations (OCR)
1. Transactional dependence	Buyer seeks to maintain low dependence by trading with large number of competing suppliers. Suppliers seek to trade with many customers	For both customers and suppliers, avoidance of independence is not a priority. Buyers and suppliers have few customers
2. Ordering procedure and projected length of trading relationship	Open bidding for orders. Short-term commitment desired and real	Bidding may not take place; established suppliers tend to win continued business. Long-term commitment desired and real
3. Inspection	Inspection on delivery	Little or no inspection on delivery for most parts. Costumer is involved in establishing and/or monitoring suppliers' quality system.
4. Technical assistance	Expertise rarely pooled, and assistance only when paid for	Extensive unilateral or bilateral technology transfer over time
5. Communication	Infrequent and through formal channels. Narrowly focused on purchasing departments	Multi-channeled, frequent and often informal
6. Risk sharing	Risk resulting from price and demand fluctuations distributed according to explicit prior agreement	Much sharing of risk. Gains and losses distributed on a case-by-case basis according to some principles of fairness

Source: Dolan, Humphrey & Pascal (1999:8) based on Sako (1992:11-12)

Dolan & Humphrey (2000) analyze the fresh vegetables trade between the UK and Kenya and Zimbabwe from the global commodity chains perspective. Additionally, they also pay particular attention to the governance of the chain, identifying the key decision-makers and how their requirements for the performance of the chain are translated into structure and practice. In particular, they highlight the role played by large retailers in defining the outputs and structure of the chain and the impact of supermarket requirements on exporters and producers of these countries. Three different aspects of governance in the horticulture value chain are identified:

i) the positioning of the chain: the UK supermarkets decide what is offered to customers and which characteristics the products should have (quality, consistency, variety, processing, product combinations, packing, supply and price). It also involves the specification of the chain structure and the systems that ensure that the actor in the chain meets the performance standards;

ii) the structure of the chain: the UK supermarkets increase the control in the chain shifting from wholesaler markets to a lower number of suppliers, by tightening the

links. Overall, the number of actors, the distribution in the chain and the relationships between them change;

iii) meeting performance standards: producers and exporters wishing to supply the UK market need monitoring systems that ensure compliance with retail (product quality) and legislative (due diligence) requirements.

The rising competition in the fresh fruit industry and the need to meet norms and standards related to e.g. product characteristics, the production process and its impact on food safety and on the environment has meant a changing relationship between growers and buyers. The alternative strategies of buyers like supermarkets include formal and informal contracts directly with farmers and the establishment of their own distribution centers, which allow them greater leverage in forcing their quality and safety norms and standards (Farina, 2002). The compliance on the producers' side is driven by the demand of supermarkets on: varieties, production methods, post harvesting technologies, packaging and labeling specifications, and acceptable environmental impacts and working conditions. The global value chain analysis emphasizes that local producers learn significantly from global buyers on how to improve their production processes in order to attain consistent high quality and to increase the speed of response (Humphrey & Schmitz, 2002).

There are different marketing chains for fruits and vegetables which differ among countries, crops and farmers. An important stage to understand is the first link in the production or marketing chain between the farmer and the trader. Some actors who can form this link are shown in Table 2.2, according to FAO (1989):

Table 2.2: Relationship between farmers and buyers in the marketing chain

Type of buyer	Characteristics of the buyer
Contractors	Buy crops in the field and undertake the harvesting
Agents, collectors or country wholesalers	Buy the harvested crop at the farm
Wholesalers	Buy produce from farmers at firm prices and sell at the wholesale market for their own account
Secondary wholesalers	Buy at the wholesale market and transport the produce either to sell to retailers or at another wholesale market where prices are higher
Semi-wholesalers	Are located near the wholesale market and sell produce by the box either to small retail businesses or directly to consumers
Commission agents	Auction produce in a wholesale market on a commission basis
Retailers	Sell to the final consumer such as street hawkers, stall holders, retailers, greengrocers or supermarkets

Source: Own compilation based on FAO (1989)

The banana market structure is for example very heterogeneous, depending on the producing and importing countries. The presence of diverse economic actors is also different among countries and regions at the several stages of the banana chain. Due to high perishability, bananas require a careful control of the growing, packaging, transport, ripening and distribution process. This leads to a highly vertically integrated banana sector, where large transnational companies tend to control from direct growing of bananas in producing countries, through ownership of specialized refrigerated shipping and ripening facilities to distribution networks in importing countries. An analysis of the banana marketing chain reveals that companies face the challenge of an increasing role that is being played by supermarkets and retail chains in the distribution of bananas in developed countries, mainly in the US and the EU. Supermarkets tend to build long-term relationships with preferred suppliers in order to guarantee a continuous supply at the required level of quality (United Nations Conference on Trade and Development UNCTAD, 2007).

In another study UNCTAD (2007a) develops the international citrus marketing chain. International trade in the fresh citrus fruits sector is characterized by a reduced degree of concentration of supply with a multitude of medium-sized firms providing the fruit. On the contrary, orange juice trade is highly concentrated. A small number of companies that operate in Brazil and Florida dominate the market. The major supplier of orange juice in the world is Brazil, followed by the US. The most significant players in the distribution channels for orange juice and fruit juices are the global retail chains, responsible for more than 80% of the total exports to Europe.

Cueller (2003) aims to identify challenges faced by retailers in different marketing specificities in the US market. The study reveals that the key issues in the marketing of imported fruits and vegetables among retailers are food safety assurance, transportation cost reduction and quality improvement. Further, the key issues in marketing include improving packaging, adding value to products and assuring food safety.

2.2.3 Diffusion of innovation approach

Rogers (1995) develops the diffusion of innovation theory, which offers an analytical framework, identifying the determinants of the innovativeness of the actors involved. Roger (2003:101) defines an innovation to be an idea, practice or object that is perceived as new by an individual. Diffusion is defined by Rogers (2003:5) as the process by which an innovation is communicated through certain channels over time among the members of a social system.

The diffusion theory relies on the assumption of a multistage decision model. Rogers (2003) has developed a five-stage model where the decision-making unit passes from hearing about an innovation for the first time, to forming an attitude towards the innovation, on to deciding whether to adopt or to reject it, to implementing the new idea and finally to confirming this decision.

The decision model provides three main advantages when it comes to analyzing the compliance process with food standards. Firstly, it systemizes the decision process, distinguishing the different stages of the whole process and thereby making it possible to identify the determinants of the decision process, which might differ according to the stage. Secondly, the model puts the decision-maker at the center of the analysis, while at the same time taking interlinkages with the institutional environment into account. Thirdly, it combines various schools of thinking, including those of economics, education, rural sociology and geography to form an analytical framework of diffusion (Rogers, 2003).

Chemnitz (2007) argues that the adoption of quality and safety standards can be considered as the adoption of an innovation and hence, can be analyzed following the concept for the diffusion and innovation theory. Tackie et al. (1996) evaluate the marketing of fruits and vegetables in South Central Alabama using the diffusion approach. Their aim is to verify whether farmers would adopt innovation regarding grading and packaging fruits and vegetables or not. The results of this study indicate that the farmers were using the information they obtained from workshops in their operations, implying that they considered the information important and useful. Ghadim & Pannell (1999) presented a conceptual framework of individual farmers' decisions on adoption of a new innovation, using new crop species. Besides the influences of socio-demographic factors, farmers' personal perceptions, managerial abilities and risk preferences were also considered.

Kleinwechter & Grethe (2006) analyze the adoption of GlobalGAP by mango exporters in Peru based on a theoretical framework of a compliance process divided into three stages: the information stage, the decision stage and the implementation stage. A comparison between certified farmers and a control group then identifies the mechanisms that lead producers to adopt the standard or not. The findings reveal that access to information by the producers promotes the adoption, influences decision-making and supports the producer in the implementation stage and finally, excludes producers from GlobalGAP markets.

Chemnitz (2007) provides an empirical analysis of the compliance decision behavior and the compliance process of standards related to the Moroccan tomato export sector. The study aims at

understanding who the drivers for the compliance decision are, by comparing the determinants of the decision process between certified and non-certified producers. The results suggest that small producers are not particularly disadvantaged in the compliance process. However, less organized and less integrated farmers tend to be less favored, especially in cases when integration diminishes the cost of compliance. Additionally, integration may facilitate the information access from buyers' requirements.

2.2.4 Transaction cost approach

Transaction costs between buyers and sellers have several dimensions. First, they include information search cost for quality and food safety, second, cost for negotiations and third, the costs for monitoring and enforcement (Hobbs, 1996). Consequently, the higher the transaction cost, the less likely the transaction will occur. International standards help to ensure technical compatibility across countries and convey information to consumers about products that have been produced abroad or about processes that took place in another country. International standards thus reduce transaction costs and facilitate international trade (WTO, 2005).

Lu (2005) uses a composite of various indicators to measure the effects of different variables of transaction costs on the technical efficiency of the tomato supply chain. The four categories of transaction costs used are: (a) transportation costs: depending on distance, time, road conditions and availability of own means of transport; (b) information costs: depending on the number of traders visited before selling and the sources of access to market information; (c) negotiation costs: related to the number of visits for reaching an agreement with respect to selling the tomato; and (d) monitoring costs: related to the number of years that the farmer is engaged with the trader.

Christensen et al. (2003) analyze the consumer perceptions of certifying agencies to certify beef products in aspects regarding food safety and quality in the US and UK. While US consumers see it as the role of the government to assure food safety, UK consumers prefer the private sector to assume this role. Thus, the validity of the certification signal begins with the customer, who is dependent on credible quality labels when making purchasing decisions.

Dörr (2004) studies the poultry sector in Brazil regarding the compliance of this industry with the requirements on food safety, quality and animal welfare of wholesalers and retailers in Europe. The New Institutional Economics (NIE) and the Transaction Cost Theory were used as the conceptual background. She finds that transaction cost increased due to changes in the contractual relationships between the poultry industry and the input suppliers.

Neves (1999) analyzes the orange juice chain in Brazil using transaction cost approach as theoretical background. He analyzed the transaction costs between fruit growers and the processing industry. His findings reveal that the transaction costs between fruit growers and the industry still have to be better coordinated for the chain to be more competitive. He suggested to reduce costs, to improve supply guarantee and to enhance trust via contracts.

A similar study carried out by Lopes et al. (2003) seek to analyze the relationship between the citrus industry and orange growers in Brazil. The objectives were to describe the characteristics of the standard contract used and to investigate the attributes of contracts. The description of the contract characteristics was derived from secondary data (copies of standard contracts). In addition, he conducted 48 structured and closed question interviews with orange growers. The attributes considered in the study were classified according to their level of importance: price paid for the fruit, payment conditions, type of relationship between grower and buyer, distance from the farm to the final destination, contract duration, general conditions, discount criterion for defective fruit, transportation fees added to the fruit price and finally, correlation between the fruit payment and the price of orange juice at the international market. In the case of the orange industry, the findings show that a more sophisticated contract is used with specific clauses on fruit quality, while traders utilize more simple contracts not specifying any details.

A study by Carvalho (2003) investigates the fruit trade between Brazilian exporters and British importers. He did qualitative research interviewing 22 import agents in the UK and 19 Brazilian fruit exporters to find out the determinants for the configuration of transaction arrangements in the fruit trade. The results support the conviction that quality management strategies have been used to favor their commercial activities. Five strategies are presented in Table 2.3.

Table 2.3: Results on fruit trade between Brazilian exporters and British importers

Product specifications	Specifications are settled in agreements with the fruit buyers and negotiated with fruit exporters abroad
Quality control	Visits to fruit suppliers and quality control are done after the arrival of the fruits in the UK.
Monitoring	Agents control quality standards carried out on three different stages in the fruit trade sequence
Logistics	Exporters have to coordinate the fruit supply and arrange long distance transportation procedures
Strategic alliances	Import agents are present in the chain and prioritize strategic alliances with the UK buyers.

Source: Own compilation based on Carvalho (2003)

2.2.5 Macro level approach

The theoretical model presented by Chau, Basu & Grote (2004) analyzes the economic incentives of eco-labeling initiatives. In the first stage of the model, countries decide whether or not to initiate eco-labeling in a multi-country context. In the second stage, countries compete in a horizontally differentiated market – via green and baseline production method. Based on a sub game perfect Nash equilibrium as the theoretical background, the study highlights the selection criteria of countries that adopt eco-labeling, the endogenous characteristic of labeling incentives and the welfare consequences of observed labeling initiatives. The findings reveal that the food industry export appears to be correlated with the speed with which countries implement their own eco-labeling programs. Regarding the model results on the selection criteria of the labeling adoption and the welfare consequences, countries perceive a strictly positive price premium. The speed of adoption depends on the fixed cost of eco-labeling programs, the scale effect and the comparative cost advantage of a specific industry.

Furthermore, Basu et al. (2007) extend the study cited above in two directions. First, they examine the set of welfare consequences associated with the move towards eco-labeling by some countries. Second, they aim at understanding whether the prior focus exclusively on export rivalry may have ruled out possible strategic interactions via import competition. Comparing producers' welfare with and without competition based on eco-labeling, the results show that it depends on the size of the industry level green premium. The green premium depends on a demand side consumption green premium effect and supply side cost of green technological adoption effect. Additionally, export orientation of an industry can itself be a driving force that makes the practice of eco-labeling an attractive option.

2.2.6 Logistic regression model

There have been very few studies related to the determinants of farmers' adoption of certification in developing countries. Among them, Burton et al. (1998) analyzed the determinants of adoption of organic certification in horticulture in Spain, UK and Brazil at the farm level. The determinants may depend on (i) the socio-economic characteristics of the farmer, (ii) the characteristics of the farm, (iii) sources of information, (iv) membership of organizations, and (v) farmers' attitudes. Regarding factors explaining the timing of the decision, variables such as age, managerial experience, and policy interventions were added. The main results show that: (i) non-economic factors play a primary role in the adoption decision in the European samples, but not in Brazil; (ii)

educational attainment was insignificant in both the UK and Spain, while gender, age, farm and household size were all found to be insignificant in the Spanish sample; (iii) UK managers of smaller holdings are more likely to convert to organic practices, but farm size per se does not explain the timing of that decision and, (iv) attempts to increase the uptake of organic techniques needs to take into account the different information sources currently prioritized by organic and conventional producers.

Similarly, Carambas (2005) studies the decision adoption of eco-labeling farmers of agricultural sectors in Thailand and the Philippines. The range of factors that may influence their decision making are categorized as (i) socio-economic characteristics of the farm; (ii) factors relating to farmers' support/assistance; (iii) farmers' expectations and (iv) other economic factors. The findings reveal that the determinants that have relatively smaller influence on the decision of Thai farmers to adopt certification are gender, family size and tenure. On the contrary, if (a) it is easy to get information about eco-labeling; (b) farmers perceive positive yield and environmental effects and (c) farmers experienced sickness in conventional farming, the probability to adopt organic farming increases by 50% on average. For Filipino farmers, variables such as gender, age, family size and income and farmers' organization campaign [10% level] have been found to be statistically significant.

Continuing in this context, D'Souza et al. (1993) aim to identify the characteristics significantly influencing the decision to adopt organic certification using a logit model. Factors affecting technology adoption are grouped in human capital, structural, institutional and environmental categories. The variables influencing the adoption are: (i) human capital: age and education; (ii) structural and financial: farm size, debt/asset ratio, off-farm employment, hired labor; (iii) institutional: participation in farm commodity programs; (iv) environmental: ground water quality. Among the statistically significant variables, the variable awareness of the producers on groundwater contamination influences by 23% the probability of adoption. Considering that the producer has at least high school education, the likelihood to adopt certification increases by 20% and if the farmer is over 55 years old, the probability decreases by 14%. Producers not employed for more than 200 days a year, are 12% less likely to adopt the organic practices.

Hattam & Halloway (2005) study the determinants that lead small Mexican avocado producers deciding to adopt organic certification compared to conventional ones. They find that adoption is positively influenced by economic and management factors (i.e. production cost per ha) and also by social factors (i.e. membership in an association). Education has shown a negative and

insignificant influence, while experience in agriculture has a negative effect but is significant. In the same line, Udovc & Perpar (2007) compare conventional and organic farmers in Slovenia regarding the differences and similarities. The variables which distinguish organic from conventional farms are farm size, income structure, education, membership of associations, dependency of farm on income and personal attitudes towards environmental concerns. However, education and share of income from agriculture were not statistically significant.

2.2.7 Other approaches

Besides the approaches mentioned above, some other approaches exist which are relevant for analyzing certification in agro-food sectors. Marette, Crespi & Schiavina (1999) use the cartel theory to analyze the influence of labeling on agricultural markets. An analytical framework of adverse selection where consumers are imperfectly informed about the quality of products is used to investigate the welfare effects of a cartel. The authors hypothesize that the societal welfare increases if consumers can distinguish between high and low quality products. In this case, certification implies that the high quality producers gain market power and the low quality producers are no longer producing. Thus, the former can exercise market power by acting as a Cournot quantity agent. Basically, the societal welfare increases when high quality producers come together in a certification scheme and eliminate asymmetric information. The findings reveal that market inefficiencies may arise as a result of asymmetric information in the absence of a cartel. Additionally, given high cost of labeling, a cartel that provides information about product quality may improve overall welfare even if producers collude to reduce quantity competition.

Nilson et al. (2003), based on the study of Marette, Crespi & Schiavina (1999), aim to analyze certification systems and their impact on market structure using a complementary model in order to verify the demand behavior of low quality products under certification. It is hypothesized that there is a positive welfare impact when producers choose to label their products. Their results show that the modified model presents an ambiguous welfare impact of certification when varying the number of firms providing low quality. If there is a firm with low quality instead of high quality, the welfare impact of a certification scheme is negative; and if the number of high quality firms rises, the welfare impact increases.

Furthermore, Marette & Crespi (2003) focus on the relationship between cartel formation and quality certification. The adverse selection framework is used for cartel theory under Cournot competition with many sellers. It is hypothesized that third-party certification may provide

information about product quality for imperfectly informed buyers; individual sellers can choose whether they want to signal the quality of their products independently or join a cartel. Additionally, the cases where producers are able to share the cost of certification are also classified. The authors simulate two scenarios. The first one refers to the case where each seller incurs a cost for certification. The analysis includes the incentive for a seller to certify its products with and without a cartel. Each potential seller has three options to choose: join a cartel, certify independently, or remain independent without certification. The results reveal that some high-quality sellers will form a cartel to collude in quantities. The second one proposes cost sharing within a cartel in order to make certification more attractive. This case considers that several sellers who decide to certify have an incentive to share the cost of certification. The results show that the larger the number of firms, the lower the share of fixed cost of certification.

Luning et al. (2002) develop a conceptual food quality relationship which assumes that food quality is a function of both food and human behavior and their interaction. They used a techno-managerial approach for the analysis. They define this approach as "the integrative use of technological and managerial theories in order to explain and predict food quality from food and human behavior" (Luning et al., 2002:383). The authors conclude that the approach requires increased information (to reduce uncertainty) and enhancement of knowledge (to reduce ambiguity) of both food and human systems to enable a more accurate level of prediction. Understanding how technological and administrative conditions influence food and human behavior and how they affect each other will provide better insight about the way food quality is perceived and managed.

Schiefer (2003) analyzes some problems which occur in sector-oriented quality assurance in the agro-food sector regarding traceability and certification. His discussion is based on logical arguments and expert conclusions rather than on empirical studies. The framework includes: (i) establishment of a hierarchical control and certification system which allows a transparent identification in all food levels regarding quality and safety, (ii) visible delineation of co-operating sub-networks of stricter quality claims and for improved use of quality-supporting elements and (iii) utilization of quality-supporting and trust-generating elements by sub-networks. The author argues that sector quality-assurance systems are essential for the development of food markets.

Segerson (1998) presents a framework for examining firms' incentives to adopt adequate food safety measures voluntarily and the role of the market in providing those incentives. Supposing the

firm has two alternatives that comprise: either to undertake measures to ensure increased food safety voluntarily or not taking any initiative unless forced by government regulations or other forms of mandatory public policies. The two key determinants of the decision to undertake protective measures voluntarily are the expected changes in the net income earned by the firm and the expected loss incurred by the firm with and without those measures. The important issue in determining the independence between market structure, product nature and damages is whether consumers perceive the potential hazards associated with product consumption correctly and their willingness to pay.

2.3 Summary

Many approaches have been applied to analyze certification in agro-food products. Table 2.4 presents a summary of the main studies in the horticulture sector. While many authors have discussed empirical approaches to different products, only few studies have focused on the theory (see (Chau, Basu & Grote, 2004) and (Basu et al., 2007)). A more comprehensive approach to standards is certification consisting of a number of different standards and regulations relating to food quality, environmental or social issues. Certification generally aims at providing consumers with better information about the characteristics and quality of food products, thus enhancing market transparency. The question of governance arises when some firms in the chain work according to standards set by others. Standards that are specified also have to be monitored and enforced. Therefore, value chain governance involves institutions for monitoring and enforcing compliance of certification. Specifically in the fruit sector, given the large number of certification systems, it is important to provide an economic analysis to increase the competitiveness and efficiency.

Table 2.4: Summary of the main studies in the horticulture sector categorized by the approach

Authors	Year	Type of product	Country	Contents	Approach
Carambas	2006	Organic rice	Thailand	Cost: capital costs, raw material, testing and certification; Benefits: financial, environmental and health	Cost and benefit
Gogoe	2003	Pineapples	Ghana	Cost and benefits to implement EurepGAP	Cost and benefit
Cook	2000	F&V	US	Identification of drivers of change	Global value chain
Shipmann	2006	Chili	Ghana	Comparing international and national value chains	Global value chain
Dolan & Humphrey	2000	F&V	UK, Kenya and Zimbabwe	Identifying the key decision-makers and how their requirements for the performance of the chain	Global value chain
UNCTAD	2007	Banana	international	Identification of actors in the chain	Marketing chain
FAO	1989	F&V	international	Understand the link in the marketing chain between farmers and traders	Marketing chain
UNCTAD	2007a	Citrus	Brazil and US	Identify the players in the distributional channel; degree of concentration	Marketing chain
Chemnitz	2007	Tomato	Morocco	Identification of drivers for the compliance decision	Diffusion of innovation
Kleinwechter & Grethe	2006	Mango	Peru	Identification the mechanisms that lead producers to adopt the EurepGAP standard	Diffusion of innovation
Lu	2005	Tomato	China	Transaction costs on the technical efficiency: transportation information, negotiation and monitoring	Transaction cost
Neves	1999	Orange juice	Brazil	Transaction costs between fruit growers and the processing industry	Transaction cost
Carvalho	2003	Fresh fruit	Brazil and UK	Determinants for the configuration of transaction arrangements in the fruit trade	Transaction cost
Lopes	2003	Citrus	Brazil	Characteristics of the standard contract used and the attributes of contracts	Transaction cost

Source: Own compilation based on the literature review (note: F&V= fruits and vegetables)

3 Methodology and Conceptual Framework

This chapter presents in Section 3.1 the conceptual framework of the marketing chain applied to the fruit sector. Section 3.2 and 3.3 discuss the relevance of the value chain and transaction cost theories relevant for the analysis of certification. Section 3.4 focuses on the framework for the analysis of the certification decision. Finally, summary and the hypotheses are presented in section 3.5.

3.1 Concepl of the marketing chain

An analysis of marketing channels and upgrading strategies for fresh fruit shows how the development of niche markets for high-value produce creates new opportunities for developing countries' producers and exporters that can meet the required standards. New marketing channels have opened up as a result of a combination of changing consumer tastes and the increasing dominance of large retailers in the markets of industrialized countries. The identification of opportunities for adding value and the development of strategies to take advantage of them are based on an analysis of the changing governance structures of food value chains (UNCTAD, 2000).

The framework presented in Figure 3.1 aims to facilite the understanding of the marketing chain process of non-certified and certified producers in the fruit sector. Certified farmers are more likely to have access to international markets and non-certified ones are more likely to sell the fruit production in the domestic market. Farmers can either trade with groups, associations and cooperatives or with individual buyers, who sell the fruit production in the domestic market.

However, farmers who expect to export, may trade their fruit in the domestic market in case of a non-favorable situation; such a situation is given if there is a lack of quality caused by bad-crop formation, disease or climate conditions. Non-certified farmers are also vulnerable to those factors. However, non-certified producers may also export directly or indirectly to international markets. Directly occurs when they export via a trading company and indirectly, when they sell the fruit production to the middleman who repack and export.

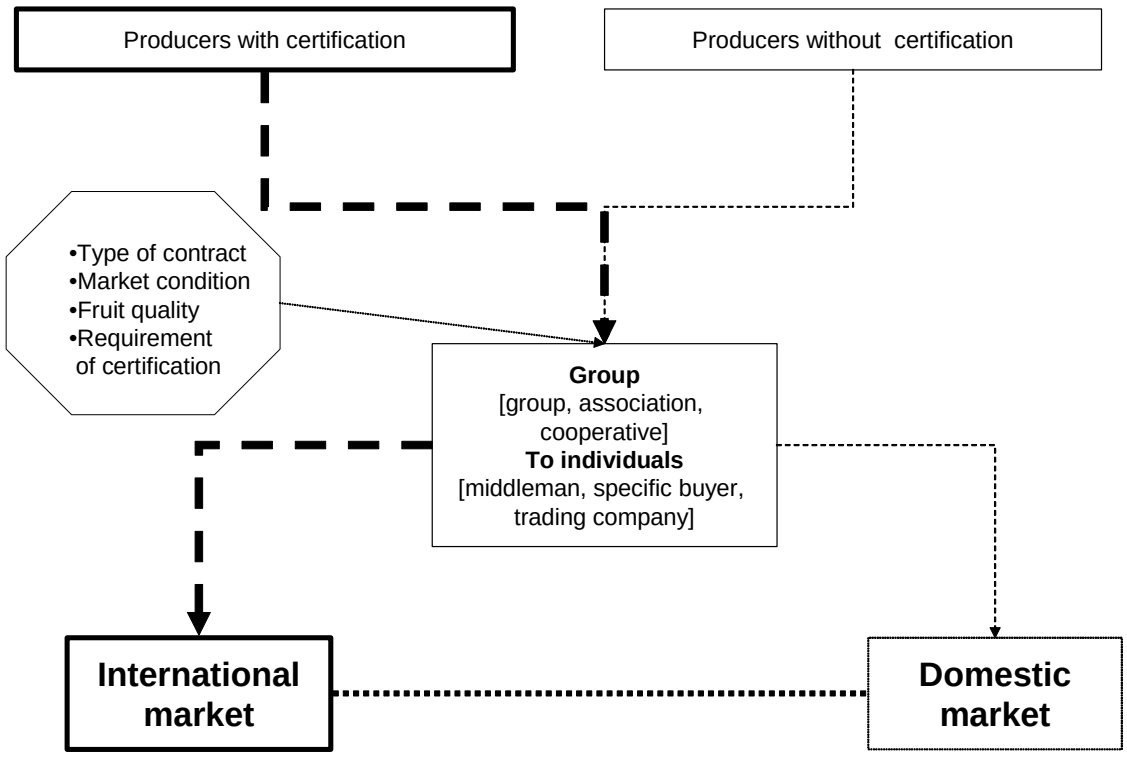

Figure 3.1: Conceptual framework on the marketing chain for certified and non-certified producers

Source: Own illustration

3.2 Value chain analysis

3.2.1 Definition and types of value chains

During the last decade, the concept of the value chain has been highlighted in the literature and widely discussed among researchers and policy makers. Global value chain analysis evolved from global commodity chain analysis, which emphasized the importance of global buyers, particularly retailers and brand-name companies, in creating global production, distribution, and marketing systems. According to Kaplinsky & Morris (2002:4), the value chain describes "the full range of activities which are required to bring a product or service from conception through the different phases of production (involving a combination of physical transformation and the input of various producers' services), delivery to final consumers, and final disposal after use".

The analysis of global commodity chains (GCC) developed by Gereffi (1995) highlights that trade is increasingly organized through networks linking dispersed actors across the global economy. According to the author, "what is novel about GCCs is not the spread of economic activities across national boundaries *per se*, but the fact that international production and trade are increasingly organized by national and commercial firms involved in strategic decision making and economic networks at the global level" (Gereffi, 1995:113).

This strategic decision making may determine how the chain is positioned in the market, the inclusion and exclusion of actors and how functions are divided within the chain. Gereffi (1994) distinguishes two types of governance structures: buyer-driven and producer-driven. The producer-driven commodity chains are usually exemplified by capital and technology-intensive industries, where barriers to entry are related to production and to the development of technologies, for instance, transnational firms. In contrast, buyer-driven commodity chains are governed by retailers, importers and branded companies. Value chain analysis identifies the impact of these new buyers by focusing upon, first, the different positions of lead firms in value chains, their competences, and what this implies for the activities of other agents in the chain, and second, what different types of buyers are trying to get out of the chain and its implications for the structuring of value chains in the competences of firms within them.

Another study from Gereffi (1999a) mentions further specifications and examples of "producer-driven" and "buyer-driven" commodity chains. The first is composed of those in which large manufacturers play the central role in coordinating production networks, characterized by capital and technology-intensive industries [automobiles, aircraft, computers, semiconductors and heavy machinery]. The second refers to industries where the largest retailers, brand marketers and manufactures play the pivotal role in setting up decentralized production networks located mainly in developing countries. It is characterized as labor-intensive, as in consumer goods industries [garments, footwear, toys, house wares, consumer electronics and handicrafts].

> "One of the main characteristics of firms that fit the buyer-driven model […] is that frequently these businesses do not own any production facilities. They are not manufacturers because they have no factories. Rather, these companies are merchandisers that design and/or market, but do not make, the branded products they sell. These firms rely on a complex network of subcontractors that perform almost all their specialized tasks […] Profits in buyer-driven chains thus derive not from scale economies and technological advances as in producer-driven chains, but rather from unique combinations of high-value research, design, sales, marketing, and financial services that allow the buyers and branded merchandisers to act as strategic brokers in

> linking overseas factories and traders with evolving product niches in their main consumers markets" (Gereffi, 1994:99).

Furthermore, Gereffi (1999b) points out that producer-driven chains are more likely to be characterized by foreign direct investments than buyer-driven chains. And each of these different types of value chains is associated with different types of production systems (Table 3.1).

Table 3.1: Comparison between producer-driven and buyer-driven chains

	Producer-driven commodity chains	Buyer-driven commodity chains
Drivers of global commodity chains	Industrial capital	Commercial capital
Core competences	Research & Development; production	Design, marketing
Barriers to entry	Economies of scale	Economies of scope
Typical industries	Automobiles; computers; aircraft	Apparel; footwear; toys
Ownership of manufacturing firms	Transnational firms	Local firms, predominantly in developing countries
Main network links	Investment-based	Trade-based
Predominant network structure	Vertical	Horizontal

Source: Gereffi (1999b)

A reason which justifies the importance of a value chain is that it plays a key role in understanding the need and scope for systematic competitiveness. The analysis and identification of central competences may lead firms to invest in competent sectors. In addition, it helps to understand whether the way producers are connected to final markets influences their ability to gain by participating in global markets (Kaplinsky & Morris, 2002).

3.2.2 Governance: definition and determinants

The concept of governance " […] is central to the global value chain approach […] the concept is used to refer to the inter-firm relationships and institutional mechanisms through which non-market co-ordination of activities in the chain takes place. This coordination is achieved through the setting and enforcement of product and process parameters to be met by actors in which developing country producers typically operate" (Humphrey & Schmitz, 2001:3).

The authors use the concept of governance "to express that some firms in the chain set and/or enforce the parameters under which others in the chain operate. A chain without governance would be a string of market relations" (2001:4). Thus, the importance of governance is highlighted in the value chain using the following five reasons:

i) Market access: access of producers to new markets is limited to lead firms;

ii) Fast track to acquisition of production capabilities: producers, who gain access to chains of lead firms need to be able to improve continuously;

iii) Distribution of gains: governance facilitates the understanding of the gains distribution;

iv) Leverage points for policy initiatives: besides the fact that global value chains offer leverage points for government initiatives, they can also undermine government policy and

v) Funnel for technical assistance: to combine technical assistance to developing country producers with connectivity.

The determinants of governance presented by Humphrey & Schmitz (2000:6) are: arm's length market relations [buyer and supplier do not define the product; no long term relationship and the buyers' and producers' risks are low]; networks [the buyer and supplier define the product specifications together; the buyers' risk is minimized because of the suppliers' high level of competence]; quasi-hierarchy [high degree of control from buyers over suppliers; the former define the product] and hierarchy [buyers control the supplier production process]. The authors suggest that quasi-hierarchy is more likely to occur where global value chains frequently link producers in developing countries and retailers in developed countries.

Similarly, Keesing & Lall (1992) argue that producers in developing countries are expected to meet requirements that frequently do not apply to their domestic market. For instance, this creates a gap between the capabilities required for the domestic market and those required for the international one. This gap is widened when the buyers require consistent quality and supply, creating two reasons for quasi-hierarchical governance. The first refers to monitoring and control which might be required to ensure that products and processes meet the required standards. The second reason, in case the gap needs to be closed quickly, is that buyers will need to invest in a few selected suppliers and help them to upgrade. Mostly buyers have a higher interest in suppliers according to their relationships.

Gereffi, Humphrey & Sturgeon (2005:83) propose a more complete typology of value chain governance, divided into five types: (i) markets: market linkages can persist over time with repeated transactions - the cost of shifting the partner is low for both; (ii) modular value chains:

suppliers make the products according to the customers' specifications, detailed more or less by the former; (iii) relational value chains: complex interactions among buyers and sellers, often creating mutual dependence and a high level of asset specificity; (iv) captive value chains: small suppliers are transactional dependent on larger buyers, characterized by a high degree of monitoring and control by lead firms, and finally (v) hierarchy: characterized by vertical integration.

In the same study, the authors develop a theory of value chain governance based on three factors: (i) the complexity of information and knowledge required to sustain a particular transaction with respect to product and process specifications, (ii) the extension in which knowledge and information are codified and transmitted efficiently, and (iii) the capabilities of actual and potential suppliers regarding the requirements of the transaction.

Table 3.2 presents the five global value chain governance types combined with the values of three variables that determine them [complexity of transactions, ability to codify transactions and capabilities in the supply-base]. Each type of governance provides a different trade-off between the benefits and the risks of outsourcing. The last column shows that the type of governance changes from a low level of explicit coordination and power asymmetry, between buyer and supplier [in the case of markets], to a high level [in the case of hierarchy].

Table 3.2: Determinants of global value chain governance

Type of Governance	Complexity of Transactions	Ability to Codify Transactions	Capabilities in the Supply-base	Degree of Explicit Coordination and Power Asymmetry
Market	Low	High	High	Low
Modular	High	High	High	↕
Relational	High	Low	High	
Captive	High	High	Low	
Hierarchy	High	Low	Low	High

Source: Gereffi, Humphrey & Sturgeon (2005:87)

There are economies of scale in governance. Large firms have the management capabilities required to coordinate complex relationships with suppliers and customers. Dealing with a few large suppliers or customers is easier than dealing with many small ones. At the same time, large buyers have more purchasing power and therefore more opportunities to enforce compliance with their wishes. Therefore, governance is associated with buyer power. Increasing buyer power in

global value chains has four main consequences for producers in developing countries: access to export markets, opportunities for upgrading, systemic competitiveness and returns to participation in global markets (Humphrey, 2005).

Ponte & Gibbon (2005) emphasized quality management as a competition and/or cooperation factor between actors of a value chain. Key actors might verify the quality of information in order to determine the form of coordination used within a specific segment of the chain. As quality becomes more complex, it is expected that firms move toward tighter forms of coordination, i.e. closer to vertical integration. On the other hand, if the actors are able to embed complex information about quality, labeling, certification and codification procedures, they might be able to operate with looser forms of coordination, i.e. closer to market coordination.

Moreover, quality standards play an important role in accessing global value chains in developed countries due to changes in consumption. Thus consumption is characterized by safety awareness, identification of consumers' tastes as well as social and environmental concerns. They emphasize the proliferation and differentiation of products due to market saturation. Likewise, an increased importance of issues of quality control and management, traceability and certification, has also contributed to increase the role played by quality standards (Ponte & Gibbon, 2005).

3.2.3 Upgrading

Entering new export markets could be considered a major challenge for many firms in developing countries. New skills and knowledge are demanded, mainly related to bureaucratic procedures, national standards and procedures, marketing channels and consumers' tastes. Upgrading could facilitate and promote competitiveness to access those markets.

The value chain literature focuses on the role of global buyers and chain governance in defining upgrading opportunities. Humphrey & Schmitz (2000) use the concept of upgrading to refer to three different shifts that firms might undertake. First, process upgrading: firms can upgrade either through transforming inputs into outputs more efficiently by re-organizing the production system or introducing superior technology; second, product upgrading: firms can upgrade by moving into more sophisticated product lines and third, functional upgrading: firms can upgrade by higher value added. Kaplinsky & Morris (2002) added a fourth case, intersectional upgrading: where firms can upgrade by moving out of a chain into a new one.

Upgrading occurs as a result of learning by exporting, the buyer promotion of the capabilities of developing countries producers or by entering value chains with more demanding customers. The knowledge required for upgrading flows downstream through the chain supplied by customers (Humphrey & Schmitz, 2002:23). The three key elements of value chain analysis are economic rent, barriers to entry and distribution. Kaplinsky & Morris (2002) state that economic rent:

i) arises in the case of differential productivity of factors (including entrepreneurship) and barriers to entry (scarcity);

ii) takes various forms within the chain, including technological, organizational, skills and marketing capabilities,

iii) may arise in form of relational rents from activities between groups of firms;

iv) is dynamic in nature and is transferred into consumer surplus in the form of lower prices and/or higher quality.

Furthermore, "[…] the concept of rent provides an important analytical vehicle to explain why some activities in the chain are well-rewarded and others are not – the central part of this story lies in the determination of barriers to entry which limit competitive pressures […] the greater the barriers to entry, the higher the level of profitability" (Kaplinsky & Morris, 2002:41).

3.3 Transaction Cost Economics (TCE)

New Institutional Economics is formed by two complementary lines. One studies the Institutional Environment, while the second one focuses on transaction cost theory. The first one, headed by Douglass North, refers to the macro-institutional parameters, while the second one, headed by Oliver Williamson, has micro-institutions as the main focus. Thus, the New Institutional Economics is concerned with the origins, incidence and ramification of the transaction costs (Williamson, 1979).

3.3.1 Definition and characteristics

Williamson (1985:1) considers the term transaction cost economics as "the basic unit of analysis and holds that the organization of economic activity is largely understood in transaction cost economizing terms. Transaction costs are realized by aligning governance structures […] with the attributes of transactions in a discriminating way". Further, the author mentions that the theory of

transaction cost economics maintains that bilateral contracts are complex and invariably incomplete (Williamson, 1985).

Furthermore, Farina et al. (1997) mention that the characteristics of transactions will condition the most efficient governance form or the form which is expected to reduce transaction costs. They emphasize the difficulties in measuring the transaction costs and their identification. Thus, transaction costs are not those directly associated with production, but might appear according to the relationships of the agents, and problems in coordinating them arise as a result of their activities.

Arguing on vertical integration, it will be more common where (i) the cost savings gained due to asset specificity are great; (ii) design features prevent the allocation of assets to alternative use; (iii) economies of scale are small, or among firms of different sizes, the largest ones will be more integrated than the smallest, and (iv) bureaucratic cost related to internal organization are smaller (Williamson, 1985). In a former paper, Williamson (1979:253) mentioned that "the advantage of a vertical integration is that adaptations can be made in a sequential way without the need to consult, complete, or revise inter-firm agreements. Where a single ownership entity spans both sides of the transactions, a presumption of joined profit maximization is warranted". Both price and quantity adjustments will be more complete than in inter-firm trading.

Transaction costs hold a problem of economic organization as a problem of contracting. Thus, transaction costs are distinguished between ex ante and ex post. The first are the costs of drafting, negotiating and safeguarding an agreement. The parties involved agree in advance about the contingencies. The second, the ex post costs refers to costs incurred when transactions drift out of alignment, costs associated with the governance structures and costs related to security commitments (Williamson, 1985).

3.3.2 Behavioral assumptions

Williamson's (1979) concept about transaction costs refers to factors as: (i) opportunism which is its central concept, relevant for the economic activity that involves transaction-specific investments in human and physical capital, (ii) the efficient processing of information which is an important and related concept, and (iii) the assessment of transaction cost as a comparative institutional undertaking. In other words, the basic elements of behavioral decision-making are opportunism, bounded rationality and asset specificity (Williamson, 1985). According to the

author, these three assumptions are the elements why the market mechanism often fails. Opportunism refers to the strongest form of self-interest and actors are usually motivated by it. The second, bounded rationality states that, individuals are incompetent to make allowance for every possible effect that a certain transaction or decision would have. Third, transaction-specific assets refer to uncertainty caused by human and physical assets (Williamson, 1985). Therefore, transaction costs are greater when the asset specificity is high. This is because the market mechanism fails when the number of qualified partners is too low (Williamson, 1975).

3.3.3 Transaction dimensions

Azevedo (1996) points out that transaction costs differ from each other. This is the basic reason that explains the existence of different institutional arrangements to rule each transaction. These institutional arrangements are divided in spot markets, contracts and vertical integration.

Basically, there are three critical dimensions to characterize transactions: (i) frequency; (ii) uncertainty; and (iii) asset specificity. Frequency is characterized as one-time, occasional and recurrent, and investments are classified as nonspecific, mixed and idiosyncratic. In addition, three structures of governance were considered: non-transaction-specific, semi-specific and highly specific (Williamson, 1979).

Farina et al. (1997) define transaction frequency as the sequence and the regularity of a transaction. According to the authors, frequency has a dual role, because the greater it is, the smaller the average fixed costs associated with information gathering and with preparation of a complex contract that can impose restrictions on opportunistic behavior. The second attribute, uncertainty, includes the variance or lack of knowledge of future elements related to the transaction. Neves (1999a) emphasizes that transactions with greater uncertainty should have more future adaptations in contracts and demand more complex control structures. The third attribute, asset specificity, relates to the binary view of how global production might be organized, either through markets or within transnational firms, in terms of the complexity of inter-firm relationships and the extent to which they involve investments specific to a particular transaction. Thus, asset specificity refers to how specific the investment is for the activity and how costly its reallocation is for alternative use (Williamson, 1985). Therefore, the more specific an asset is in a relationship, the greater the frequency and the risk. In this case, a firm manages towards vertical integration relationships (Farina et al., 1997).

Furthermore, market governance refers to non-specific transactions of occasional and recurrent contracting [where buyers and sellers meet to exchange goods at equilibrium prices]. In the case of highly specific governance, only recurrent transactions will support semi-specific structures (Williamson, 1979). Favoring arguments towards structural decision-making based on hierarchical relations, transactions will increase when the uncertainty of operation and environment is great and asset specific investments are needed. Williamson (1985) highlights that behavioral uncertainty is essential in order to understand transaction cost deeply.

3.3.4 Institutional environment

Douglass North has developed many studies regarding institutions, definitions and importance in the economic focus. The definition of institutions consists "[…] of formal rules, informal constraints (norms, behavior, conventions, and self imposed codes of conduct) and the enforcement characteristics of both. The degree to which there is an identity between the objectives of the institutional constraints and the choices individuals make in the institutional setting depends on the effectiveness of enforcement […] Institutions affect the economic performance by determining (together with the technology employed) transaction and transformation (production) cost" (North, 1990:2).

North (1990) discusses further that "if institutions are the rules of the game, organizations are the players. They are groups of individuals engaged in purpose activity. The constraints imposed by the institutional framework (together with the other constraints) define the opportunity set and therefore the kind of organizations that will come into existence" (North, 1990:3). Changes in the formal rules are results of legislative changes and changes in informal norms; they occur gradually and subconsciously as individuals develop alternative patterns of behavior, according to the cost and benefits perceived.

North (1990) describes five propositions about institutional change. First, continuous interaction exists between institutions and organizations; second, competition forces organizations continually investing in skills and knowledge; third, the institutional framework provides the incentives regarding the types of skills and knowledge perceived to maximize the pay-off; fourth, perceptions are derived from mental constructions of the players and fifth, economies of scope, complementarities as well as network externalities of an institutional matrix make changes increase in a dependent way.

3.4 A framework for the analysis of certification decision

The economic model underlying the empirical investigation presupposes expected utility maximization and the notation $E(U_{ij})$ where E(U) denotes expected utility, with *i*=1,2,3,...,N denoting an individual in the sample and j (=1, if the agent adopts, =0 otherwise) denoting action. Using this notation, individual i adopts certification if the expected utility from adoption exceeds the expected utility from non-adoption, or, in other words, if $E(U_{i1}) \geq E(U_{i0})$,

where the expected utility is $EU_{ij} = v_{ij} + \varepsilon_{ij}$; v_{ij} denotes the observable utility and ε_{ij} is the error term.

Rewriting the observable utility as below:

$$v_{ij} = f(Cha\,\mathrm{Pr}_{ij}, ChaFarm_{ij,} Cha_{ij}) \qquad \text{(Equation 3.1)}$$

where

$Cha\,\mathrm{Pr}_{ij}$ = characteristics of producers;

$ChaFarm_{ij}$ = characteristics of their farms; and

Cha_{ij} = other characteristics

This is a standard interpretation of the binary response in a structured survey (Feder et al., 1985), and a standard set of techniques is available for investigating the factors that influence the adoption decision (Greene, 2003). It is expected that farmers' decision of adopting certification or not be influenced by a range of factors that can be categorized as: (i) characteristics of the producers; (ii) characteristics of their farms; (iii) obtaining information; (iv) cost to certify; (v) benefits to certify; and (vi) future expectation. Figure 3.2 highlights the factors which determine the returns and the cost to certify. The resulting net present value again is decisive for the decision to adopt certification or not. The hypotheses are presented in the next section.

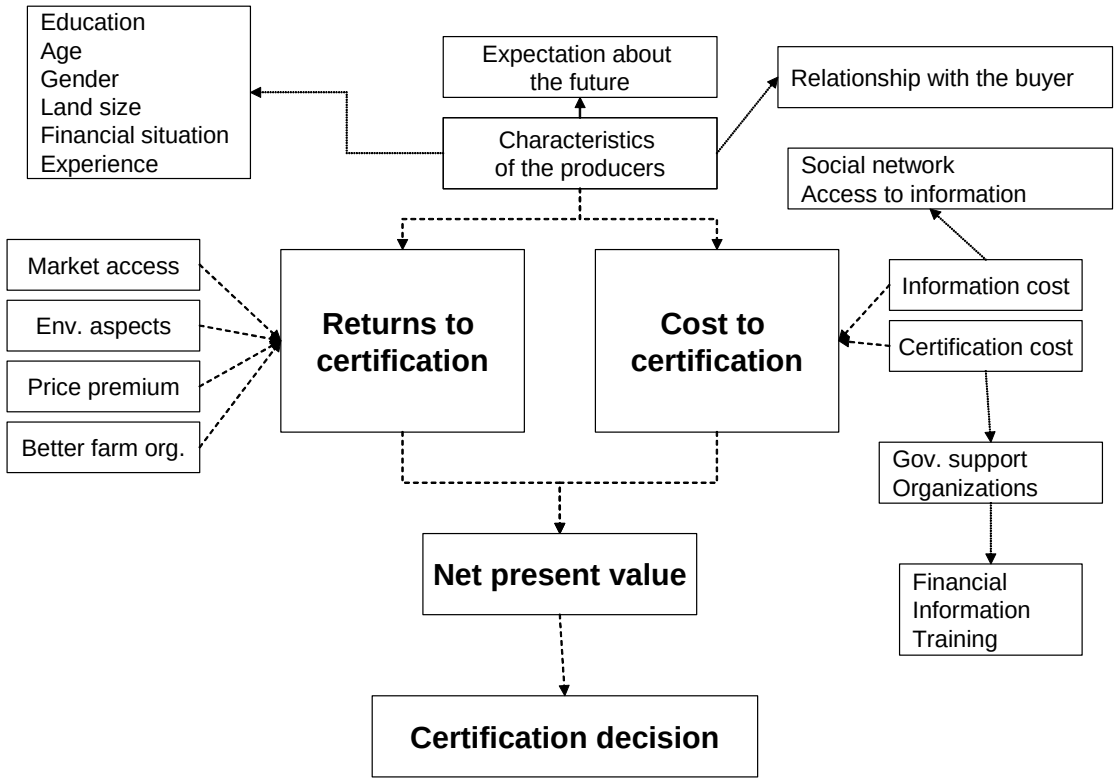

Figure 3.2: Determinants of producers' decision to adopt certification

Source: Own illustration

Logistic regression is used to investigate the determinants of the producers' decisions whether they certify or not. As described in Figure 3.2 the decision may be influenced by a range of different variables. Thus, the logistic model is used for the analysis of binary responses or dichotomous and allows one to examine how a change in any independent variable changes all the outcome probabilities (Hosmer & Lemeshow, 2000). In general, the results are reasonably robust to changes in the set of independent variables included in the regression. The method leads to the least squares function under the linear regression model (when the error term are normally distributed), and yields values for the unknown parameters which maximize the probability of obtaining the observed set of data (Hosmer & Lemeshow, 2000).

Nevertheless, logistic regression diagnostics are similar to linear regression, but unlike OLS regression, logistic regression does not assume linearity of relationship between the independent

and the dependent variables, it does not require normally distributed variables, does not assume homoscedasticity and in general has less stringent requirements (Baum, 2006).

The assumptions of logistic regression are described by Hosmer & Lemeshow (2000) as follows: 1) the true conditional probabilities are a logistic function of the independent variables; 2) no important variables are omitted; 3) no extraneous variables are included; 4) the independent variables are measured without error; 5) the observations are independent and 6) the independent variables are no linear combinations of each other. Furthermore, Brannick (2007) adds that the error term is not normally distributed, is not linearly related and has not equal variance in each group. Thus the relationship between the discrete variable and a parameter is non-linear.

The pseudo R-square calculated in the logistic regression is not similar to the R-square found in OLS regression, where R-square measures the proportion of variance explained by the model. The pseudo R-square is not measured in terms of variance, since in logistic regression the variance is fixed as the variance of the standard logistic distribution. However, it is still a proportion in terms of the log likelihood. It is highlighted that different pseudo R-squares can give very different assessments of a model's fit, and that there is no one version of pseudo R-square that is preferred by most data analysts over other versions (Wooldridge, 2003).

In the basic model, let Y_i be the binary response of a producer which can take one of two possible values: Y = 1 if the producers decide to certify and Y = 0 if not. Suppose x is a vector of explanatory variables (producers' characteristics, information cost, cost to certify, benefits to certify, future expectation) contributing to the adoption decision and β a vector of slope parameters, measuring the changes in x on the probability of the producers decision to certify. The model is:

$$Y_i = \alpha + \beta_i x_i \qquad \text{(Equation 3.2)}$$

where α and β_i are the unknown constant term and vector of regression coefficients to be estimated respectively.

Once the coefficients are estimated, one can calculate the probability that lead a farmer to certify. The probability of the binary response is defined as:

$$\text{If } Y_i = 1; \quad P(Y_i = 1) = \pi(x) \qquad \text{(Equation 3.3)}$$

$$Y_i = 0; \quad P(Y_i = 0) = 1 - \pi(x) \qquad \text{(Equation 3.4)}$$

where $\pi(x) = E(Y/x)$ represents the conditional mean of Y given certain values of x.

Thus, the probability of adopting certification is then expressed as (Hosmer & Lemeshow, 2000):

$$P(Y_i = 1) = \pi(x_i) = \frac{1}{1 + \exp[-(\alpha + \beta_i x_i)]} \qquad \text{(Equation 3.5)}$$

For the quantitative analysis of the descriptive statistics in this survey, t-test and the correlation analysis have been applied at 90% confidence level. All quantitative analyses were performed using SPSS and STATA softwares.

3.5 Summary and Hypotheses

Based on the concepts of governance in global value chain approaches presented by Gereffi (1994) and Gereffi, Humphrey & Sturgeon (2005), this thesis will identify and explain different ways of coordination in which fruit value chains are structured in order to deliver effective governance. In addition, it considers how new forms of global coordination affect the possibilities for upgrading fruit producers in Brazil. It will address the issues of market access and the acquisition of technological capabilities such as certification. It will also consider how different forms of insertion in the global economy facilitate the potential for the acquisition of capabilities and market access, and the policy frameworks which might enhance upgrading opportunities.

The transaction cost approach will be used as a framework for the analysis of contracts between buyers and sellers in fruit marketing chains. High-value crops, such as fruits, are typically associated with high transaction costs which increase the risk of buyers behaving opportunistically and defaulting on the contract. Reduction of the transaction costs could be envisaged as a useful device for enhancing productivity and quality that could eventually lead to higher farmers' income as well as better resource management practices.

In the following, the hypotheses which derived from the literature review are presented. Considering the findings of previous studies, fruit adopters of certification are expected to have the following characteristics:

- The adoption of certification provides incentives to producers to access more sophisticated markets and to upgrade;

- The determinants that lead to certification adoption are similar for any fruit growers, but their impact on the decision may differ due to the specificities of the product;

- The impact of certification on small, medium and large land size producers has different dimensions. Small farmers face higher difficulties to comply;

- Certified producers who trade with groups or cooperatives present a higher level of coordination;

- The marketing chain for certified products are more sophisticated and more efficient regarding post harvesting processes providing better contractual arrangements.

4 Brazilian fruit sector: background information, survey areas and data collection

This chapter deals with the case study undertaken in Brazil in 2006. The economic importance of fruit production in Brazil, in general, and in the surveyed regions, in specific, is described in Section 4.1. Section 4.2 summarizes the importance of organizations in supporting certification programs in the surveyed regions. Section 4.3 discusses the data collection procedures. The survey was carried out with mango and grape farmers from July to October in the Juazeiro/Petrolina region, and with cashew nut and melon growers from mid October to December in the Serra do Mel/Mossoró region.

4.1 Economic importance of fruit production in Brazil

4.1.1 Fruit production in Brazil

Brazil is the third largest fruit producer in the world after China (161 million tons) and India (58 million tons), growing more than 35 million tons of fresh fruit on an area of 1,8 million ha in 2004. Table 4.1 shows the 12 main produced fruits in the country and their respective planted area in ha. Orange and banana production represents around 70% of both the total volume and of the land planted with fruits. Grapes, mango and melon production makes up around 7% of the whole volume.

Table 4.1: Brazilian fruit production in 2004

Fruits	Volume (Tons)	% of total volume	Planted area (ha)	% of total planted area
Orange	18,313,717	51.7	823,902	44.6
Banana	6,583,564	18.6	495,385	26.8
Watermelon	1,719,392	4.8	81,281	4.4
Papaya	1,612,348	4.5	35,553	1.9
Grape	1,291,382	3.6	71,640	3.9
Tangerine	1,163,213	3.3	63,099	3.4
Lemon	985,623	2.8	49,372	2.7
Apple	980,203	2.8	32,993	1.8
Mango	949,610	2.7	73,239	4.0
Maracock	491,619	1.4	37,252	2.0
Guava	408,283	1.2	18,826	1.0
Melon	340,863	1.0	15,505	0.8
Other fruits[2]	616,523	1.7	49,345	2.7
Total	35,456,340	100.0	1,847,392	100.0

Source: IBRAF (2004)

Table 4.2 shows the fresh fruit exports in volume and value terms for 2004. The main fruits designated to international markets are apples, mangoes, melons and grapes, responsible for nearly 60% of the country's total revenue. However, comparing the total production and exports figures, it is found that the share of fresh exported fruits in 2004 amounted to only 2.4% of the total production in volume terms.

[2] It does not include data on coconuts and pineapples represented in units.

Table 4.2: Brazilian fresh fruit exports in 2004

Fruits	Exports (US$ Free on Board (FOB)	% of total prod. (US$)	Exports (tons)	% of total production (tons)
Apple	72,549,960	19.6	153,043	18.0
Mango	64,187,221	17.4	111,037	13.1
Melon	63,251,151	17.1	142,587	16.8
Grape	52,755,494	14.3	28,815	3.4
Banana	26,983,243	7.3	188,087	22.2
Papaya	26,563,343	7.2	35,930	4.2
Orange	21,492,237	5.8	90,119	10.6
Lemon	18,298,500	4.9	37,326	4.4
Tangerine	8,190,572	2.2	18,014	2.1
Watermelon	4,003,153	1.1	16,143	1.9
Other fruits	11,480,870	3.1	27,207	3.2
Total	369,755,744	100.0	848,309	100.0

Source: IBRAF (2005)

Melon have the highest export rates. Mango in Pernambuco state have an export share of almost 30% and apples from Rio Grande do Sul state of 20%. Sao Paulo is the biggest producer of bananas, oranges and the third in mangoes, but its production is mostly consumed domestically. The individual states in Brazil differ in terms of exported volume and type of fruit (Table 4.3). For example, in 2004, 95% of the melon was exported by Ceará and Rio Grande do Norte states.

Table 4.3: Participation of the main states of the country in fruit exports in 2004

Fruits	States	Production (ton)	Exports (tons)	Export share (%)
Melon	Rio Grande do Norte	167,492	100,504	60.0
	Ceará	109,566	38,492	35.1
Banana	Sao Paulo	1,060,520	8,965	0.8
	Bahia	872,474	0	0.0
Watermelon	Rio Grande do Sul	451,429	0	0.0
	Sao Paulo	215,868	0	0.0
Orange	Sao Paulo	14,717,790	89,363	0.6
	Bahia	794,916	0	0.0
Apple	Santa Catarina	583,205	80,870	13.9
	Rio Grande do Sul	353,140	70,816	20.1
Mango	Bahia	305,658	52,669	17.2
	Sao Paulo	245,085	3,525	1.4
	Pernambuco	145,893	43,077	29.5
Grapes	Rio Grande do Sul	696,599	1	0.0
	Sao Paulo	193,300	322	0.2
	Bahia	85,910	16,193	18.8
	Pernambuco	152,059	12,193	8.0

Source: IBRAF (2005) and Aliceweb[3] (2004)

With respect to cashew nuts, Brazil is the fourth largest producer, after Vietnam, India and Nigeria. Based on the statistics from Aliceweb (2007), it is shown that Rio Grande do Norte State exported around 23% (9.7 thousand tons out of 41.8 thousand tons) of the total Brazilian shelled cashew nuts (i.e. kernels) production in 2005. From the total exported volume of this state, 66% (6.4 thousand tons) was transported to the US and 12% (1.2 thousand tons) to the EU.

The European Union is the main importer of almost all kinds of fruits from Brazil, as listed in Table 4.4. Almost all melons, grapes, apples and oranges were exported to the EU from 2003-2005. Also mango exports to the EU were significant with increasing shares between 2003 to 2005. Banana and cashew nuts exports are less important. In comparison with the EU, the United States did not import any melons, apples, oranges and bananas, but they imported mangoes [23%] and grapes [11%] with the latter showing increasing rates from 2003 to 2005. Furthermore, the US was the biggest importer of shelled cashew nuts from Brazil with 64% of the total shelled cashew nuts production. Putting the figures of the EU and the US together, it can be found that most of the Brazilian fruits' exports are designated to them.

[3] Aliceweb is a statistical database with information regarding Brazilian imports and exports, supported by the Ministry of Development, Industry and Foreign Trade (MDIC)

Table 4.4: Destination of Brazilian fruit exports to European Union and United States, in percentages, 2003-2005

Fruits	European Union			United States		
	2003	2004	2005	2003	2004	2005
Mango	44.7	68.3	71.5	28.8	25.6	23.0
Grapes	94.0	89.5	85.7	1.5	4.8	10.6
Cashew nuts shelled	12.0	10.8	14.7	70.9	70.6	64.3
Melon	98.5	99.2	98.7	0.0	0.0	0.0
Apples	93.8	91.9	91.6	0.0	0.0	0.0
Oranges	91.3	86.7	89.6	0.0	0.0	0.0
Banana	23.0	28.9	31.2	0.0	0.0	0.0

Source: Aliceweb (2007)

To what extent Brazil will be able to increase its export shares in the future depends on a number of different factors. Nachreiner & Santos (2002) identified some difficulties that Brazilian fruit exporters face: (i) phytosanitary and legislative barriers in the importing countries; (ii) lack of national phytosanitary policies; (iii) inadequate quality according to buyers' requirements; (iv) lack of organized infrastructure for storage and trading; (v) lack of pre-fixed contracts between importers and exporters; (vi) bad road and port conditions; (vii) weakness of the government to support the sector at international negotiations and (viii) lack of advertisement of tropical fruits in countries with cold climate.

4.1.2 Fruit production in the survey regions

A survey was conducted in two regions in Brazil, namely in Juazeiro/Petrolina and Mossoró/Serra do Mel. The choice of the survey areas was based on two considerations: (i) the extent to which standards and certification have been applied in the regions, and (ii) the importance of their fruit production in the export market. In view of these considerations, mango and grapes were chosen as the focus of the analysis in the Juazeiro/Petrolina region, whereas cashew nuts and melon were selected in the case of Serra do Mel/Mossoro region. The Figure 4.1 shows Brazil with the survey sites. A map of the Northeast states is presented in the Appendix 1.

Figure 4.1: The study sites

Source: http://www.guianet.com.br/guiacidades/

Juazeiro/Petrolina region

The Sao Francisco Valley (SFV) region is composed of the following states: Minas Gerais, Bahia, Goiás, Pernambuco, Sergipe, Alagoas and Distrito Federal. The total area is around 640 km^2 and the number of inhabitants was about 13 millions in 503 cities in 2005. The study area Juazeiro/Petrolina is located at the sub-medium Sao Francisco Valley in the semi-arid zone of the Northeast (Brazilian Institute of Geography and Statistics IBGE, 2005).

The SFV region has historically been a poor region of Brazil, mostly due to its very dry climate and geographical conditions. Before the adoption of irrigation in the 1970s, there were few economic activities in the region. The region gained economic importance in agricultural production once the government promoted investments in irrigation infrastructure. However, the largest boom in the region occurred only in the 1990s, mainly after the devaluation of the currency that enabled farmers to become competitive in foreign markets (Hirsch, 2005). Nevertheless, it constitutes a territory which is a natural connection between the Northeast and the Southwest, which is now considered as one of the most developed regions in Brazil. It has played an important role in the economic and social development of Brazil after 1990s (Domingues et al., 2003).

Research conducted by Hirsch (2005), divided types of farmers in the SFV region in Brazil into two main types namely large-scale and small-scale farmers. On the one hand, there are large-scale farmers that are basically top fruit companies producing mostly high-quality grapes and mangos with sophisticated technology and infrastructure. On the other hand, there is the group of small-scale producers farming on about two to five ha under projects assisted by the Company for the Development of the Valleys of the Sao Francisco and of the Paraíba (CODEVASF). These small farmers represent around 70% of the total farmers in the region. However, their cultivated area represents only 17% of the cultivated area.

Figures from Aliceweb (2007) show that the production and cultivated area of mango and grapes in Juazeiro/Petrolina region are very high. The region was responsible for 88% of mangoes and 99% of grapes country's total exports in 2006 to the EU. The total cultivated area in these regions in 2005 was 155 million ha while the harvested volume was around 260 thousand tons of grapes and 550 thousand tons of mangoes. Apart from grapes and mangoes, the region currently also produces various other fruits including mangoes, grapes, sugarcane and guava at a relatively large scale, as well as melons, coconuts, bananas, tomatoes, passion fruit, lemon and papaya at a small scale.

Serra do Mel/Mossoró region

The second biggest region with irrigated tropical fruits production in Brazil is located in the semi-arid region in the Rio Grande do Norte state. The region Serra do Mel/Mossoró is part of this huge region which extends over 20,000 ha and has approximately 306,000 inhabitants. At the beginning of the 1990's, this region was nominated as the cluster of integrated development by the Northeast Bank due to its potential in producing irrigated fruits. The production from this region is considered as an example of technological progress (Gomes da Silva, 1999). The main harvested fruits are melons, bananas and mangoes. Crops like coconuts and cashew nuts, which are usually planted in dry areas, are increasingly cultivated in irrigated areas as well (Costa et al., 2007). Cashew nuts are the major economic products of Serra do Mel farmers and melon for the Mossoró ones.

4.2 Policies and institutions of Brazil's fruit sector

In Brazil, a number of different policies, organizations and instutions have an influence on the fruits and vegetables sector. Major characteristics of these are outlined in the following. A special focus is put on the two surveyed regions Petrolina/Juazeiro and Mossoró/Serra do Mel.

IBRAF[4] aims at promoting the growth and development of the country's fruit agribusiness through the disclosure of technical and marketing information along the sector. Together with the Trade and Investment Promotion Agency (APEX-BRASIL), IBRAF coordinates the "Brazilian Fruit Program" – a National Plan to promote the fruit sector in Brazil. The first phase was successfully implemented in 1998. Its objectives were the creation of strategic actions for selected types of fruits, and increasing the market access for a greater number of small fruit producers. In a new phase (2003/2004), it was decided that the sector should continue to export to consolidated markets (Germany, United States, United Kingdom and France) but also to invest in new ones (Spain, The Netherlands, Portugal, Scandinavia, Canada, Asian Countries, Arab Countries and Latin American Countries including Mexico, Chile and Argentina) (Brazilian Fruit, 2007). Currently, the program includes fresh fruits [lime, apple, mango, melon, papaya, grape, pineapple, banana, orange, tangerine, peach, persimmon, watermelon, figs and strawberries] and processed fruits [pulps and juices, cashew nuts, coconut water among others] (Brazilian Fruit, 2007). Apart from this national program, the government also promotes the development of the fruit production in selected regions, as outlined in the following.

4.2.1 Importance of organizations in the Petrolina/Juazeiro region

In the past, the Petrolina/Juazeiro region was underdeveloped and lacked basic infrastructure. The development process in the region began first in the late 1960s. Government infrastructure investments, particularly large-scale land and water management projects (reservoirs, delivery canals, and settlement and irrigation), triggered the region's development. CODEVASF, a federal government agency which was created to promote the development of the Sao Francisco River Basin, carried out most of these projects (Rocha et al., 2007).

The Brazilian government has substantially contributed to the development of the Petrolina/Juazeiro region through investments in many organizations. The most important one is the CODEVASF, but the Northeast Bank and the Support Agency for Small and Medium-sized

[4] Is a private and non-profit organization created between Brazilian fruit producers' groups in the early 1990s.

Firms (SEBRAE), Producers and Exporters Association of the São Francisco River Valley (VALEXPORT) and the EMBRAPA have also contributed to the success of the development of the regions. This will be briefly described in the following.

SEBRAE in Petrolina

In 2004, the SEBRAE and the National Institute of Metrology, Standardization and Industrial Quality (INMETRO)[5] settled an agreement which aims at promoting the sustainable inclusion of small and medium enterprises or farmers in the market in order to stimulate their economic and social development. This is expected to be achieved by providing technical support from the producers through weekly visits and enable them to obtain PIF and GlobalGAP certification. In addition, financial support was given by SEBRAE covering 50% of the certification cost, and the remaining 50% of the certification cost should have been paid back by the farmer. According to the agreement, the financial support amounts to €5,550 per farmer. This amount should be paid back in three years-based installments (Agenda SEBRAE de Notícias, 2005).

Since 1999, SEBRAE had invested €370,400 in research for the development of new varieties of seedless grapes on approximately 4,000 ha, in the region, as covered by the Fruitculture Program. The project was supported by EMBRAPA and the VALEXPORT. Overall, the Fruitculture Program supported is based on three pillars: technology, management and trading. The target is to make small farmers competitive on both national and international levels by providing them with field visits and training courses.

EMBRAPA Semi-Arid (CPATSA)

EMBRAPA is a federal agricultural research agency with a branch located in Petrolina, and focusing on products for non-irrigated areas. Only by the end of the 1990s, the EMBRAPA Semi-Arid division did re-evaluate its priority list and started to develop research on irrigated agriculture. It actively became involved in the study of export crops. Hirsch (2005) pointed out that the presence of EMBRAPA in the Sao Francisco Valley is fundamental to the sustainable development of the region.

In 1999, the branch of EMBRAPA Environment, in cooperation with the EMBRAPA Semi-Arid, VALEXPORT, the Irrigated District Nilo Coelho and other national and international organizations, elaborated an environmental program for the Sao Francisco Valley, called

[5] INMETRO was created by law in December 1973.

"Environmental quality in the irrigated fruitculture in the Brazilian Northeast – Ecofrutas". This program was the starting point for the implementation of the PIF certification of grapes and mangoes in the region. For the experimental stage, 14 grapes and mango exporting companies were selected to participate in the program. The first stage was financially supported by VALEXPORT [with resources obtained by The National Fruitculture Developing Program]. The second stage was however, financially supported by the MAPA and the National Council for Scientific and Technological Development (CNPq) to support not only the production of grapes and mangoes but also of apples, peaches, bananas and citrus fruits (EMBRAPA CPATSA, 2006).

CODEVASF

The success of irrigated agriculture in Petrolina/Juazeiro relates partly to heavy investments in irrigation infrastructure carried out since the late 1960s by the CODEVASF. This organization not only built water reservoirs, pumping systems and delivery canals, but also expropriated lands for irrigated agriculture. These irrigation projects cover more than 40,000 ha in the region and attract further private investments in irrigation that led to a total of 80,000 ha of irrigated land in 1997 (Damiani, 2003).

The initial CODEVASF's strategy was the establishment of a tomato-processing industry during the early 1980s. Unfortunately, this industry turned out to generate limited results and not to deliver the expected development effects. The region was also an important melon producer before becoming a leader in mango and grapes production. Production problems due to heterogeneity of products and the inability to guarantee a certain level of quality led to a decrease in prices and the production was interrupted. Investments in grapes and mango production began during the 1980s, and the exports first started to grow during the late 1980s, especially due to the introduction of seedless grapes (Rocha et al., 2007).

In sum, CODEVASF's actions had a positive impact on the development of the region because of three aspects: (i) it provided the necessary incentives to attract potential investors to the region; (ii) it stimulated these newcomers not only to bring capital but also to technology and share their knowledge with locals, and (iii) it applied effective selection and control mechanisms that stimulated production, penalized speculation, and delivered highly competent producers with an entrepreneurial mind-set (Rocha et al., 2007).

VALEXPORT

CODEVASF also stimulated the creation of VALEXPORT in 1987, an association which was considered as necessary for at least the following powerful reasons: (i) to collect information and search for exports markets, and (ii) to press the federal government to carry out policies and other interventions that helped fruit producers to export, such as investments in infrastructure (Rocha et al., 2007).

Initially, VALEXPORT consisted only of a small group of four large firms, but by 1997, it covered around 200 members, of which 66% were small-scale producers and the remaining agricultural firms. Since its creation, VALEXPORT had been involved in many projects and cooperation agreements with federal, state and local organizations, as well as research organizations and private laboratories (Damiani, 2003). In 1994, the first project aimed to support the irradication of the fruit fly in the region, followed in 1995 by a research program of seedless grapes. In the period between 1994 and 2003, there were totally 24 projects developed by VALEXPORT in the SFV.

Northeast Bank

The development of the region was also supported by the Northeast Bank, one of the main public banks in the Northeastern region. The Bank had an instrumental role in providing credits to farmers, but was also actively engaged in technology transfer. Damiani (2003) mentions that, the Bank was not only involved in the process of providing credits to firms and settlers, but at the same time it also acted as an intermediary in the transfer of technology between these players. The Bank required small-scale farmers to use the same technology as large-scale farmers in order to grant them credit lines. Bank officers control the farmers through regular visits. However, some farmers in the region are not satisfied with the ability of this Bank to process credits in a timely manner. Thus, in practice, there is a lack of financing for the agricultural activities in the region, especially for the small and medium sized farmers (Hirsch, 2005).

4.2.2 Importance of organizations in the Mossoró/Serra do Mel region

SEBRAE in Mossoró

Considering the economic importance of cashew nuts production for small-scale producers in the Northeast region of Brazil, SEBRAE and the Bank of Brazil launched the project “revitalization of the cashew mini-factories” in 12 cities of the Rio Grande do Norte state in 2004. The project aims

at first including small cashew nuts producers and second, organizing them in cooperatives or associations (SEBRAE, 2004). According to Notícias (2006), one of the first successfully established cooperative was the 'Cooperativa dos Beneficiadores Artesanais de Castanha de Caju do Rio Grande do Norte' (COOPERCAJU) located at Serra do Mel city. This is a producer cooperative with 182 members of which 46 members have organic certification. Since 2006, the cooperative started to export to international markets. Even though the COOPERCAJU is responsible for trading around 10% of all nuts production in the state, the cooperative still faces many limitations in promoting production. Parreiras (2007) highlights the need of further research to assure that more rural families continue working in this field instead of migrating to cities.

EMBRAPA Tropical Agro industry (CNPAT)

The original mandate for EMBRAPA Tropical Agro industry (CNPAT), which is another specialized center of EMBRAPA, was the development of cassava and cashews, but not fruits. It was only in the mid 1990s that EMBRAPA-CNPAT renamed and reoriented this center towards research in tropical fruits. In 2003, it was responsible for conducting experiments and implementing the Integrated Fruit Production scheme in the cashew and melon sectors in the region.

4.3 Survey design and implementation

4.3.1 Mango and grapes

A survey of 303 farmers was conducted between July and October 2006 in the surrounding areas of Petrolina/Juazeiro. The survey was conducted after a pilot test which was performed to identify questions in the questionnaire which respondents may find problematic to answer. The final version of the questionnaire is presented in Appendix 2.

The two-stage stratified sampling technique was applied as outlined by Levy & Lemeshow (1999). The first stratum included small[6] (<12 ha), medium (>13 and <49) and large producers (>50 ha) in both regions. The final step involved the identification of producers with certification, the ones without certification and those in the process of becoming certified. A total of 18 strata were identified. To ensure that this sample population could yield significant results from econometric analysis, a statistical power analysis was made to determine the sample size, whereby expected

[6] Definition of land size according to SEBRAE of Petrolina

effect size, i.e., expected differences of means of two populations or the alternative hypothesis, can be detected with a certain power and significant level. This approach requires information on population means (μ) and standard deviation (σ) based on lists of producers. The sample size of each stratum was calculated using the program Russlenth[7]. The sample sizes and the population from which the samples were obtained are presented in Table 4.5.

Table 4.5: Population and sample sizes of the producers in Juazeiro/Petrolina

Type of producer		Population			Sample size		
		Juazeiro	Petrolina	Total	Jua/Petro		Total sample
Farm's land size	Certification	Farmers	Farmers	population	Farmers	%	size
Small	Without	587	2799	2212	90	39.0	120
	In process	30	149	119	30	13.0	59
	With	0	91	91	30	13.0	30
Medium	Without	4	58	54	30	13.0	34
	In process	4	67	63	30	13.0	34
	With	0	20	20	20	8.7	20
Large	Without	1	1	0	0	0.0	1
	In process	0	1	1	1	0.4	1
	With	4	24	20	0	0.0	4
	Total	630	3210	2580	231	100	303

Source: Own compilation based on the list of producers

Table 4.6 presents the figures of mangoes and grapes farmers in the surveyed regions. Considering both regions, 68% of the total farmers are producing mango while 26% of them are concentrating on grapes production, and 5% of the total farmers produce both fruits.

Table 4.6: Population of grapes and mango farmers in the region

	Juazeiro		Petrolina		Both municipalities	
Type of fruits	Total of farmers	%	Total of farmers	%	Total of farmers	%
Mango	64	88.9	144	62.3	208	68.6
Grapes	1	1.4	78	33.8	79	26.1
Mangoes and grapes	7	9.7	9	3.9	16	5.3
Total	72		231		303	100.0

Source: Own compilation

[7]Available on the website: http://www.cs.uiowa.edu/~rlenth/Power/ (Accessed on August 2006)

4.3.2 Cashew nuts

After the data collection related to mangoes and grapes, the survey continued with 85 cashew nut farmers from October to December 2006 in the region of Serra do Mel/Mossoró. The study considered small producers (<49 ha) of cashew nuts with certification and farmers without certification. The population of the producers with certification was 47 and the producers without certification were around 1,000 (see Table 4.7). There are no medium (>50 and <99 ha) and large producers (>100 ha) in the region[8]. The final version of the questionnaire is available in Appendix 3.

Similar as in the mango and grapes case, the study in cashew nuts also followed a two-stage stratified sampling technique as described by Levy & Lemeshow (1999). The first stratum included only small producers in the regions. The final step involved the identification of producers with certification and those without certification. A total of two strata, from which the data were collected, were identified. The sample size of each stratum was also calculated with the program Russlenth. The sample sizes and the population from which the samples were obtained are presented in Table 4.7.

Table 4.7: Population and sample sizes of the producers, in Mossoró region

Type of producer	Population size			Sample size		
	Mossoró	Serra do Mel	Total	Mossoró	Serra do Mel	Total
Small without certification	1000	0	1000	60	0	60
Small with certification	0	47	47	0	25	25

Source: Own compilation based on list of producers

4.3.3 Melons

A list of producers has been provided by the Comitê Executivo de Fitossanidade do Rio Grande do Norte (COEX). There are 26 companies of melons located in the region (Table 4.8). The categorization into small, medium and large farmes is according to the definition of COEX.

[8] Definition of land size according to SEBRAE of Mossoró

Table 4.8: Population of the melon producers in Mossoró region

Size of producer	Ha	Number of producers
Small	<100	11
Medium	≥100 up to 499	12
Large	≥500	3
Total		26

Source: Own compilation based on a list of producers provided by COEX

Six interviews were carried out with melon growers, considering their access to international markets, either directly or indirectly, and their farm size (Table 4.9). Direct access means that farmers export to international buyers without a trader. Indirect access to international markets means that farmers sell the fruit production to a trader or a bigger company, being responsible for the exports. Each interview has the character of a case study.

The methodology of case studies is recommended when the researcher aims to increase the understanding of the subject (Yin, 1994). According to the author, general applicability results can be obtained from the qualitative data. In addition, case studies meet three branches of the qualitative method: describing, understanding and explaining. Further details on procedures for constructing a case were also mentioned: case studies can have single or multiple-case designs. Single designs are applied in cases where there is no chance for replication, while multiple design refers to cases with replication. Therefore, generalization of results from both designs is straightforward in the case of theory but not in the case of populations (Yin, 1994). Further, interviews are considered one of the most important sources of case study information. There are several forms of possible interviews: open-ended, focused and structured or survey types. In open-ended interviews, key respondents are asked to comment on certain events. In focused interviews, the interviewer asks a set of questions in a short period of time. In the third type of structured interviews, the researcher organizes and details the questions in advance.

Accordingly, multiple-design cases were conducted through personal structured interviews with the owners or managers of the companies (Appendix 4). The study seeks to understand the characteristics of these farmers, their perception of certification and their marketing chains. The interview was recorded with the interviewees' permission. In order to preserve the integrity of the farmers, names were not mentioned.

Table 4.9: Case studies selected according to the type of producer

Size of producer	Exports directly	Exports indirectly
Small	1	0
Medium	1	2
Large	2	0
Total	4	2

Source: Own compilation based on information released by COEX

4.3.4 Data cleaning and missing data

Data cleaning was conducted after the data entry. It implies detecting and removing errors and inconsistencies in order to improve data quality. Usually, data quality problems are present in single data collections due to spelling mistakes during data entry, missing information or other invalid responses. The major purpose of cleaning data is to identify overlapping data, in particular by matching records referring to the same farmer. In general, data cleaning involves two steps: detection and correction of errors in a data set. Errors were detected using mainly three procedures: descriptive statistics, scatterplots and histograms.

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5 Certification in the fruit sector in Brazil

There are different certification schemes which are applied to fruit production in Brazil. These are GlobalGAP, Integrated Fruit Production (PIF), Fairtrade and Organic. Section 5.1 briefly discusses the role of certification in Brazil. Sector 5.2 describes major requirements of the certification programs, steps to certifiy and monitoring. Finally, Section 5.3 discusses how food standards and regulations from the European Union and the United States affect the Brazilian fruit sector.

5.1 The role of certification in Brazil

There are a few studies on certification which have been carried out in Brazil. Major results will be briefly presented. A more detailed description of the four certification schemes will follow in the next section. The adoption of selected certification schemes in the fruit sector differs by region and product in Brazil. According to the statistics from INMETRO (2007), there are more than 1,500 producers with Integrated Fruit Production (PIF) certification or being in process of having it. They are responsible for nearly 1 million tons of fresh fruit produced on 40 thousand ha. Figure 5.1 shows the percentage of the total 1,521 producers spread over the country producing one of the 16 types of fruits. In the SFV, there are totally 49 mangoes producers and 101 grapes producers who adopted PIF certification.

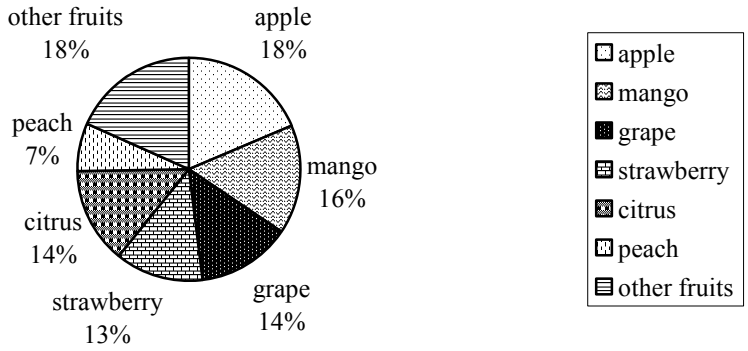

Figure 5.1: Number of producers with Integrated Fruit Production in 2006

Source: INMETRO (2007)

With respect to organic certification, Darolt (2000) verifies the evolution of organic production in Brazil and points out that the lack of updated statistics makes it difficult to evaluate this alternative agricultural system. Nevertheless, the author gathered data from the organic certifying companies and associations and concluded that around 100 thousand ha have been planted by 4,500 farmers concentrated mainly in the states of Paraná, Sao Paulo, Rio Grande do Sul and Espírito Santo in the year 2000.

Agrotecnologia (2007) presents data regarding the number of farmers with GlobalGAP certificate. In 2007, there were more than 68,000 producers spread all over the world, with approximately 10,000 being fruits and vegetables growers. Table 5.1 presents figures with respect to Brazilian certified GlobalGAP producers and cultivated area.

Table 5.1: Number of and area occupied by Brazilian producers certified with GlobalGAP in 2007

Product	Number of producers	% of total prod.	Area (ha)	% of total area
Soybeans	7	1.3	18,900	34.1
Maize	1	0.2	8,000	14.4
Melons	12	2.2	5,396	9.7
Apples	28	5.2	5,162	9.3
Mangoes	17	3.1	4,261	7.7
Grapes	245	45.4	3,797	6.8
Oranges	2	0.4	3,141	5.7
Bananas	10	1.9	1,857	3.3
Lime	177	32.8	1,680	3.0
Pineapple	21	3.9	1,527	2.8
Papaya	6	1.1	1,032	1.9
Other fruits[9]	14	2.6	746	1.3
Total	540	100.0	55,499	100.0

Source: Agrotecnologia (2007)

In total there are only 540 Brazilian farmers who are certified according to GlobalGAP standards. This national figure is - in comparison with the global figure - relatively small. Most of the certified farmers are grapes (45%) and lime growers (33%). In terms of land, soybeans and maize crops require huge areas, occupying 48% of the total area certified involving only 8 farmers. On the other hand, fruit culture is characterized as an activity with intensive labor and is compatible with small productive areas. Therefore, it represents an important alternative to producers who

[9] Includes watermelon, guava, figs and taro.

depend largely on family labor force. There are no official data available on Fairtrade certification in Brazil though it does play some role in the survey regions. Implementation of Fairtrade certification started in 2005 only.

Cintra et al. (2002) focus on the impact of certification adoption by mango and grape farmers in the Sao Francisco Valley. The results show that the adoption process is considered advanced, if compared to the remaining exporter regions in the country, and that its adhesion has not caused drastic changes in their productive system. Additionally, the producers seem to be aware of quality and food safety standards demanded by the international market. Producers having a certificate have preference when buyers and traders are selected as potential exporters. Data was collected by interviewing producers and experts in the region. But neither the sample size nor the farm sizes were mentioned and therefore, it is difficult to draw more general conclusions for the whole region.

Dörr & Marques (2005) conduct three case studies on Brazilian companies that export apples to the EU. It was observed that the challenges of the sector are ensuring that the fruit is acceptable to the European consumers. The biggest problem the companies face is to export the fruit through consignment apart from attending clients' requirements. These requirements are related to certification, the maximum residual of pesticides allowed, hygiene, traceability, among others. Cavichiolli et al. (2005) highlight that certification is considered as passport to access international markets. The authors' analysis relates to responses of fruit producers in different regions in Brazil regarding positive and negative aspects of having certification. These are listed in Table 5.2.

Table 5.2: Positive and negative aspects of having certification

Positive aspects	Certification leads to higher quality of the fruit
	Better market access
	Increase in volume exported
	Improved farm organization and more skilled labor
Negative aspects	When there is a price premium, it is usually not high enough
	Certification cost is too high
	High bureaucracy to obtain certification
	If the producers adopt different schemes they need specialized workers
	Small and medium producers have difficulties to abide to the certification rules
	The Brazilian consumer does not know about certification schemes

Source: Cavichiolli et al. (2005)

According to Pereira (2007), the benefits of having certification include (i) the enrichment in terms of the experience by the producer; (ii) better farm organization; and (iii) training; among others. It could be possible that the economic analysis between investments and benefits of a certification process cannot capture all gains in terms of productivity, efficiency, decrease of environmental damages, concern about the consumers' health, etc., which are maintained in the long run. Nevertheless, certification guarantees the quality and traceability, enabling Brazilian fruit producers to reach new international markets, even though it does not guarantee higher prices to the fruit producers. It can be concluded that organic certification is the most widespread applied program in Brazil, followed by PIF, GlobalGAP and Fairtrade.

5.2 Description of each certification scheme

The analysis focuses largely on comparisons among Integrated Fruit Production (PIF), GlobalGAP[10], Fairtrade from the Fairtrade Labeling Organizations International (FLO), and Organic Certification. Similarities and differences among them are investigated regarding the requirements for fruit producers. Appendix 5 presents a summary of the requirements, the so called control points of criteria among GlobalGAP, PIF and Fairtrade. The materials used in this analysis are based on information from Normative N. 012 (2003) for mango production and from Normative from N. 011 (2003) for grapes concerning PIF and GlobalGAP (2007a) for GlobalGAP. Data on Fairtrade standards for fresh fruits are based on FLO (2007) and standards on organic production are based on (International Federation of Organic Agriculture Movements IFOAM, 2008).

5.2.1 Integrated Fruit Production (PIF)

5.2.1.1 Definition and objectives

Integrated Fruit Production was first implemented in Europe in 1970 aiming to reduce the level of pesticides used in fruit production. Argentina, South Africa, New Zealand, US and Chile adopted the program in 1993, 1994, 1996 and 1998, respectively (Associacao Gaúcha dos Produtores de Maçã AGAPOMI, 2005). In Brazil, the Integrated Fruit Production (PIF) scheme started with apple production in the cities of Vacaria-RS and Fraiburgo-SC, in 1998. The producers' concern was that, without an adequate certification program they would certainly be out of the international

[10] Since 07th of September 2007, EUREPGAP has changed its title and logo to GlobalGAP.

market. Furthermore, other regions in the country started to implement the program supported by the Ministry of Agriculture, Food Supply and Livestock (MAPA) (AGAPOMI, 2005).

PIF is a program which was created in Brazil by the Normative N. 20 in 2002. The Normatives N. 11 (2003) and N. 12 (2003) establish the requirements for grapes and mango production, respectively. In 2006, the Normative N. 58 instituted the control of agro-toxic residues in fruits designated to the European Union, in compliance with the MAPA in the National Plan of Security and Product Quality of Vegetal Origin (PNSQV). The purpose of this instruction is to guarantee the fruits' quality and safety as well as the environmentally-friendly production.

5.2.1.2 Description of the requirements

Regardless of the fruit type, there are many requirements to be met by the producers to acquire the certificate. The level of compliance of requirements is divided in mandatory, recommended, forbidden and allowed with restrictions. Data were compiled considering each sub-thematic area within the major thematic area as one requirement having a different level of compliance (Table 5.3).

Table 5.3: Description of the PIF requirements according to the Normative N. 11 and N. 12

Thematic areas	Level of compliance				
	Mandatory	Recomm.	Forbidden	Allowed with restrictions	total
Capacity building	3	5	0	0	8
Organization of the producers	1	1	0	0	2
Natural resources	1	2	1	0	4
Propagation material	1	1	1	1	4
Implementation of the orchards	5	4	0	0	9
Plant nutrition	1	1	1	1	4
Soil management	3	2	1	1	7
Irrigation	1	1	1	0	3
Plant management	3	3	2	1	9
Integrated crop protection	5	5	5	2	17
Harvest and post-harvest process	5	5	3	1	14
Residues analysis	1	1	1	0	3
Packing process	9	9	2	4	24
Traceability and book-keeping records	3	1	0	0	4
Technical assistance and workers	1	1	1	0	3
Total	43	42	19	11	115

Source: Normative N. 11 and N. 12 (2003)

According to the figures in Table 5.3, there are a total of 115 requirements of which mandatory thematic areas and recommended ones represent each around 37%. The forbidden sub-thematic areas relate to 16% of all requirements, while the remaining 10% is allowed with restrictions.

However, differentiating between the three stages (i) crop management, (ii) harvest and post-harvest and (iii) the remaining areas, it was found that the crop management stage represents almost 50% of total requirements, followed by harvest and post-harvest with 35% and finally nearly 15% for the remaining topic (Figure 5.2). Technical training of the farmers regarding Good Agricultural Practices (GAP), including all stages of the crop development, until the post-harvest process, is provided.

Figure 5.2: Summary of the PIF requirements

Source: Normative N. 11 and N. 12 (2003)

For PIF certification, book keeping records are required for inspections. The book keeping process along the production chain is well-defined, including three stages. Table 5.4 and Table 5.5 present a summary of book keeping requirements.

Table 5.4: Summary of the thematic areas of the PIF book keeping 1

Thematic area	Data recorded
Information	Number of the plots: variety, number of plants, year of implementation, distance between plants and columns, area in ha, productivity
Climatic records	Pluviometer coefficient, temperature
Machinery and spreading equipment	Code, type, year
Machinery and spreading equip Maintenance	Type, date, reposition, maintenance, responsible person

Source: PIF book keeping 1 (2003)

While the book keeping 1 includes more general information, climate conditions and machinery, field book keeping 2 contains data with respect to each plot of the productive area. In this section, the producers have to control for possible diseases, plagues and natural enemies which may occur during the different stages of growth. The data regarding crop management, fertilizers, agrochemicals, irrigation and crop protection is also required in detail. A summary is presented in Table 5.5.

Table 5.5: Summary of the thematic areas of the PIF book keeping 2

Thematic area	Data recorded
Data on each plot	Date, variety, orchard formation, number of plants per ha, spacing, area in ha, height, productivity in tons per ha
Plot mapping	Mapping of the farm
Monitoring diseases	Date, type of disease: part of the crop. Mango book keeping listed 6 main diseases while grapes listed 7.
Monitoring plagues	Date, type of plague: part of the crop. Mango book keeping listed 6 main diseases while grapes listed 9 plagues
Natural enemies	Date, both book keepings listed 4 natural enemies
Crop management	Date, plant development stage, type of crop management, tool used, reason
Irrigation	Technical details on management
Fertilizer	Macronutrients: name of fertilizer, text, quantity, application procedure
Organic fertilizer	Date, type, quantity, procedure
Crop protection	Date, reason, product, quantity used, application procedure
Agro-chemical products	Date, stage of crop development, harvesting forecast, target plague, reason, product, quantity, application process
Harvesting	Harvesting quantity forecast, productivity per plot

Source: PIF Book keeping 2 (2003)

The post-harvest book keeping is related to data about the identification of the fruit, and an analysis of defective fruits. Furthermore, producers have to fill in the form of the packed fruit, the

control of the sample quality, the hygienic control of the packing house and calibration control of the equipment (Table 5.6).

Table 5.6: Summary of the thematic areas of post-harvesting book keeping

Area	Data recorded
Identification	Producer's name, plot, variety, time, number of boxes, weight
Defect analysis	Spots, deformation, bad-handling, mechanic damages, diseases
Control of packed fruit	Delivery, classification process, destination
Quality control of sampling	Date, identification code, category, weight, pH, percentage of defect, destination
Cleaning control and sanitization	Local, date, product, quantity, application procedure

Source: PIF book keeping post-harvesting (2003)

5.2.1.3 Certifying steps and monitoring

Andrigueto (2002:42) describes the procedure when an individual or entity decides to become part of the Integrated Fruit Production system. Roughly, they must go through a waiting period necessary for provisions and requirements (Normative N. 20) of the PIF system, according to the individual fruit species, as published by the Ministry of Agriculture, Livestock and Food Supply. The waiting period corresponds to one agriculture cycle. The conformity to acquire the PIF certificate is developed into six stages: regularization; request; auditing; decision; acquiring the certificate and maintenance.

1) Registration: producers or entities should register at the National Register of Producers and Packing Houses. The registration will proceed according to the Conformity Evaluation Organization (CEO) forms, criteria and procedures;

2) Request: producers or entities should make a formal request to the CEO at the beginning of the annual plant cycle. The adhesion is voluntary and the farms are monitored during 3 years in cyclical periods by an auditor. Within a period of 30 days, producers or entities can carry out pending requirements;

3) Auditing: after the three cycles of production, the auditing process takes place. The auditor verifies the checklists and elaborates a final report for the CEO appreciation;

4) Decision: based on the report, the CEO decides whether the certificate is issued or not;

5) Acquiring the certificate: once approved by the CEO, the license of conformity is issued for a three- year period of contract, renewed yearly;

6) Maintenance: monitoring and controlling processes are done by CEO, according to the Specific Auditing Plan. Producers and entities must have the book-keeping updates for inspection. A monitoring auditing report must be elaborated and approved by the CEO to keep the certificate. The certificate is valid for 12 months.

5.2.2 GlobalGAP

5.2.2.1 Definition and objectives

GlobalGAP started in 1997 as an initiative from retailers belonging to the Euro-Retailer Produce Working Group (EUREP). It has subsequently evolved into an equal partnership formed by agricultural producers and their retail customers. Their aim was to develop widely accepted standards and procedures for the global certification of Good Agricultural Practices (GAP) (GlobalGAP, 2007b).

GlobalGAP is a private sector body that sets voluntary standards for the certification of agricultural products. The standard is primarily designed to reassure consumers about the way food is produced on the farm by minimising detrimental environmental impacts of farming operations, reducing the use of chemical inputs and ensuring a responsible approach to workers' health and safety as well as animal welfare (GlobalGAP, 2007b).

The characteristics of GlobalGAP which can be summarized as (a) a pre-farm-gate standard, which means that the certificate covers the process of the certified product from farm inputs like feeding or seedlings and all the farming activities until the product leaves the farm; (b) including annual inspections of the producers and additional unannounced inspections; and (c) consisting of a set of normative documents. These documents cover the general regulations, the Points of Control and Compliance Criteria and the checklist (GlobalGAP, 2007b).

5.2.2.2 Description of the requirements

Even though the organization possesses an updated version from July 2007, the analysis considers the former version, Version 2.1 from October 2004, valid during the data collection of this survey. There are three types of points of control within the GlobalGAP program that producers need to meet to obtain the GlobalGAP recognition: "major musts", "minor musts" and

"recommendations". As regards "major musts", a 100% of compliance is required, while for "minor musts" it is 95%. The "recommendations" do not require a minimum percentage.

In total, there are 214 control points and compliance criteria of the GlobalGAP certificate. They are categorized as major musts which represent 23%, minor musts 46% and recommended 31%. Within the highlighted compliance points classified as major musts are crop protection with 31% and production handling with 24%. The item crop protection is also a control target in the minor musts category with 43%, followed by fertilizer use with 15% and finally, both produce production handling and worker health, safety and welfare with 14% each. Recommendations emphasize fertilizer use with 23% compliance points, worker health, safety and welfare with 14% and environmental issues with 12% (Table 5.7).

Table 5.7: Summary of GlobalGAP points of control and compliance criteria

Compliance and control points	Major Musts	Minor Musts	Recom.	Total
Traceability	1	0	0	1
Record keeping and internal self-inspection	3	1	0	4
Varieties and rootstocks	1	6	4	11
Site history and site management	3	1	1	5
Soil and substract management	1	3	6	10
Fertiliser use	2	15	4	21
Irrigation/fertigation	1	0	15	16
Crop protection	15	43	6	64
Harvesting	6	1	2	9
Production handling	12	14	5	31
Waste and pollution management, recycling and re-use	0	0	6	6
Worker health, safety and welfare	2	14	9	25
Environmental issues	0	1	8	9
Complaint form	2	0	0	2
Total	49	99	66	214

Source: Own compilation based on EurepGAP checklist (2004)

The same requirements cited above were grouped into three sets: the first one refers to all stages related to crop management (soil, fertilizer, varieties, etc); the second includes after harvesting and production handling and the third comprehends the remaining points such as traceability, environmental issues, book keeping, worker health, safety and welfare. According to the compilation, nearly 60% of the three categories of compliance relate to the crop management;

within this, minor musts requirements sum 46% of the total, 31% are recommendations and finally 30% are major musts (Figure 5.3).

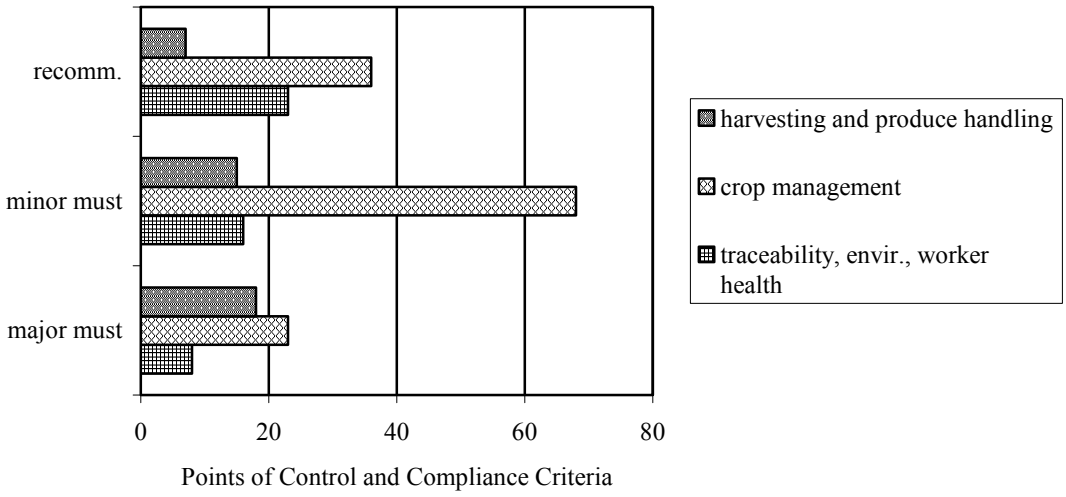

Figure 5.3: Summary of GlobalGAP requirements

Source: Own compilation based on EurepGAP checklist (2004)

5.2.2.3 Certifying steps and monitoring

GlobalGAP (2007b) highlights that the standard requirements have to be applied equally around the world. Due to structural reasons small-scale farmers often face more difficulties to meet the requirements to the same extent as medium and large producers. As a result the small-scale farmers are at risk of missing out market access. GlobalGAP has, therefore, implemented group certification to facilitate market access for small-scale farmers. Group certification implies that smallholders form a group and obtain a certification together. It allows the farmers to significantly reduce certification costs such as inspection charges and overhead costs. In addition, since many requirements necessary for GlobalGAP certification can be centralized (e.g. pesticide controls), farmer groups can benefit from the scale effects. Group structures are also an easier way to provide farmers with advice regarding the implementation of the standard. The monitoring is done twice a year. The farmer is aware about the time of the first visit, while the second one takes place without informing. The certificate is valid for 12 months.

5.2.2.4 Benchmarking among GlobalGAP and other schemes

Initially, individual supermarkets had developed their own systems and labels. For example, in the UK, Tesco has developed "Tesco's Nature's Choice," and Marks & Spencer created the "Farm to Fork" label. As a result, the various companies' codes of practice became increasingly confusing, and the multiple inspections were costly and time-consuming. In response, firms have organized collective action to formulate and apply joint or industry-wide protocols embodying the core elements of GAP, Good Manufacturing Practices (GMP), and HACCP. In doing so, they hoped to reduce problems created by having a plethora of industry standards. EurepGAP has been one prominent initiative as such at the level of primary production which developed into GlobalGAP later on.

Jahn, Schramm & Spiller (2004b) argue that a wide variety of certification systems lead to increasing transaction costs. Therefore, they recommend an international benchmarking and the harmonization of standards. Retailers in particular introduced umbrella organizations to ensure the same quality level for all their products independent of the country of origin. GlobalGAP has developed certain benchmark procedures. Recently, the Belgian, Dutch, Danish and German meat sector has founded the "European Meat Alliance" to create common standards.

On the contrary, as highlighted by WTO (2005:26), "harmonization to international standards is not always desirable, as it reduces product variety. Besides, it may not always be easy to agree on a global standard as local standards are often the outcome of specific technical requirements of domestic producers as well as the reflection of social values in a society".

The benchmarking process is based on existing national or regional farm assurance schemes recognized as an equivalent to GlobalGAP. Examples of benchmarking processes can be seen in South and Central America, Africa, and Asia, most recently in Japan and Thailand [such as ChileGAP, ChinaGAP, KenyaGAP, MexicoGAP, JGAP (Japan) and ThaiGAP]. They are backed by national governments, retailers, producers and exporters. The figures presented by GlobalGAP (2007b) show that worldwide 11 processes of benchmarking between a national certification scheme and GlobalGAP of fruit and vegetables as well as flowers have already been approved, 6 cases are provisionally approved and 7 cases are in process.

Garbutt & Coetzer (2005) explain in their paper that the GlobalGAP certification system tries to set the benchmark for the procedure and the importance of harmonizing different private sectors.

The GlobalGAP certification system also tries to guarantee food assurance standards on a global level. The benchmarking process consists of a multi-staged process: (i) application; (ii) the technical review process (preliminary technical review, peer review, independent technical review, independent witness assessment, technical and standards committee review) and (iii) formal recognition of applicant's standards.

In a discussion by Espanion et al. (2005), benchmarking between GlobalGAP and PIF systems for fruits and vegetables in Brazil was mentioned. The authors pointed out some equivalence between PIF and GlobalGAP such as the guarantee of food safety, traceability, and the use of pesticides registered in the exporting or importing country as well as safety of the worker. While PIF shows the details of each product, for example, color of the fruit, size, level of sugar, pH, texture, etc. GlobalGAP represents generic requirements for fruits and vegetables, meat, seeds, etc. The attempt of the Ministry of Agriculture, Livestock and Food Supply to benchmark is still ongoing.

5.2.3 Fairtrade

5.2.3.1 Definition and objectives

The Fairtrade Labeling Organization (FLO) was created in 1997. It is recognized as a non-profit organization which offers the development of standards that benefit small farmers and their employees and also promote sustainable production as well as guarantee fair prices and an extra premium. Besides the minimum requirements, FLO expects that producers continuously improve the working conditions, increase the environmental sustainability and also invest in human capital. Furthermore, FLO supports producers with information regarding new business and market opportunities. Apart from fruits and vegetables, the range of products to which FLO is applied includes tea, coffee, cocoa, honey, juices, wine grapes, dried fruits, nuts and spices and non-food products such as flowers and plants, sports balls and cotton seed (FLO, 2006:3-5).

According to FLO (2007a), Fairtrade requires fair and transparent trading conditions concerning prices, payment and quality procedures. The standards require that all products sold with the Fairtrade label must be produced by certified producers. Considering prices and price premium, the buyers shall pay the producers' organizations at least the minimum Fairtrade price set by FLO. Producers and buyers should have a contract establishing the volume, quality, price and payment conditions. The payment requirement is for example that 50% of the price should be paid at the

moment the product is delivered and the payment of the rest should follow 48 hours after receiving the product.

5.2.3.2 Description of the requirements

According to FLO (2007) the total number of requirements is 105, 55 being considered as "minimum" (or 52%) and 50 considered as "progress" (48%). The "minimum" must be achieved by all producers, while with respect to the "progress requirements", permanent improvement must be visible as documented through a yearly report by the producer organizations. FLO tries to ensure that fair trade benefits are reaching small farmers and small producers' organizations which have potential for development.

In addition, FLO requires that these organizations should always follow the national legislation and in case of standards being higher than those issued by FLO, the former ones should prevail. The standards applied to small producers' organizations are divided into four sections: social development, economic development, environmental development, and standards on labor conditions (Table 5.8).

The first section considers social aspects such as democracy, participation, transparency and non-discrimination, among others. In the economic development part, the concerns are about the premium, the ability to export and the organizational improvements. The environmental part focuses on the assessment, planning and monitoring based on an environmental plan, with each producer being responsible for ensuring his/her compliance. Thus, the maintenance of protected areas, the sustainability of native species, the improvement of the environmental and agricultural practices should be planned and reported. The concern is extended to the conservation of fauna and flora and to water management issues. The details about the use and non-use of agrochemicals are well defined. Recycling materials, fire, soil management and non-use of Genetically Modified Organisms (GMO) deserve some attention in the analysis. The last section sets the standards on labor conditions according to International Labor Organization (ILO) Conventions.

Table 5.8: Description of the Fairtrade requirements

	Minimum	Progress
Social development		
Fairtrade adds development potential	1	1
Members are small producers	2	1
Democracy, participation and transparency	4	6
Non-discrimination	1	1
Economic development		
Fairtrade price premium	2	1
Export ability	6	1
Economic strengthening of the organization	2	0
Environmental development		
Impact assessment, planning and monitoring	11	0
Agrochemicals	7	10
Waste	0	6
Soil and water	6	0
Fire	0	3
Genetically Modified Organisms (GMO)	1	3
Standards on labor conditions		
Forced labor and child labor	5	0
Freedom of association and collective bargaining	3	4
Conditions of employment	2	7
Occupational health and safety	2	6
Total	55	50

Source: Own compilation based on FLO (2007)

An overview of the four sections is presented in Figure 5.4. There is higher emphasis on environmental development issues (45% of the minimum and 44% of the progress requirements) and standards on labor conditions (22% and 34%, respectively).

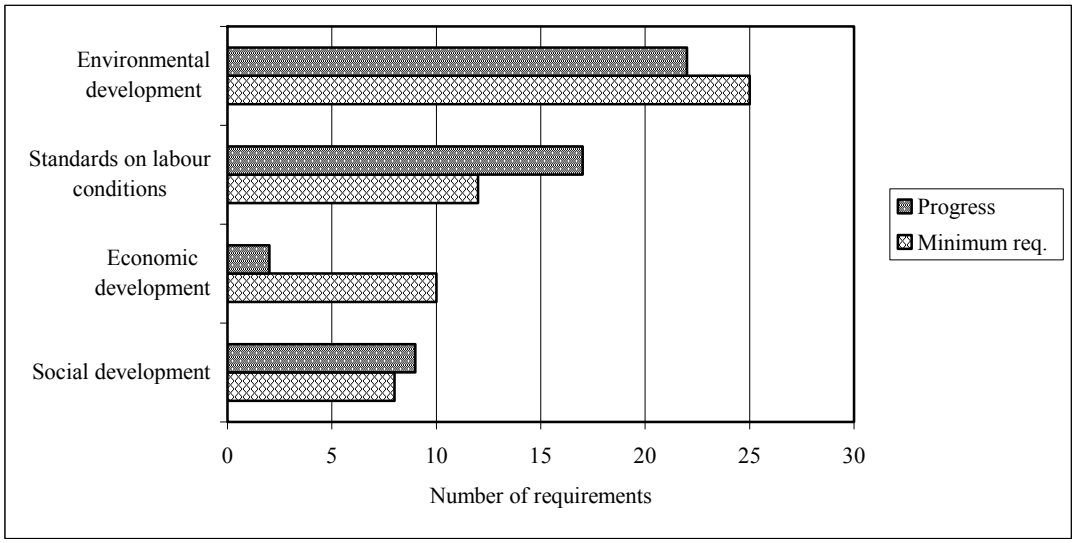

Figure 5.4: Summary of Fairtrade requirements

Source: Own compilation based on FLO (2007)

5.2.3.3 Steps to acquire certification and monitoring

Fairtrade certification is accomplished by an international certification company, the FLO-CERT GMBH, in more than 70 countries (FLO, 2006; FLO-CERT, 2007). The steps to be followed for certification can be divided into: application, initial inspection, evaluation, acquiring certification and after certification.

The application process begins with filling the application form. The purpose is to provide some information and clarify the rules of FLO. Afterwards the inspection takes place in order to evaluate the compliance of the producer or trader with the relevant Fairtrade standards. In a next step, the correction of the earlier non-conformities is evaluated. Once all of them are fixed, the organization issues a one-year period certificate. Before the end of a certification cycle, a renewal inspection is done in order to verify the compliance with the standards.

5.2.4 Organic certification

5.2.4.1 Definition and requirements

According to IFOAM (2007), organic standards have long been used to create an agreement within organic agriculture about what an "organic" claim on a product means, and to some extent, to inform consumers about it. Certification is a voluntary activity, although the market began to

demand it for sales transactions. The Organic Guarantee System (OGS) Commitee is designed to facilitate the development of organic standards as well as to provide an international guarantee. It unites the organic world through a common system of standards, verification, and market identity. Furthermore, organic certification is a procedure to verify that the production process conforms to certain standards. In other words, certification is primarily an acknowledgement that these products have been produced according to organic standards.

Table 5.9 presents the summary of organic requirements according to IFOAM (2008). They are divided in (i) organic system, (ii) type of production (plant and crop production and genetically modified organisms); (iii) processing and handling; (iv) labeling; and (v) social justice. The 70 organic agriculture's requirements are classified in "required" and "prohibited" standards. The requirements on the sections which address more attention are crop production and processing/handling with 14 or 25% of the required standards for each of them. However, processing/handling also has 7 of the requirements classified as prohibited. The requirements on the sections GMO, labeling and social justice are fewer.

Table 5.9: Description of the organic requirements

	Required	Prohibited
Organic system		
Ecosystem management and biodiversity	2	1
Resource management	6	0
Collection of wild products	3	1
Plant production and animal husbandry		
Conversion requirements	2	0
Conversion for plant production	1	0
Split production and parallel production	2	0
Maintenance of organic management	1	0
Avoiding contamination	3	0
Crop production		
Seed, propagation material and seedlings	3	0
Soil convervation and crop rotation	3	0
Management of soil fertility	5	2
Pest, disease, weed and growth management	3	0
Processing/handling		
Principles	5	0
Ingredients and processing aids	2	2
Processing methods	1	4
Packaging and containers	1	1
Cleaning, disinfecting, sanitizing processing facilities	3	0
Pest and disease control	2	0
Genetically Modified Organisms (GMO)	2	0
Labeling	4	0
Social justice	3	2
Total	57	13

Source: Own compilation based on IFOAM (2008)

Regarding ecosystem and biodiversity principles, IFOAM (2008) notes that organic standards must ensure firstly that the biodiversity is maintained or enhanced on the farm holding on crop and/or non-crop habitats. Secondly, socially significant elements of the landscape on the farm holding such as historic features or sacred sites must be preserved. The principle applied to resource management relates to a set of requirements that standards have to meet, such as:

- crop production, livestock production, processing and handling systems employ measures to reduce or recycle residual materials;

- measures are employed to prevent land degradation;
- management systems ensure that water resources are used sustainably;
- measures are employed to prevent pollution and preserve water quality;
- the living soil is maintained and improved; and
- land preparation by burning vegetation is restricted.

The conversion of a plant production system takes at least 12 months. The objective is to establish a suitable period of organic management prior to the organic status of a crop, during which contaminants are reduced and healthy soils and sustainable ecosystems are being established. The organic management aims at sustaining production at all production stages in order to ensure that organic practices are implemented along the entire production chain from propagation to the final product including the production of seeds and propagation materials. Further, organic crop production sustains and enhances the health of the soil and ecosystem. The management of soil fertility requires the enhancing of the soil-ecosystem by incorporating green manure and other biodegradable inputs. The substances used are on the IFOAM Indicative List of Substances for Organic Production and Processing. The prohibited practices refer to the use of synthetic nitrogen fertilizers, phosphates and sodium nitrate as well as producing crops in hydroponics systems (IFOAM, 2008).

The standards on processing and handling require that risks of product contamination and environmental pollution are identified and minimized, transparency and traceability in the organic processing chain are guaranteed, and measures are taken to prevent co-mingling of organic products with non-organic products in processing, packing, storage, and transport. A product labeled as organic or in-conversion should comply with the applicable organic standards where 95 to 100% of the ingredients are organic. The labels identify the person or company responsible for the product and the body that assures conformity to the applicable organic standard (IFOAM, 2008).

Organic agriculture has a social policy that is in accordance with the International Labor Organization's (ILO) conditions; employees and contracted workers have the freedom to associate, to organize, to bargain collectively, to have equal opportunities, are not discriminated and are guaranteed human rights and fair working conditions (IFOAM, 2008).

5.2.4.2 Procedure to certify and monitoring

According to FAO (2001) producers and exporters of organic fruits and vegetables seeking to sell their products under the organic label in developed countries have to obtain organic certification. This can be done by the certification bodies of the countries targeted for export, or by other foreign certification bodies, or under a partnership agreement between these two types of certification bodies. To date, relatively few developing countries have certification bodies within their borders, although the situation is changing.

In Brazil, according to the Organic Planet (2007), there are 18 certifying companies able to certify organic products such as fruits, vegetables, dairy products, sugar, poultry, coffee and grains. The Institute of Biodynamic Certification Association (IBD) is one of the companies which deals with the certification and control of organic and biodynamic production. According to this company, the certification procedures involve, apart from other requirements, a process to convert the land lasting from 2 to 3 years. This process is accompanied by extension workers who inspect the land and guide the producers during all stages. The monitoring is done once a year (IBD, 2007).

5.2.5 Summary

This chapter presents a detailed review of the PIF, GlobalGAP, Fairtrade and organic certification schemes. Farmers have a certificate assured for 12 months. The monitoring occurs three times a year for PIF certified farmers, twice for GlobalGAP and once for organic and Fairtrade ones. Particularly, farmers with PIF certification have to comply with 115 requirements. In order to acquire GlobalGAP certification, farmers have to comply with 214 requirements. A comparison of the compliance points of PIF and GlobalGAP reveals that PIF has 85 of the total requirements set as mandatory or with some restrictions, while GlobalGAP has 148 major and minor musts. Most of the requirements from GlobalGAP are inclusive in PIF, but differences exist with respect to their level of importance and distribution over various stages. PIF focuses with 57 of the total requirements on the crop management compared to 128 of GlobalGAP. In both cases, the second major stage is the post-harvesting process and related issues. Additionally, it has been found that farmers with GlobalGAP certification utilize the book keeping provided by PIF, although GlobalGAP itself does not require any book keeping. It means that the process to certify with GlobalGAP becomes easier and faster when the farmer has already PIF. PIF provides through normatives, specific procedures with regard to plant management and post-harvesting for each

type of fruit. GlobalGAP in contrast presents overall requirements to be applied for all fruits and vegetables, not observing their different characteristics.

The analysis of the Fairtrade requirements reveals that it focuses on small producers' organizations. All producers must achieve 55 out of the 105 of the requirements. Considering both types of requirements, minimum and progress, it was found that the stage which receives most attention is the environmental part with 48 requirements, followed by the labor conditions with 29. Fairtrade certification does not have its own book keeping. It focuses more on the overall process instead of on particular characteristics and procedures of the production system. It guarantees a minimum price premium for farmers, in contrast to other certification systems.

An analysis of the organic certification standards reveals that the program disposes requirements as required (total of 57 out of 70) and prohibited (total of 13) but does not specify their level of compliance. In addition, the requirements are not directed to any kind of product or crop in particular. Major emphasis is put on the production system. Organic certification does not include any book keeping obligation.

5.3 Third country standards affecting Brazilian fruits exports

Apart from certification, selected food standards and regulations from other countries affect Brazilian fruits exports. The following section presents a description of regulations from the European Union and the United State, the two major export markets of Brazilian fruits.

Access to markets in the European Union depends on meeting a variety of regulations. The extent of regulation and its complexity has increased significantly in the last decade. The European Union fruit standards were regulated first in 1972. Regulation (EEC) 1035/72 specifies the size, color, and caliber and other quality requirements of fruits and vegetables. In 1990, the Council Directive (EEC) 90/642 determined the maximum residue levels (MRL) of pesticide products and its requirements for traceability to this sector.

Furthermore, the Regulation (EC) 466/2001 sets the maximum levels for certain contaminants in foodstuffs. In 2004, the Regulation (EC) 852/2004 presented the general rules on the hygiene of foodstuffs including the procedures for verification and compliance. The main objective is to ensure a high level of consumer protection with regard to food safety along the chain. In 2005, the Regulation (EC) 2073/2005 on microbiological criteria for foodstuffs included precautionary measures. Additionally, the Regulation (EC) 396/2005 established new maximum residue levels of

pesticides in food, plant and animal origin products. The Regulation (EC) 178/2002 sets the general principles and requirements of EU food law related to all stages of production, processing and distribution (complemented by Regulation 882/2004). Many regulations had been also created specifically for fruits and vegetables. Regarding specifically watermelons e.g., the Regulation (EC) 1862/2004 sets the respective marketing standards, while the Regulation (EC) 2789/1999 sets them for grapes.

The Regulation EC (834/2007) establishes a set of objectives, principles and basic rules for organic production as well as a permanent importing regime and consistent controlling for organic products. For instance, food will be only able to carry the EU organic logo if at least 95% of the ingredients are organic. FAO (2001) highlights that organic fruits and vegetables exported to the European Community, Japan or the United States must meet import requirements relating to size, grade, quality and maturity. A certificate based on an inspection must be issued by the country's relevant authority to indicate compliance with standards.

Similarly to the EU, also the US has certain regulations which affect exports of fruits from Brazil. According to the United States Department of Agriculture (USDA), quality standards are based on measurable attributes that describe the value of the product. Standards for each product describe the entire range of quality requirements for a product, and the number of grades varies by commodity. For example, USDA defines the standards related to grading, level and application of pesticides, maturity requirements and packing for table grapes for mangoes (USDA, 2007).

To be accepted as a potential exporter, the area where melon is harvested must be free of the *anastrepha grandis*, which is a type of tropical fruit fly. Only in 2002 (Decree N. 16245) some municipalities in the Rio Grande do Norte and Ceará states were considered as fruit fly free area. According to APHIS (2008), the United States Department of Agriculture, Animal and Plant Health Inspection Service has to ensure that all consignments of melons from Brazil to the US are accompanied by a phytosanitary certificate issued by a Brazilian National Plant Protection Organization that includes a declaration indicating that the fruit was grown in such a free area. In response to this law, COEX [11] was created in 1990 in the Rio Grande do Norte state. In addition, quarantine treatment by immersion in hot water is used for fruits that are hosts of tropical fruit flies. This also applies to Brazilian mangoes for example (APHIS, 2001).

[11] The interview took place at COEX, on 11/12/2006.

6 Data analysis of the fruit sectors

This chapter analyzes the primary data deriving from the field survey. In the descriptive statistics, the producers have been divided by type of fruit, namely mango and grapes producers, cashew nut producers, and melon producers. The objective is to first assess the differences and similarities among certified, non-certified and those farmers who are in process to obtain certification. Section 6.2 then presents some econometric results.

6.1 Descriptive statistics of the survey

In the first group, the mango and grapes producers, a total of 155 surveyed farmers (51%) have no certification, those in process comprise 94 (31%) and those who are already certified comprise 54 (18%). Further, the analysis on the cashew nuts considers small producers without certification as one group (70% or 60 producers) and small producers with certification as another (30% or 25 producers). Finally, the results from six interviews with melon farmers, labeled as cases A-F, are discussed. While the first three cases A, B and C relate to non-certified farmers, D, E and F refer to certified ones.

The descriptive statistics based on the survey are presented in the following separately for each type of fruit. It is structured according to the (a) socio-economic factors, (b) farm characteristics, (c) investments done on the farms and certification costs, (d) benefits of certification, (e) availability of information, and (f) farmers' expectation about the future.

6.1.1 Socio-economic factors

Mango and grapes

The survey collected data regarding socio-economic characteristics of mango and grapes producers, including age, gender and level of education. With respect to age, it was found that the producers are on average 49 years old. It was expected that the ones who have adopted certification would be younger than the non-certified producers since they might be more open to new technologies or practices (D'Souza et al., 1993). However, there is hardly a difference between the two groups: certified producers were on average 48.8, while non-certified ones were 50.5 years old. Thus, the expected result is not supported by the data. Similarly, it was expected, that producers who are certified would have more years of schooling and long-term experiences in growing fruits than the non-certified ones. However, the results show that on average certified and non-certified producers have both 7.7 years of schooling. The farmers in process have the highest

level of education with 10.2 years of schooling. The figures on the years of experiences show that certified producers have on average 7.3 years of experience in grapes and 9.2 years in mango production while the non-certified producers have only 5 years and 7 years, respectively. While the years of schooling do not seem to influence the decision to adopt certification, the years of experience do.

The data show that mango and grapes were the main source of income for 91% of the certified producers, for 80% of the producers in process, and for 75% of the non-certified producers. Apart from producing mangoes and grapes, farmers are also involved in the production of other tropical fruits such as coconuts, guava, melons, banana and papaya (15% of non-certified producers and 2% of certified ones). This result reflects the high dependence of the producers on fruits in general, but also indicates a stronger trend towards specialization for certified producers.

Cashew nuts

Data on the importance of the cashew nuts production shows that for 18% of the non-certified producers and 32% of the certified producers, cashew nuts production is the main source of income. This also indicates that certified farmers are more specialized than non-certified ones. Apart from producing cashew nuts, farmers are also involved in other activities such as off-farm activities (32% and 4% for non-certified and certified producers, respectively), in other agriculture activities (4% and 44%), or they are retired (37% and 44%).

Certified cashew nuts producers are 57.3 years old on an average while non-certified ones are 43.3 years old. Regarding education, on average, certified producers have 7.3 years of schooling compared to 3.8 years in the case of non-certified farmers. Additionally, non-certified producers have 3.2 years of experience in producing cashew nuts on average, while the certified producers have only 1.2 years. This indicates that cashew nuts growing is a relatively new agricultural activity for all surveyed farmers.

6.1.2 Characteristics of the farms

Mango and grapes

A comparison of the mean values between the groups clearly indicates that certified mango and grapes farmers have much more land (100 ha and 93 ha) and more irrigated area (40 ha and 29 ha) compared to non-certified (Table 6.1). Indeed, an irrigation system is necessary for fruit production in the surveyed region. There are two types of irrigation systems: the drip and micro

sprinkler which are considered very sophisticated while furrow and conventional sprinkler are less sophisticated. The study reveals that most of the certified farmers use very sophisticated irrigation systems (83%). However, also a high percentage of the non-certified farmers have very sophisticated systems (59%).

The type of used irrigation system plays an important role with respect to the productivity of the farm. The results show that mango yields on average amount to 19.3 tons per ha for non-certified producers, 20.5 tons per ha for producers in process, and 25.9 tons per ha for certified producers. Concerning grapes, the productivity for non-certified producers is nearly 16.3 tons per ha, while for those in process and for the certified ones, 18 and 23 tons per ha are achieved. Thus, certified farmers achieve in the given sample higher yields than non-certified ones. But they also have relatively higher net income. Regarding the average net income of grapes farmers, it was found to be around R$12,700[12] per ha for non-certified farmers, R$15,850 for those in process and R$20,150 for the certified ones. Concerning mango farmers, the average net income is approximately R$9,000 for non-certified farmers, R$8,300 for those in process and R$10,100 per ha for the certified ones[13].

[12] 1US$ = R$2 at the time of data collection
[13] The total income refers to the fruit production only, however other income sources were found to be negligible.

Table 6.1: Farm characteristics of mango and grapes farmers

Variables	Non-certified N=155		Producers in process N=94		Certified N=54		
	Mean	Std. deviation	Mean	Std. deviation	Mean	Std. deviation	Ch², t test
Mango							
Land size (ha)	20.0	66.8	18.2	27.2	101.0	299.1	0.003***
Irrigated area (ha)	10.3	10.1	11.7	21.8	39.8	86.1	0.000***
Yield (tons per ha)	19.3	8.9	20.4	9.3	25.9	9.6	0.003***
Total income (R$)	125,263	187,526	141,236	219,134	1,215,991	3,434,017	0.000***
Income (R$/ha)	17,050	21,095	8,325	5,839	10,076	8,960	0.000***
Production costs (R$)	58,314	79,995	62,831	98,081	463,108	1,279,293	0.000***
Costs (R$/ha)	7,965	3,601	7,631	3,897	11,814	4,390	0.000***
Total net income (R$)	67,048	123,327	78,405	124,005	752,882	2,171,144	0.327
Net income (R$/ha)	9,085	21,095	8,325	5,839	10,076	8,960	0.887
Grapes							
Land size (ha)	34.7	113.5	8.2	3.1	93.5	304.9	0.194
Irrigated area (ha)	14.4	35.6	6.3	4.1	28.9	77.1	0.198
Yield (tons per ha)	16.3	10.5	17.9	7.9	22.9	8.5	0.014***
Total income (R$)	188,878	450,182	348,396	269,089	606,227	861,867	0.006***
Income (R$/ha)	28,947	20,279	31,513	13,917	42,748	21,177	0.016***
Production costs (R$)	89,279	156,313	160,348	110,438	324,250	485,235	0.083***
Costs (R$/ha)	16,249	8,779	15,666	7,222	22,612	10,049	0.005***
Total net income (R$)	99,598	297,713	188,048	161,734	281,977	456,505	0.012***
Net income (R$/ha)	12,698	14,129	15,847	8,788	20,145	15,288	0.085***

*** Statistically significant at 1% level;** at 5% level; * at 10% level

Source: Own compilation

Cashew nuts

The total land size and the area occupied with cashew nut trees show that certified farmers have more land (53 ha) and a larger area covered with cashew nut trees (29 ha) than non-certified ones. Irrigation is not used for cashew nut production in the surveyed region. Farmers rely on rainfall and on ground water instead.

With regard to cashew nuts, the productivity in 2005 is, on average, 253 kg/ha and 302 kg/ha for non-certified and certified producers, respectively. The productivity depends on the number of trees per ha, the type of tree, their age, rainfall (recommended above 600 mm), adequate management and the technology used. However, no further details on these factors are available from the survey. Since most surveyed cashew nut farmers are not aware of their production cost, a further analysis on total cost and total net income is not available. Instead, the total income is calculated using the price received and the volume sold. The average income in 2005 is around R$2,033 for non-certified and R$7,886 for certified producers. Thus, also for certified cashew nuts growers, the yields and net income are relatively higher.

Melon

Comparing certified and non-certified growers of melons, it is found that the certified ones have more land allocated to this fruit, have a higher productivity and more years of experience in the field. All surveyed producers harvest the Yellow type of melon and some Piel del Sapo, both considered as common varieties. Certified growers plant additionally other varieties classified as nobles[14]. Taking into consideration the soil and climatic conditions, a drip irrigation system is needed for a successful production.

Since the production of melons is very capital intensive, with investments per ha ranging between R$11,000 to R$ 15,000 per ha, the trading company or importer provide a certain percentage of the value required to finance a portion for the coming harvesting year to the producer in advance. Alternatively, it is found that the producer invests his or her own resources. This was the case for one non-certified producer; two certified producers indicated that they financed 90% and 70%, respectively from their own financial resources. A third possibility refers to taking loans from commercial banks, however, this is considered as the last and not favored option due to the high

[14] Cantaloupe, Orange Flesh and Galia.

rates of interest. Only two producers indicated that they took very small amount of loans from the bank.

6.1.3 Investments and certification costs

Mango and grapes

Farmers have to invest on their farms in order to qualify for certain certification schemes. All producers pointed out the new infrastructure and reconstruction on their farms in 2005 and their estimated amount in Reais which arose due to certification. In order to make the analysis easier, the items were categorized into four groups (Table 6.2):

i) group 1: machines, tractors and spraying equipments;

ii) group 2: deposits for empty packages, tools, agro-chemicals, fertilizer, agro-chemical mixture room and water station;

iii) group 3: office building, computers, house for the caretakers, lodgings for employees, kitchen, toilettes and signaling plates, and

iv) group 4: sheds for packing, cold storage and packing houses.

It is observed that producers with certification have done more investments in new infrastructure on their farms: investments related to group 2 and group 4 had a mean value of around R$48,000 and R$45,000, as opposed to only very minor investments done by non-certified ones. The mean values spent on reconstruction were low. The results indicate that most of the certified farmers have invested on their farms in new infrastructure rather than on reconstruction in order to meet the certification requirements.

The last analysis refers to the cost of the certification which includes the yearly cost of monitoring and renewal of the certificate, paid to the certifying agency. Besides, there are costs associated with the tests of agro-toxic residues, water, soil and leaves. For the producers who belong to different certification schemes, it is not possible to differentiate between values spent on the individual schemes. Partly, this is due to the problem that the same infrastructure is used for different types of certification schemes. The results show that overall, farmers paid yearly R$1,000 for certification. The yearly costs of the tests are quite similar for certified farmers.

Table 6.2: Cost of new infrastructure, reconstruction and tests for mango and grapes farmers

Description of the variables	Producers			Chi²,t test
	Non-cert.	Process	Certif.	Sig.
Investments due to certification				
Group 1 (mean value in R$ in 2005)	568	0.0	12,555	0.000***
Group 2 (mean value in R$ in 2005)	367	3,465	47,575	0.067*
Group 3 (mean value in R$ in 2005)	684	2,990	16,313	0.009***
Group 4 (mean value in R$ in 2005)	167	1,478	44,962	0.001***
Cost of certification	0.0	33	1,093	0.000***
Tests	74	72	646	0.000***
Certified [n=54]; in process [94] and non-certified producers [n=155]				
*** Statistically significant at 1% level;** at 5% level; * at 10% level				

Source: Own compilation

It was investigated whether producers with certification invest a higher amount of their own resources than producers without certification. The average amount invested on their farms in 2005 by mango and grapes certified producers was R$143,000 compared to R$45,900 by producers without certification and R$43,900 by those who are in process. However, it must be considered that the farms of the certified farmers are relatively large.

Cashew nuts

Certified cashew nuts farmers invested in 2005 R$852, compared to R$107 by producers without certification. These results show that certified farmers generally invest more but at a very low level. Unlike the investments done in infrastructure and reconstruction in the grapes and mango sectors, the cashew nuts sector requires a basic infrastructure. The total amount spent by all cashew nuts producers in new infrastructures was R$37,300 and R$7,100 in reconstruction. For the certification, the certified farmers indicated that they do not pay anything. Since the certified producers are members of the cooperative, the organic certificate is assured by the group and not individually. The monitoring is done once a year, but farmers are not aware of the cost. Further, none of the producers, whether certified or not, have tested water, soil, leaves or conducted any other kind of test.

Melon

The estimated values on new infrastructure and reconstruction indicate that all certified farmers concentrated more on the latter. Comparing the amount invested, two of the certified farmers (Case D and E) are quite similar (R$60,000 or R$500 per ha), while the third one (Case F)

presented a value of R$1,000,000 (R$555 per ha). Non-certified farmers plan to invest in their farms huge amounts: one plans to build a packing house estimated at R$1,000,000; the other two expect to invest around R$300,000 (R$1,500 per ha) and R$80,000 (R$615 per ha).

With respect to monitoring, the certified farmers mentioned that the certifying company which they are working with is a foreign one with a branch in Brazil. Monitoring vary between one to three times a year. It is interesting to note that one of the farmers faced three annual audits and paid R$15,000, while another paid an amount of R$11,300 for only one visit. The third certified farmer who indicated that he received 2 visits a year, paid only around R$6,000. Thus, there seem to be large differences with respect to the monitoring and the costs of certification.

6.1.4 Benefits of certification

Mango and grapes

All producers were asked to rank different favorable aspects of certification according to their importance. Looking individually at each group of producers, the analysis reveals that the major advantage is related to receiving a higher price. This was perceived by 100% of the certified, 82% of producers in process and 75% of the non-certified ones. Decreasing the production cost was mentioned by 89%, 61% and 35% of producers who are certified, those in process and those who are not certified respectively. To decrease the use of agro toxics and pesticides is mentioned by 89% of certified farmers, 66% of those in process and 33% by non-certified ones, as the third most favorable aspect of certification (Table 6.3).

Furthermore, it is interesting to compare the results of certified farmers' expectation of receiving a price premium with the actual price premium received. The survey reveals that almost all producers with certification received a price premium. Regarding the price received per fruit, the survey reveals that the certified group received R$0.83 per kg of mango and R$1.86 per kg of grapes, before certification and R$1.31 and R$2.40, respectively, after certification. This is equivalent to an increase of 58% and 28% for mango and grapes, respectively, due to certification. The price levels of the non-certified farmers are comparable with those the certified farmers received prior to certification.

Having certification also contributes towards environmentally-friendly production. The findings reveal that having an environmental plan and recycling empty agro toxic packages were the main

processes that have been used to maintain environment friendliness. Certified farmers are more likely to have an environmental plan (89%) and to recycle packages (83%).

Table 6.3: Benefits of certification in the case of mango and grapes

Description of the variables	Producers			Chi², t test
	Non-cert.	Process	Certif.	Sig.
Economic aspects				
Expectation of receiving price premium (in %)	74.8	81.9	100	0.000***
Price received per kg of mango before certifying (mean value in R$ in 2004)	0.8	0.7	0.83	0.750
Price received per kg of grapes before certifying (mean value in R$ in 2004)	1.5	1.7	1.8	0.208
Price received per kg of mango after certifying (mean value in R$ in 2005)	-	-	1.31	-
Price received per kg of grapes after certifying (mean value in R$ in 2005)	-	-	2.4	-
Environmental aspects				
To decrease the use of pesticides and agro-toxics (in %)	32.9	66.0	88.9	0.000***
To decrease the production cost (in %)	34.8	60.6	90.1	0.000***
To have an environmental plan (in %)	0.0	57.4	88.9	0.000***
To recycle empty agro-toxic packages (in %)	0.0	66.0	83.3	0.000***
Certified [n=54], in process [94] and non-certified producers [n=155]				
*** Statistically significant at 1% level;** at 5% level; * at 10% level				

Source: Own compilation

Cashew nuts

The analysis on the benefits of having certification reveals that the major advantage is related to food safety for 88% of the certified producers and 8% of the non-certified ones. Receiving a higher price was mentioned as a second benefit, and to decrease the environmental damages was indicated by 76% of certified producers and by 8% of non-certified ones.

Regarding the expectation of receiving price premia, the following is found: 92% of producers with certification and 58% of producers without certification have a positive expectation of receiving a price premium. Furthermore, nearly 88% of the certified producers have received a price premium. The price received per kg of cashew nuts before certifying was similar between the two sets of farmers, namely, around R$1.20, while the price received per kg of kernel was higher for certified farmers (R$7.11) compared to R$5.35 for non-certified ones. Hence, those farmers who decided to certify received an 82% higher price per kg of nuts and 62% per kg of kernel in 2005 (Table 6.4).

Furthermore, with respect to the environmental benefits, certified and non-certified producers mention the following main measures they have adopted to maintain environmental friendliness: having an environmental plan, avoiding burning, practicing adequate soil management, using less pesticides and agro-toxics on the trees and recycling the packages. Certified farmers concentrated more on avoiding burning on the farm (92%) compared to (71%) non-certified ones and having an adequate soil management (88%) and (10%), respectively. All certified farmers, but only 30% of the non-certified ones indicated that they use less pesticides and agro-toxics. Thus, the recycling of used agro-toxics packages was considered by only 32% of the certified farmers and 71% of the non-certified ones as an advantage. The findings on having an environmental plan were indicated by 96% and 90% of the certified and non-certified producers.

Table 6.4: Benefits of certification in the case of cashew nuts

Description of the variables	Producers		Chi², t test
	Cert.	Non-cert.	Sig.
Economic aspects			
Positive expectation of receiving a price premium (in %)	92.0	58.3	0.002***
Price received per kg nuts before certifying (mean value in R$ in 2004)	1.26	1.21	0.750
Price received per kg kernel before cert. (mean value in R$ in 2004)	7.11	5.35	0.094*
Price received per kg nuts after certifying (mean value in R$ in 2005)	2.29	-	-
Price received per kg kernel after certifying (mean value in R$ in 2005)	11.51	-	-
Environmental aspects			
Avoiding burning on the farm (in %)	92.0	71.7	0.033**
Having an adequate soil management (in %)	88.0	10.0	0.000***
Use of less pesticides and agro-toxics (in %)	100.0	30.0	0.000***
Recycling used agro-toxics packages (in %)	32.0	71.7	0.001***
Having an environmental plan (in %)	96.0	90.0	0.332
Certified [n=25] and non-certified producers [n=60]			
*** Statistically significant at 1% level;** at 5% level; * at 10% level			

Source: Own compilation

Melon

Opposed to farmers without certification, producers with certification expected to receive a price premium, but this expectation was not met. Instead, the farmers mentioned that certification enabled them to remain in the market of fresh melons. One of the certified farmers (Case F) answered that the level of exports and the quality of his/her melons increased. The two remaining certified producers (Case D and E) expected to increase the planted area. Also, those farmers

without certification had a clear plan to increase the planted area and to obtain certification in the future. Besides, all certified farmers agreed that training courses and increased awareness about the certification requirements of the workers play an important role with regards to the benefits.

With respect to environmental benefits, two certified farmers (Case D and F) answered that they have an environmental plan, plant native vegetation and map fauna and flora species. Having a conservation area was mentioned by all farmers. Nevertheless, to maintain natural fences, to avoid burning, to minimize soil degradation and to recycle empty packages were mentioned by five farmers (except Case B) as advantages of certification.

According to the results, two certified farmers highlighted that the clients ask if the farm is certified with a certain scheme. From the perspective of the three farmers without certification, there is an increasing need for promoting and ensuring quality, safety and no residues in fruit production. This was perceived by the uncertified farmers, although they also indicate that domestic consumers do not seem to be concerned about their health or aware about the meaning of food safety. Thus, certification is expected to provide a control of the whole chain. The main challenge faced by all producers is the Normative N. 58 launched in 2006 by the Brazilian Ministry of Agriculture, Livestock and Food, which monitors agro toxics residues in fruits produced under the PIF system. More specifically, farmers who aim to export to the EU are obliged to have PIF certification.

6.1.5 Availability of information

Mango and grapes

Table 6.5 shows the main sources of information concerning certification. This information on certification refers to the year 2004 when most of the farmers were not certified yet and the process to certify was only starting in the survey region. Data on information sources were aggregated into three groups: (1) organizations - EMBRAPA, SEBRAE, CODEVASF; (2) social network[15], internet, TV; and (3) cooperatives, groups and associations. Some of the farmers mentioned more than one group as a source of information. Almost all interviewed producers indicated that they were informed about certification schemes from EMBRAPA, SEBRAE, or CODEVASF. Slightly over 50% of all producers indicated that they received information from cooperatives, groups and associations (Group 3); 44% of these adopted certification later on.

[15] Social network is characterized by interactions among people in the neighbourhood to communicate and share information.

About 25% of all farmers obtained information from a social network, internet or TV (Group 2), but most of these (17%) are not certified today. Thus, organizations which belong to the Group 1 play a significant role in providing information to the producers, but also Group 3 seems to influence farmers' decision on whether to adopt certification.

Additionally, 15% of non-certified and 11% of in process producers indicated that they have acquired knowledge and updated information mainly through brochures available from SEBRAE and EMBRAPA. Apart from the written material, 11% of each group - certified and in process producers - participated in training courses offered by both organizations. Even 16% non-certified farmers indicated that they participated but they did not adopt certification. EMBRAPA's role in research is considered as being important by 89% of the certified, 73% of those in process and 56% of non-certified farmers. But also CODEVASF is judged by most farmers as being very important in providing technical assistance and knowledge transfer. This opinion is shared by 82%, 67% and 93% of certified, non-certified and in process growers, respectively.

Table 6.5: Availability of information for mango and grapes farmers

Description of the variables	Producers			Chi², t test
	Non-cert.	Process	Certif	Sig.
Knowing about certification				
Group 1: EMBRAPA, SEBRAE, CODEVASF (in %)	98.9	89.7	90.7	0.020**
Group 2 : social network, internet, TV (in %)	16.8	7.4	1.8	0.004***
Group 3: cooperative, associations (in %)	4.5	3.2	44.4	0.000***
Acquiring knowledge				
Via brochures from both EMBRAPA and SEBRAE (in %)	15.5	10.6	0.0	0.008***
Via training courses from both EMBRAPA and SEBRAE (in %)	16.1	11.7	11.1	0.502
Via development of research from EMBRAPA (in %)	56.1	73.4	88.9	0.000***
Via technical assistance from CODEVASF (in %)	67.1	92.6	81.5	0.000***
Certified [n=54], in process [94], non-certified producers [n=155]				
*** Statistically significant at 1% level;** at 5% level; * at 10% level				

Source: Own compilation

Cashew nuts

Non-certified cashew nut farmers and those who are already certified were also asked to indicate the main source of information regarding certification (Table 6.6). With respect to the certified group, the question was again referred to 2004 when they were not certified yet. The results show that 88% of the certified producers received information from the social network, via internet or TV, while 88% of the non-certified growers were informed through cooperatives or buyers. In this

sector, group 1 organizations (EMBRAPA, SEBRAE) do not play any role. It is important to highlight that the information especially regarding the organic certification spread via the social network is mainly among the certified group, while the cooperatives try to provide information to producers who are not certified yet.

In contrast, in terms of knowledge transfer and updates, 32% and 48% of certified and non-certified farmers mentioned that the extension workers of SEBRAE and Institute of Technical Assistance and Rural Extension of Rio Grande do Norte (EMATER)[16] were the main source of information about organic certification. Brochures and training courses are stressed to be important for 40% of non-certified and 28% of those already certified, respectively.

Table 6.6: Availability of information for cashew nuts farmers

Description of the variables	Producers		Chi², t test
	Cert.	Non-cert.	Sig.
Knowing about certification schemes:			
Group 1: EMBRAPA, SEBRAE (in %)	1.2	3.2	0.014**
Group 2: social network, Internet, TV (in %)	88.0	0.0	0.000***
Group 3: cooperative, buyer (in %)	1.7	88.0	0.000***
Acquiring knowledge through			
Brochures from SEBRAE and EMATER (in %)	4.0	40.0	0.000***
Training courses offered by SEBRAE and EMATER (in %)	28.0	13.3	0.000***
Extension workers of SEBRAE and EMATER (in %)	31.7	48.0	0.098*
Certified [n=25] and non-certified producers [n=60]			
*** Statistically significant at 1% level;** at 5% level; * at 10% level			

Source: Own compilation

Melon

The high level of melon exports to different markets leads the certified farmers to have different certification schemes according to each buyer. According to the results, GlobalGAP was adopted by three farmers in 2002, 2003 and in 2005. However, PIF was only adopted in recent years. Melon farmers delay the adoption of PIF mainly due to its non-acceptance in the international market. Asking the non-certified farmers which certification program they would accept, they indicated that their choice would be GlobalGAP or PIF. One of the PIF certified farmers also intends to enter the Fair Trade market, BRC and UsGAP[17] certification schemes depending on the type of buyer. Furthermore, farmers revealed where they obtained information regarding

[16]EMATER provides training courses and consultancy to small and medium farmers
[17] Good Agricultural Practices (GAP) protocol aiming to access the US market.

standards. Five farmers mentioned that the main source of information was the buyer with whom they were trading. The updates are done basically through the certifying company and via internet.

6.1.6 Future expectation and perspectives

Mango and grapes

With respect to future expectations, all certified producers are likely to remain in the business in the long-run. About 90% of the certified producers, 85% of those in process and 53% of the non-certified ones indicated that they intent to export to other markets in the future. Around 33% of the certified producers aim to target Japan, 20% the US and 13% any markets to which they have access. Farmers in process mentioned the US with 38%, Europe with 18% and Japan with 19%.

Cashew nuts

Certified producers intend to remain in the business of producing nuts much longer than the non-certified ones. 100% of the certified producers are likely to remain in fruit production for an undetermined number of years and 66% of the non-certified ones as well. Farmers have no expectation to change the type of buyer or to upgrade to a more sophisticated marketing channel.

Melon

The surveyed melon producers also have positive future expectations. However, two uncertified farmers (Cases A and B) and one certified one (Case F) believe that certification schemes exclude the less capable growers from the market. The increasing level and number of requirements *per se* selects farmers who are able to comply with them. With respect to market changes, two certified farmers (Case D and E) intend to continue producing the same type of melon and dealing with the same clients in the future. Case F aims to conquer new markets and diversify the range of clients while Case B believes that once he or she is being certified he or she will be able to export directly to international markets. Finally, Case A together with other farmers plan to organize themselves and export as a group.

6.1.7 Summary

The findings reveal that certified mango, grapes and melon farmers are more specialized and highly dependent on the income obtained from these fruits and are more experienced compared to the others. Unertified cashew nuts growers are also engaged in other agricultural activities like livestock and beekeeping and are less experienced. With respect to the productivity and net income for mango, grapes, melon and cashew nuts, also higher figures are achieved by certified farmers.

Certified mango and grapes farmers clearly invested a higher amount of private resources on the farm compared to the two remaining groups. The investments on the cashew nuts farms out of private resources are generally low. In the case of melon farmers, it was found that farmers are either obtaining resources from buyers in advance or are investing own resources. Certified mango and grapes farmers had invested mainly in new infrastructure, while certified melon ones focused more on reconstruction.

The benefits of certification are also based on whether a higher price will be received. 100% of grapes and mangoes certified farmers expected to receive a higher price due to certification and they also received it. Analyzing the price receipt before and after certifying, it was found that farmers had a price increase of 58% per kg for mango and 28% per kg of grapes. Farmers who decided to certify received an 82% higher price per kg for nuts and 62% per kg for kernels in 2005. Melon producers with certification did not receive a price premium, but it enabled them to remain in the market.

For mango and grapes farmers, acquiring information on certification from organizations (SEBRAE, EMBRAPA and CODEVASF) play a significant role while the social network does not. However, the social network is important in providing information for cashew nuts farmers who finally adopted certification. Cashew nuts farmers who did not adopt were informed mainly through the cooperative and buyers. For melon farmers, the buyer was mentioned as the main source of information. Mango, grapes and cashew nuts farmers have the expectation to remain in the fruit business for a long time, but they intent to access additional or other markets in the future.

6.2 Econometric results

Section 6.2.1 presents the description of the variables, data used in the logistic regression and discusses the estimation procedure. Section 6.2.3 discusses the econometric estimates for the all fruits model, section 6.2.4 the econometric estimates for mango and grapes and lastly, section 6.2.5 presents the results on the cashew nuts model. A brief summary closes this sub-chapter.

6.2.1 Description of variables and data used in the logistic regression

This section presents the variables and data used in the econometric models. For the logistic regression model, explanatory variables need to be selected according to their relevance. The number and type of variables to be included vary depending on the objectives and hypotheses being tested, and sometimes by the limitations imposed by data availability. Generally the

explanatory variables cover characteristics of the producers, characteristics of their farms and trading relations. They include:

- ***Education***: more educated farmers are more likely to accept new ideas and adopt new production technologies. Education is expected to be positive and significantly associated with the adoption of certification (D'Souza et al., 1993; Niemeyer & Lombard, 2003);

- ***Gender***: adopters are more likely to be male because principal decisions on farming livelihood are usually delegated to or made by male counterparts [positive correlation];

- ***Manager***: having a manager to run a farm may indicate that there are better professional skills to manage the farm and thus, the likelihood increases;

- ***Level of specialization***: the high dependence on the income obtained through the harvest of a specific fruit may play a significant role in the decision. The decision of compliance with a certification scheme is expected to be positively correlated with this variable;

- ***Family members***: it is expected that more members of the family would carry on the activity. Therefore, the greater the amount of family members engaged, the higher the probability to certify. This would confirm the findings by D'Souza et al. (1993) that the use of hired labor on farms that adopted certification is likely to be less than on conventional farms;

- ***Living village:*** Analysis of the residence of the farmers, i.e., whether they live in the city, village or on the farm provides an indication of the potential engagement of the farmer put into farming. The long distance from the farm to the village or the existence of a social network may lead producers to decide not to live on the farm, but in the village instead. Also wealthier farmers are more likely to live in cities than less wealthier farmers;

- ***Non-agricultural income***: farmers who are engaged in other income-generating activities besides the cultivation of fruits, have lower chances to certify than those who are highly dependent on the income obtained by fruits;

- ***Type of irrigation system***: the level of technology of an irrigation system, whether it is less or more sophisticated may influence the decision-making positively. Luning et al. (2002:383) assumed that food quality is dependent on both dynamic properties of the food product and related to applied technological conditions;

- ***Size***: small-sized farms are expected to have a lower chance to certify. However, the chances to certify would increase if they would receive more support from government or do group certification. Thus, the outcome is ambiguous;

- ***Irrigated area***: the higher the proportion of the currently irrigated area towards the potential area to be irrigated, the greater is the probability of certification;

- ***Years of experience***: this study expects to find a positive correlation between years of experience and the decision to certify. The longer a farmer produces, the greater the chances to adopt certification.

- ***Variety***: the variety influences the productivity and consequently the level of income obtained from cashew nuts. It is expected that farmers who have the "dwarf" variety have lower productivity which would decrease the likelihood to certify;

- ***Trust_relat:*** the type of relationship between buyer and farmer is characterized by a trust-based type of contracts. The probability to certify may decrease or increase with this type of contractual arrangement, depending on whether the buye adopts certification or not;

- ***Years trading with a buyer***: if there is a long-term relationship between farmer and buyer, the buyer may more easily persuade the producer to adopt certification, because the farmer is more likely to follow the buyers' advice to certify. However, if the buyer has no incentive to trade with certified products, then the opposite is more likely to be the case.

The variables presented in this section were used to assess empirically the determinants that lead farmers to adopt certification. Four models are estimated: (i) all fruits, (ii) mango, (iii) grapes and (iv) cashew nuts. Appendix 6 summarizes the descriptive statistics for the variables included in the fruit model. Appendix 7 and Appendix 8 present the descriptive statistics for the binary variable in the mango and grapes models, and for cashew nuts, respectively. Table 6.7 presents the variables which are used in the logistic regression for the four models and their expected signs. Table 6.9, Table 6.10, Table 6.11 and Table 6.12 present logistic regression results (pseudo R-square, odds ratio, standard error, t-statistics, p values and 95% confidence intervals) for the all fruits model, mango, grapes and cashew nuts, respectively.

Table 6.7: List of variables for the econometric analysis

Variables	Description	Expected sign
Adopt_cert	=1 if producer adopts certification; 0= otherwise	
Explanatory variables		
Mango	=1 if farmer produces mango; 0= otherwise	+
Grapes	=1 if farmer produces grapes; 0= otherwise	+
Education	years of schooling	+
Gender	=1 if head is male; 0=otherwise	+
Family_HH	number of family members of the household	+
Manager	= if a manager is running the farm; 0= otherwise	+
Level_special	Level of specialization of the producer	+
Size	=1 if size of the farm is small; 0= otherwise	+/-
Non_agric_income	=1 if producer has income from non-agriculture sectors; 0= otherwise	-
Type_irrigation	=1 if type of irrigation used is micro sprinkler and drip; 0= otherwise	+
Irrigated_area	Share of current irrigated area towards the potential area to be irrigated	+
Living_village	=1 if producer lives in rural communities; 0= otherwise	+/-
Year_exper	Years of experience producing fruits	+
Variety	=1 if variety of cashew nuts is dwarf; 0=otherwise	-
Years trading with a buyer	Years trading with the buyer	+/-
Trust_relat	=1 if contract arrangements between buyer and producer is trust-based type of contract; 0= otherwise	+/-

Source: Own compilation

6.2.2 Estimation procedure

When having data, where endogeneity is a problem, consistent estimates can be obtained by suitably instrumenting the relevant variable using the Two-Stage Least Squares (2SLS) estimator. However, where endogeneity is not a significant problem, the Ordinary Least Squares estimator (OLS) is more efficient than instrumental variables. Thus both OLS and 2SLS are consistent if all variables are exogenous. Therefore, it is desirable to have a test for endogeneity of the variables 'main source of income' and 'productivity'- two variables where an endogeneity problem may exist - that shows whether 2SLS is necessary (Wooldridge, 2003).

A Hausman test (Hausman, 1978) was performed under the conventional production function framework. While the assumption is that the conventional model may be mis-specified relative to the decision making, it is nevertheless considered useful in providing a simplified basis for carrying out the necessary endogeneity tests. The endogeneity test was performed separately for the two variables 'main source of income' and 'productivity'. Table 6.8 shows the results. The Wu-Hausman F-test and the Durbin-Wu-Hausman Chi-sq test show the same results for the 'main source of income' and 'productivity' for the separate models. For the model *all fruits*, the variable 'productivity' reveals to be exogenous while 'main source of income' turns out to be endogenous. The instrumental variables tested for the former is 'share of irrigated area compared to the potential area', and for the latter is 'level of specialization' of the farmer. Similarly, productivity has shown to be exogenous also in the case of the mango and grapes models. The instrumental variables used were 'share of current irrigated area of potential' and 'irrigation system'. Thus, the first stage reveals that both variables are significant.

In the cashew nuts model, the results turn out exogenous when testing the variable 'number of crops' as an instrumental variable for 'if cashew nut is the main source of income'. However, the results are endogenous when testing with the variable 'other agricultural activities'. It means that the variable 'main source of income' is endogenous; hence the variable 'other agricultural activities' is highly correlated with the dependent variable.

In the regression analysis, the variable 'level of specialization' is included in the model and hence, the output has higher significance. With regard to 'productivity', the instrumental variable tested 'share of current area' was not significant. It indicates that 'productivity' is an exogenous variable. According to Franca & Gondim (1999), increasing the productivity of the cashew nuts is a *sine qua non* condition to ensure the sustainability of the chain. Although 'productivity' reveals to be an exogenous variable in all tests, a high correlation is found between this variable and 'manager' and 'size of the land is small' and the dependent variable[18].

[18] The procedure for the endogeneity tests in STATA provides the 2SLS estimation results at the same time. The Wu-Hausman F-test and the Durbin-Wu-Hausman Chi-square test are used to test the H_0 hypothesis that regressors are exogenous. The t-statistic is then computed to test whether the OLS estimates are significantly different from the 2SLS estimates.

Table 6.8: Tests of endogeneity 'productivity' and 'main source of income'

Variable	Wu-Hausman F-test		Durbin- Wu-Hausman Chi-sq test	
	F	P-value	Chi-square	P-value
Model: all fruits				
Productivity	0.00316	0.95521	0.00325	0.95453
Main source of income	3.68186	0.005576	3.76253	0.05241
Model: Mango and grapes				
Productivity	0.51616	0.47306	0.53834	0.46312
Model: cashew nuts				
Productivity	0.05610	0.81343	0.06451	0.79951
Main source of income	0.84354	0.36133	0.93426	0.33376

Source: Own calculation

To check for the collinearity problem, a sample estimation of the correlation between the explanatory variables in the models was carried out (see the correlation matrix in Appendices 6 to 9), showing significant correlation between some of the variables. The degree of multicollinearity can vary and have different effects on the model. When perfect collinearity occurs, i.e. when one independent variable is a perfect linear combination of the others, it is impossible to obtain an adequate estimate of regression coefficients with all the independent variables in the model.

If the correlation coefficient between any pair of explanatory variables is greater than 0.9 in absolute value, it is argued that it would serve as an indication of a strong linear relationship and cause potential bias to the analysis (Hill et al., 2001). None of the correlation coefficients is greater than 0.9. There are no formal criteria for determining the magnitude of correlation that cause poorly estimated coefficients.

Heteroscedasticity exists when the variances of all the observations are not the same, leading to consistent but inefficient parameter estimates. More importantly, the biases in estimated standard errors may lead to invalid inferences (White, 1980). Heteroscedasticity was detected when estimating the four models and was corrected using the robust standard error. The 'pwcorr test' displays all the pair wise correlation coefficients between the variables significant at the 5% level using the Bonferroni adjustment to calculate those significance levels (Baum, 2006).

Three post estimation tests were performed in order to check specification errors or omitted variables. The first post estimation test included the Hosmer-Lemeshow goodness-of-fit test which is obtained by calculating the Pearson chi-square statistic from the observed and expected

frequencies of binary responses (STATA, 2007). The second one refers to the model discrimination, assessed by examining the area under the Receiver Operating Characteristics (ROC) curve, which shows the likelihood that the predicted will be higher for observations where the outcome of interest is observed than for observations where the outcome is not observed (STATA, 2007).

The last test proceeded was the link test, which is used to detect a specification error. It is issued after running the logistic regression. The idea behind the test is that if the model is properly specified, one should not be able to find any additional predictors that are statistically significant except by chance. The test used the predicted values (_hat) and predicted value squared (_hatsq) as the predictors to rebuild the model. The variable '_hat' should be a statistically significant predictor, since it is the predicted value from the model, and '_hatsq' should not have much predicted power. However, when '_hatsq' is significant, it means that the model has relevant omitted variables (STATA, 2007).

6.2.3 Econometric estimates for the all fruits model

The adjusted Wald test for the model indicates that the model has good explanatory power at the 1% level. The R^2 is 0.09. A low R^2 is expected since an upper bound R^2 for binary-choice models is about 0.33 (Pindyck & Rubinfeld, 1981). The Hosmer-Lemeshow test shows that the model presents a good adequacy. The area under the ROC curve for the regression is 0.69 which reveals that the model presents adequate discrimination. The link test presents results according to the expectations: _hat is significant while _hatsq is not, meaning that the model does not have relevant omitted variables. The regression results for all fruits, which include mango, grapes and cashew nuts farmers are presented in Table 6.9 (see Appendix 9 for more details on the commands).

According to the findings, more educated producers are more likely to certify. The odds are 1.07 meaning that the chances increase by 7% as the producers have four more years of education. However, this result is not consistent with the results of Hattam & Holloway (2005) where their education variable was found to have a negative influence and, in their case does not have a significant result on the adoption decision of small-scale producers of avocado. Nevertheless, the results are in line with the findings of D'Souza et al. (1993) where farmers with at least a high school education have a 20% increase in the likelihood of adoption.

The variable "level of specialization" refers to the dependence on the income obtained by producing and harvesting specific fruits. Although the odds ratio is 0.91, the negative result shows that 9% of the farmers are less likely to certify if they are very specialized. One reason could be that farmers are also focusing on harvesting other fruits or to some extent are dependent on other sources of income, besides the agriculture sector. Carambas (2005) found that the variable "agriculture is the main source of income" which is similar to what was meant in this study by "level of specialization" is negative and insignificant.

The negative effect on the decision whether to certify increases by 55% at 1% level of significance if farmers are dependent on non-agricultural income. The results found are in line with those discussed by Hattam & Holloway (2005) who also found the variable "other sources of income" positive, which may be particularly important in providing extra income to aid adoption.

Farmers and buyers have basically three different types of contractual arrangements: written, only verbal and trust-based. The analysis is considering the variable trust-based. Producers who trade with the respective buyer using this type of arrangement, present 41% lower probability to certify (odds are 0.57). This result is significant at the 5% level.

The econometric estimates reveal that farmers who live in a village are 49% less likely to certify. The odds are 0.61 being statistically significant at 5% level. The experience of producers in harvesting this specific fruit was expected to have a positive effect on the decision making [odds are 1.01], however the variable turned out to be insignificant. Carambas (2005) also found a positive and insignificant coefficient for years of experience. The proportion of the current irrigated area in ha compared to the potential area that can be irrigated at the farm, shows the possibility to increase the productive area. It is important to highlight that besides these plots of land, farmers still have area which is not suitable to irrigate, mainly due to soil conditions or because it is considered a preservation area. Although the results are not statistically significant, the odds ratio is positive.

The remaining variables are not statistically significant. Among them is gender, which has a negative odds ratio. It means that female-headed farms are more likely to become certified but the variable is highly insignificant. The type of irrigation used, whether it is less sophisticated (furrow and conventional) or more sophisticated (sprinkler and micro sprinkler), has an odds ratio of 1.44. For mango and grapes, the type of irrigation is a key determinant to succeed in this production

while cashew nuts farmers do not utilize any system. Even though the results are not significant, there is a positive correlation between using a sophisticated system and the decision to certify.

Table 6.9: Logistic regression results on the certification decision for *all fruits* producers

Variables	Odds ratio	Robust Std. Err.	Z	P>|z |	95% CI	
Gender	0.92	0.318	-0.24	0.814	0.468	1.801
Education	1.07	0.029	2.61	0.011**	1.017	1.131
Type_irrigation	1.44	0.348	1.53	0.126	0.901	2.319
Level_special	0.91	0.033	-2.54	0.011**	0.848	0.978
Irrigated_area	1.28	0.444	0.73	0.467	0.653	2.530
Non_agric_inc	0.45	0.123	-2.90	0.004***	0.268	0.775
Living_village	0.61	0.148	-2.00	0.045**	0.385	0.989
Year_experience	1.01	0.028	0.45	0.651	0.958	1.069
Trust_relat	0.57	0.150	-2.11	0.034**	0.344	0.960
Dependent variable: certified and non-certified producers; n=388						
*** Significant at 1% level;** 5%; * 10%						
Adjusted Wald Test			F(9, 388)=41.23 p<0.0000			
Pseudo R2			0.0900			
Hosmer-Lemeshow goodness-of-fit test			Chi2(7)= 6.64 p< 0.4672			
Area under the ROC curve			0.6911			

Source: Own calculations

6.2.4 Econometric estimates for the mango and grapes models

This analysis focuses on the 303 grapes and mangoes producers spread in the Juazeiro and Petrolina regions (see Appendices 10 and 11 for details on the Stata commands). The regression estimates were done separately for each fruit aiming at capturing the effect of the determinants on the decision to certify. The adjusted Wald test for the model indicates that it is highly significant at the 1% level. The R^2 is 0.11 for grapes and mangoes, respectively. Thus, the Hosmer-Lemeshow test shows that both models present a good fit. The area under the ROC curve for the regressions is 0.73 for both cases which reveals that the model presents adequate discrimination. Likewise, the link test presents results according to the expectations meaning that the model does not have relevant omitted variables. The regression results are presented in Table 6.10 and Table 6.11.

The first variable to be analyzed is the type of fruit that the farmers are harvesting. Comparing the results of mango and grapes farmers, mango and grapes present an odds ratio of 0.41 and 2.19, being statistically significant at the 1% and 5% levels. The results indicate that producers, who are mango growers, have lower chances to certify while those who concentrate on grapes production

are two times more likely to certify. Producers with a higher level of education are more likely to adopt certification. The odds are the same for both fruits: 1.09 and also the differences between the groups are highly significant. For four more years of schooling, the chances to certify increase by 9%.

The small size of the farm contributes negatively to certify. Both, mango and grapes growers have an odds ratio of 0.53, which means that the probability decreases by 47% in case the farmers possess less land than 12 ha. Burton et al. (1998) mention that in the UK, managers of smaller holdings are more likely to adopt certification, but farm size *per se* does not explain the timing of that decision. The dependence on the income obtained from non-agricultural sectors also has a negative impact on the decision. In the case of grapes farmers, the probability decreases by 61% while for mango ones, the chances decrease by 64%. It indicates that the higher the dependence on non-agricultural income, the less likely the farmers are to certify.

For each additional year of experience the chances to adopt certification increase by 9%. The results are highly significant at the 1% level. The contract arrangement "trust-based" contributes to decrease the level of producers to certify by 61%. The results are statistically significant at the 1% level. The uncertainty of favourable arrangements and payment conditions may influence the decision making.

For farmers of both fruits, the variable gender has a positive impact on the decision to certify, although the results are not statistically significant. It means that male-headed households are more likely to certify than female-headed households. Having a manager to run a farm reflects positively on the level of returns of the farm as presented on the descriptive statistics. Farmers who harvest only mango have an odds ratio of 1.10 while those harvesting grapes have an odds ratio of 1.15. The positive effect of this variable is highlighted by both regressions.

The use of a sophisticated type of irrigation system increases the chances of both mango and grapes farmers to certify, although the differences between the groups are not statistically significant. The variable which refers to the share of the current area irrigated indicates that farmers who present a smaller rate have more chances to certify.

Table 6.10: Logistic regression results on the certification decision for mangoes producers

Variables	Odds ratio	Robust Std. Err.	z	P>|z|	95% CI	
Mango	0.412	0.129	-2.83	0.005***	0.223	0.761
Gender	1.078	0.411	0.20	0.842	0.510	2.278
Education	1.097	0.333	3.03	0.002***	1.033	1.165
Manager	1.106	0.385	0.29	0.771	0.559	2.188
Size	0.530	0.160	-2.10	0.036**	0.293	0.958
Non_agri_income	0.393	0.140	-2.61	0.009***	0.195	0.793
Years_experience	1.094	0.040	2.46	0.014***	1.018	1.175
Type_irrigation	1.128	0.348	0.39	0.695	0.616	2.067
Irrigated_area	0.489	0.272	-1.28	0.201	0.164	1.461
Trust_relat	0.393	0.137	-2.67	0.008*	0.198	0.778
Dependent variable: certified and non-certified producers; n=303						
*** Significant at 1% level;** 5%; * 10%						
Adjusted Wald Test			F(10, 303)=33.13 p<0.0003			
Pseudo R2			0.1198			
Hosmer-Lemeshow goodness-of-fit test			Chi2(8)= 5.72 p< 0.6785			
Area under the ROC curve			0.7353			

Source: Own calculations

Table 6.11: Logistic regression results on the certification decision for grapes producers

Variables	Odds ratio	Robust Std. Err.	z	P>|z|	95% CI	
Grapes	2.194	0.678	2.54	0.011**	1.197	4.020
Gender	1.101	0.430	0.25	0.805	0.511	2.370
Education	1.094	0.340	2.92	0.003***	1.030	1.163
Manager	1.155	0.400	0.42	0.676	0.586	2.278
Size	0.525	0.157	-2.15	0.031**	0.292	0.944
Non_agri_income	0.363	0.132	-2.77	0.006***	0.177	0.743
Years_experience	1.091	0.047	2.34	0.019***	1.014	1.174
Type_irrigation	1.120	0.344	0.37	0.711	0.613	2.047
Irrigated_area	0.478	0.267	-1.32	0.188	0.159	1.434
Trust_relat	0.397	0.138	-2.65	0.008**	0.200	0.795
Dependent variable: certified and non-certified producers; n=303						
*** Significant at 1% level;** 5%; * 10%						
Adjusted Wald Test			F(10, 303)=28.49 p<0.0015			
Pseudo R2			0.1177			
Hosmer-Lemeshow goodness-of-fit test			Chi2(8)= 6.59 p< 0.5813			
Area under the ROC curve			0.7359			

Source: Own calculations

6.2.5 Econometric estimates for the cashew nuts model

The logistic regression results for the cashew nuts model are presented in Table 6.12 (Appendix 12 presents more details). The adjusted Wald test indicates that the model is significant. The Hosmer-Lemeshow test shows that the model presents a good fit, even though the sample size is only about 85 producers. The area under the ROC curve is 0.82 revealing that the model has adequate discrimination. The link test also presents a suitable result which means that the model does not have relevant omitted variables.

The variable "education" is the one with the strongest positive and significant impact on the decision making of the producers. The odds ratio of the variable "education" is 4.63, which means that for each four additional years of schooling, the odds to certify increase by 363%.

The number of family members of the household does influence the decision to certify by 42% at 5% level of significance. Hattam & Holloway (2005) pointed out that organic farmers rely more heavily on family labor. In the production system of cashew nuts, it is more likely that producers run the farm by themselves, instead of having a caretaker or a manager. In fact, cashew nuts are a product which is not labor intensive. The figures on permanent and temporary workers are low, with only the family members counting as the main labor force.

This study has found a positive influence of "non-agriculture income" which is statistically significant at the 5% level. Considering the set of variables being tested, non-agricultural income plays a more important role. The odds ratio of this variable is 6.06, which means that for each additional non-agricultural source of income, the chances to certify increase by 506%. The results show that the lower the dependency on the cashew nuts income, the higher the probability to certify. However, the literature suggests the opposite: the higher the dependency on the income of a certain crop, the higher is the incentive to certify.

With repect to the gender of the head of the household the estimated odds are negative but not significant. It indicates that chances to adopt certification would increase if the family is female-headed. Further, the variable number of crops that producers are engaged in, besides the cashew nuts, leads to a positive odds ratio. This shows a positive association between the number of crops and the decision to certify. The current area of cashew nuts compared to the land occupied with other types of crops has a negative influence on the decision to certify. It indicates that the higher the share of the current area used for cashew nuts, the lower the chances to certify. Considering the

variety namely dwarf, farmers have lower chances to certify compared to those who cultivate other varieties. Additionally, the variable "years trading individually" has a negative impact on the decision of the producer.

Table 6.12: Logistic regression results on the certification decision for cashew nuts producers

Variables	Odds ratio	Robust Std. Err.	Z	P>|z|	95% CI	
Gender	0.295	0.246	-1.46	0.144	0.057	1.517
Education	4.631	3.109	2.28	0.022**	1.242	8.266
Family_HH	1.421	0.213	2.34	0.019**	1.059	1.907
Non-agric_income	6.066	4.398	2.49	0.013**	1.465	14.120
Number_crops	1.054	0.0528	0.97	0.330	0.951	1.159
Share_current_area	0.801	0.465	-0.38	0.704	0.256	2.502
Variety	0.500	0.308	-1.12	0.262	0.149	1.676
Years_trading_ind	0.926	0.700	-1.01	0.315	0.799	1.074
Dependent variable: certified and non-certified producers; n=85						
*** Significant at 1% level;** 5%; * 10%						
Adjusted Wald Test		F(8, 85)=15.02 p<0.0058				
Pseudo R2		0.2401				
Hosmer-Lemeshow goodness-of-fit test		Chi2(6)= 2.39 p< 0.8809				
Area under the ROC curve		0.8298				

Source: Own calculations

6.2.6 Summary

Data from the survey of mango, grapes and cashew nuts farmers were used in a logit model to determine the characteristics associated with the adoption of certification. The first model included 388 farmers of mango, grapes and cashew nuts. The second and the third models included 303 mango and grapes farmers separately. The last one estimated the determinants to certify for 85 cashew nuts producers.

The results of the first model revealed that education plays a significant and positive role. Variables such as non-agricultural income, living in a village and trust-based contracts have a negative and significant effect on the decision-making to certify. Analyzing separately the mango and grapes models, the results revealed that grapes growers are more likely to certify than mango ones. There are two variables which have a positive and significant effect: education and experience. However, small-scale farms, the dependency on non-agricultural income and a trust-based arrangement have a negative but significant effect. Finally, the findings on the cashew nuts

model show that the dependency on the income from the non-agriculture sector, education, size of the family play a major role on the decision to certify. Many variables have a negative and insignificant effect such as gender, variety, years of trading with an individual buyer and current area with cashew nuts.

7 Comparative analyses

The first section discusses the marketing chains of mango and grapes, cashew nuts and melon. The discussions start by an overview of the chains, followed by an analysis of the distribution of functions along the chains, the harvesting processes, final destinations of the fruits and finally, contractual arrangements. Section 7.2 compares certified farmers with one or more certificates and the size of small and medium farms. Section 7.3 presents some econometric results.

7.1 Marketing chain analysis

Section 7.1 analyses the trade linkages between producers and buyers of fresh mango, grapes, cashew nuts and melon in Brazil. It takes up the concept of governance in global commodity chains from Gereffi (1994) - as described in Chapter 3.2 - in order to examine how the competitive strategies of international and national buyers have led to particular governance structures. They determine not only the types of products to be produced, but also production and quality systems, the extent and location of post-harvesting processing. The first marketing chains discussed are those for mango and grapes, followed by cashew nuts and melons.

7.1.1 Marketing chain analysis for mango and grapes sectors

An analysis of the marketing chain identifies major agents and the transactions between mango and grapes farmers and buyers. In general, an investigation of the functioning of the trading process in both fruit sectors may contribute to a better understanding of the functioning of the whole sector. A differentiation is again being made between farmers who are certified and those who are not.

Figure 7.1 shows the respective marketing chains relevant in Brazil. Basically producers of grapes and mangoes have two options: either they sell to individuals (specific buyers, middlemen, exporting company) or to a group (group or association of producers, cooperative). Around 92% of the non-certified and only 4% of the already certified farmers reported selling to individuals. Nearly 96% of the certified producers belong to a group, cooperative or association exporting mainly to the international market (Table 7.1).

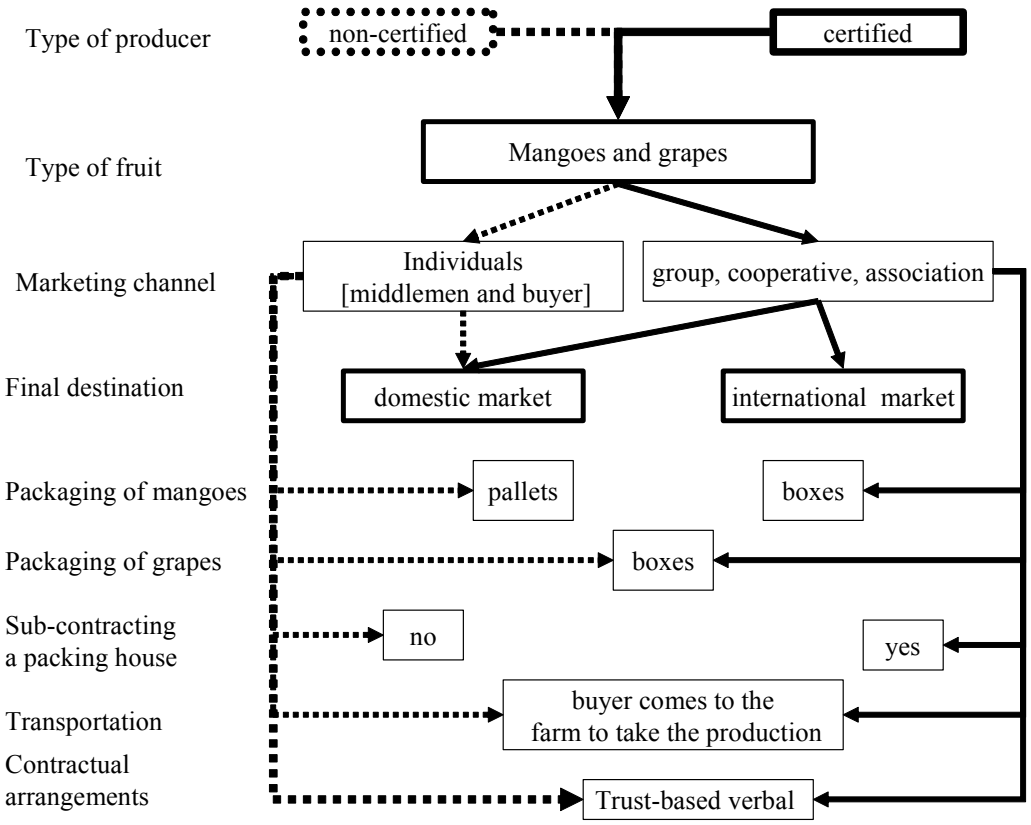

Figure 7.1: Marketing chains of grapes and mangoes

Source: Own compilation

The reasons leading non-certified farmers to trade with individuals are explained by the fact that there is no other possible buyer. The certified producers selling to groups perceived this as an advantage because first, they have assurance that their products would be sold (89%) and second, they follow the recommendation of EMBRAPA, SEBRAE or other organizations (41%).

Furthermore, the analysis also considers the number of years that the producers have been trading with buyers. The non-certified producers have been operating with their respective buyers for an average of 6.5 years, while the certified ones have an average of only 3.2 years.

Table 7.1: Description of the variables on marketing chain

Description of the variables	Producers		Chi²
	Cert.	Non-cert.	Sig.
Selling to individual buyers (in %)	3.7	92.4	0.000***
Selling to a group, cooperative or association (in %)	96.3	7.6	0.000***
Years of trading with the buyer/cooperative (mean values)	3.2	6.5	0.000***
Mangoes			
Selling to individual buyers (in %)	6.9	91.8	0.000***
Selling to a group, cooperative or association (in %)	93.1	8.2	0.000***
Years of trading with the buyer/cooperative (mean values)	3.4	6.9	0.000***
Grapes			
Selling to individual buyers (in %)	6.9	89.4	0.000***
Selling to a group, cooperative or association (in %)	93.1	10.6	0.000***
Years of trading with the buyer/cooperative (mean values)	3.9	4.7	0.000***
Certified [n=54] and non-certified producers [n=249]			
*** Statistically significant at 1% level;** at 5% level; * at 10% level			

Source: Own compilation

There are differences with respect to packaging, post-harvesting and contractual arrangements between certified and non-certified producers which will be further analysed in the following.

Harvesting process

Maturity is one of the main factors determining the quality of a product. Post harvest technologies deal with separation, sampling, sizing, and sorting as well as with grading. The fruit sector is unique due to its high perishability (Irtwange, 2006). For Newman (2007), one of the constant challenges fruit growers face is to ensure that the production reaching consumers is of a consistently high quality. Therefore, determining when to harvest fruit to sell or long-term storage plays an important role in successful post harvest crop management.

The marketing standards of mangoes (*Mangifera indica L.*) and grapes (*Citrus paradise Macfad.*) are presented by the Europe Fresh Quality Guide (2007) according to the United Nations Economic Commission for Europe (UNECE). The standards include its definition, minimum requirements, developments and conditions, classification, sizing by weight, presentation, contaminants and hygiene.

Considering the specificities of each type of fruit, the harvesting process can be done using plastic or paper boxes, or pallets. Fruits handled in boxes are supposed to be better preserved while fruits

packed in pallets have to be repacked again and this process may damage the product. Nevertheless, sometimes when fruits are sold in pallets to local markets [short distances], they are repacked in boxes for international markets or for transport over long distances in the domestic market.

As Table 7.2 shows, harvest of grapes is done using paper and plastic boxes by 100% of producers with certification and around 77% of the non-certified ones. Mangoes have been packed in pallets by 94% of the non-certified producers, while 93% of the certified producers use paper and plastic boxes.

Further, producers have mainly two options with respect to the post-harvest procedure: either they sell the production directly to the buyer after harvest or utilize a packing house. Producers, who do not have their own packing house, may decide to utilize one from the group, cooperative or association. The advantages of using a packing house are technical (keeping the fruit stored in suitable conditions and temperature in order to maintain the fruit quality) and managerial (producers are less vulnerable to climate shocks and market fluctuations and are able to settle better negotiations through market opportunities). The findings highlight that nearly 97% of the certified producers of mangoes utilize a subcontracted packing house for post-harvest handling compared to 76% of certified grapes producers. In contrast, about 88% and 95% of non-certified mangoes and grapes producers reported that they do not subcontract a packing house, i.e. the fruit is sold directly after being harvested. Some producers decide to transport the products to the respective buyer using their own means of transport, while others wait for the buyer to collect the products at the farm gate. The survey shows that regardless of the fruit and of certification, the buyer comes with a truck to collect the fruit at the farm. This is true for about 80% of the certified and almost 100% of the non-certified producers. It means that farmers are not responsible for the transportation having lower transaction costs but maybe also receiving lower prices. Choosing the most efficient post harvest system is also closely connected with the contractual arrangements, which will be discussed in the following section.

Table 7.2: Description of the variables on post-harvesting

Description of the variables	Producers		Chi², t test
	Cert.	Non-cert.	Sig.
Grapes			
Post-harvesting of grapes is done using paper and plastic boxes (in %)	100.0	77.3	0.000***
Use of a subcontracted packing house for post-harvest handling (in %)	75.9	4.5	0.000***
Buyer transports the fruit (in %)	79.3	100.0	0.000***
Mangoes			
Post-harvesting is done in using paper and plastic boxes (in %)	93.1	3.6	0.000***
Use of a subcontracted packing house for post-harvest handling (in %)	96.6	11.8	0.000***
Buyer transports the fruit (in %)	79.3	98.5	0.000***
Certified grapes producers [n=29] and non-certified grapes producers [n=66]; certified mango producers [n=29] and non-certified mango producers [n=195]			
*** Statistically significant at 1% level;** at 5% level; * at 10% level			

Source: Own compilation

Final destination of the fruits

Table 7.3 presents results on the final destination of the grapes and mangoes production. With respect to non-certified producers, they almost all mention that their mangoes and grapes are sold on the domestic market. However, most of the producers are not aware of where the fruit is sold to after the gate. Thus, it is possible that the fruits are repacked and exported without the producers knowing about it. Certified farmers provided information on the destination of their fruits for the periods before certification and after certification. Interestingly, the percentage of farmers saying that their fruits are sold on the domestic market is lower than that of non-certified farmers: 48% of grapes farmers and 68% of the mango farmers indicate that their fruits were sold on the domestic market because they obtain certification. After having obtained certification, the shares decreased: only 22% of the grapes farmers and 20% of the mango farmers say that their fruits are sold on the domestic market.

The data also reveals that the importance of the European market as a final destination increased for both grapes and mango producers after certification. The number of certified farmers mentioning Europe as a final consumer market almost tripled over time. The role of the United States is also important as a final market for Brazilian fruits, however, the share of grapes farmers mentioning the US decreased by 30%, while that for mangoes almost doubled. The importance of the other countries as final destinations is almost negligible, although they slightly increased for certified farmers when comparing before and after certification. The shift of export flows might be

explained by the introduction of GlobalGAP, being an initiative of European retailers. However, also other factors like transport capacities or trade agreements may play a role.

Table 7.3: Details on grapes and mango exports in 2005, percentage of the total volume

Description of the variables (mean value in percentage)	Certified		Non-certified
	Before certifying	After certifying	Current
Grapes			
Domestic Market	48.0	22.0	92.3
US	31.0	20.7	3.2
Europe	20.6	54.0	3.8
Other	0.4	3.3	0.7
Total	100	100	100
Mangoes			
Domestic Market	67.8	20.0	93.3
US	15.3	28.7	0.7
Europe	16.3	49.5	5.1
Other	0.6	1.8	0.9
Total	100	100	100

Certified grapes producers [n=29] and non-certified grapes producers [n=66]; certified mango producers [n=29] and non-certified mango producers [n=195]

Source: Own compilation

Contractual arrangements

Producers of fruits and vegetables operate in an unusually risky economic environment. While these farmers face the same sort of production risk common to other agricultural products, they also produce a perishable commodity whose price is subject to large fluctuations. Ligon (2001) points out that one important practice which helps to shield fruit and vegetables producers from price and production risk are contracts. The author emphasizes the importance of written contracts between the producer and the first handler, or intermediary who takes hold of the fruit.

In this study, the contractual arrangements between producer and buyer can be divided into three categories: written contracts; trust-based verbal contracts[19]; and verbal contracts only. As **Table 7.4** shows, 87% of the certified farmers reported dealing with the buyer through a trust-based verbal contract. The remaining 13% even have a written contract. With respect to the non-certified

[19] The verbal contract based on trust relates to settlements between producer and buyer after a certain number of successful negotiations.

producers two third (about 73%) have a trust-based verbal contract. A written contract was given only in 3% of the cases. The remaining 24% indicate to have a verbal contract only.

Analyzing the type of contract by fruit, the study shows that written contracts are much more often given to grapes farmers, especially the certified ones. Only 4% of the mango farmers receive a written contract, but most certified mango farmers indicate to have a trust-based verbal contract, compared with only 73% of the non-certified producers.

Table 7.4: Description of the variables on contractual arrangements

Description of the variables	Producers		Chi², t test
	Cert.	Non-cert.	Sig.
Both mango and grapes			
Verbal contract with trust (in %)	87.0	73.5	0.015**
Verbal contract (in %)	0.0	23.3	0.000***
Written contract (in %)	13.0	3.2	0.008***
Only mangoes			
Verbal contract with trust (in %)	95.6	72.8	0.000***
Verbal contract (in %)	0.0	23.6	0.001***
Written contract (in %)	3.4	3.6	0.723
Only grapes			
Verbal contract with trust (in %)	75.9	69.7	0.345
Verbal contract (in %)	0.0	24.2	0.002***
Written contract (in %)	24.1	6.1	0.017**

Certified grapes producers [n=29] and non-certified grapes producers [n=66]; certified mango producers [n=29] and non-certified mango producers [n=195]

*** Statistically significant at 1% level;** at 5% level; * at 10% level

Source: Own compilation

A deeper analysis of the contractual clauses may provide a better understanding of the characteristics of the transactions. The analysis below tries to illustrate the contractual arrangements between mango and grapes growers and their respective buyers (Table 7.5).

The analysis relates to the verbal trust-based agreement. Farmers who deliver their fruits to a middleman or exporter indicate that they had eleven negotiations, while those who sold to a group or cooperative had only four negotiations. Interesting is the result that all groups or cooperatives pay in cash, while 15% of the individual buyers pay in rates and 16% do not pay at all. Thus, the farmers are better off when selling to a group or cooperative. However, a group or cooperative is

more likely to set the price while the producers selling to individual middlemen or exporters have a little more flexibility in negotiating the price.

Table 7.5: Contractual trust-based arrangements

Details of the negotiation (mean value)	Verbal trust-based	
	Individuals (N=189)	Group/cooper. (N=47)
Number of trading relations	11.0	4.0
Payment in cash (in %)	74.6	100.0
Payment in rates (in %)	15.3	0.0
Non-payment cases (in %)	16.4	0.0
Price determined by the buyer (in %)	34.4	95.7
Price determined by the producer (in %)	92.6	2.7
Buyer is not flexible in the negotiations (in %)	92.1	97.9

Source: Own compilation

7.1.2 Marketing chain of the cashew nuts sector

The marketing chain of cashew nuts is simpler when compared to the marketing chains of mangoes and grapes but it entails its own peculiarities. The following sections give an overview of the chain, the final destination of the products and the contractual arrangements. A simplified presentation of the cashew nuts marketing chain is presented in Figure 7.2. The diagram reveals how certified and non-certified farmers trade with individual buyers and the cooperative. Producers sell their products either to an individual or to a cooperative. In this sector, there are no other associations or groups besides the cooperative. The findings reveal that 83% of the non-certified farmers trade with individual buyers, while 78% of the certified ones trade with the cooperative. The final destination of the products sold to individual buyers is mainly the domestic market, while those sold to the cooperative are targeted to both international and domestic markets. Individual buyers come to the farm to collect the cashew nuts production, while the farmers transport their kernel production to the cooperative. Basically, the type of relationship between buyer and farmer is a verbal trust-based agreement.

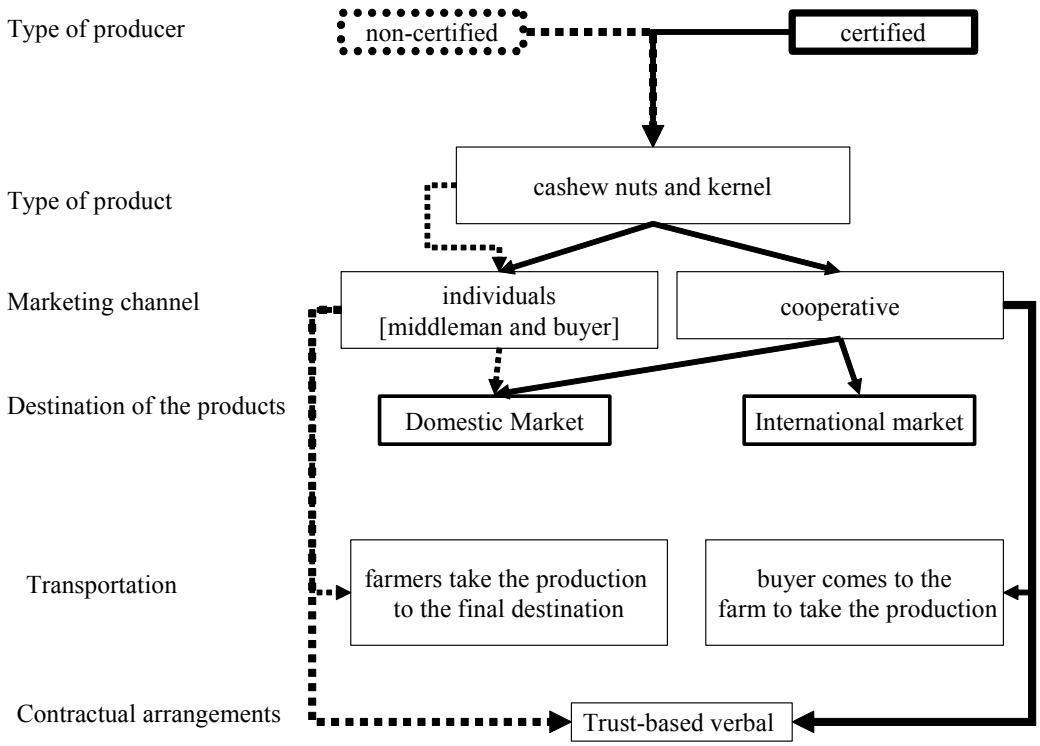

Figure 7.2: Marketing chain of cashew nuts

Source: Own compilation

Final destination of the products

This section focuses on the final destination of the products (Table 7.6). Among the possibilities, farmers have the choice to sell both processed nuts (kernels with higher value added) and unprocessed nuts (nuts with lower value added). Thus farmers can also buy raw cashew nuts from their neighbors, process them and sell the kernels.

The results show that 90% of the farmers before adopting certification sell cashew nuts in the domestic market. After certifying, 82% of the same farmers sell their production of kernels to the cooperative which trades high shares of the products in international markets while small shares remain in the domestic market. Thus, the cooperative plays an important role for farmers to upgrade. With respect to the non-certified producers, 88% mentioned that their cashew nuts production is sold on the domestic market.

The final destination also depends on the modes of transportation. After the harvest, some producers decide to transport the products to the respective buyer using their own means of transport while others wait for the buyer to collect the products at the farm gate. The decision of whether to transport the products themselves depends not only on the characteristics of the producer but also on the type of product. For instance, 87% of the non-certified and 32% of certified producers have their cashew nuts transported by the buyer. With respect to the kernels, 52% of the certified producers transport them themselves to the buyer, while 16% of the certified farmers indicate that their kernels are being picked up from their farms.

Table 7.6: Final destination of cashew nuts and kernel production and modes of transport

Description of the variables	Certified		Non-certified
	Before certifying	After certifying	
Cashew nuts (non-processed)			
Domestic Market (in %)	89.5	10.6	88.3
Kernels (processed)			
Domestic market (in %)	7.5	8.0	13.7
International market (in %)	3.0	81.4	0.0
Transportation			
Buyer comes to the farm to buy the cashew nuts production (in %)		32.0	86.7
Buyer comes to the farm to buy the kernel production (in %)		16.0	6.6
Producer takes the kernel production to the final buyer (in %)		52.0	6.7
Certified producers [n=25] and non-certified producers [n=60]			

Source: Own compilation

Contractual arrangements

Almost 76% of the certified farmers and 64% of the non-certified ones report dealing with the buyer through a trust-based verbal contract. Further, about 33% of non-certified producers have a verbal contract with the buyer compared to 16% of certified ones. Only 8% of the certified producers have a formal written contract.

Table 7.7 shows the results on the trading negotiations considering the trust-based type of contract. In general, certified farmers have been trading only during 3 harvesting periods with the cooperative and non-certified farmers during 5 harvesting periods with individual buyers. The buyers are not only inflexible in the negotiations (67% for individuals and 83% for the cooperative) but also exert high power in determining the price. Besides, the cooperative acquires

a higher quality of kernels (87%). Regarding payments, the cooperative pays part of the payment in advance (57%) and part in cash (37%). Payments done by individual buyers are mainly in cash (78%). The non-payment rate is very low.

Table 7.7: Negotiations trust-based between buyer and producer of cashew nuts

Details of the negotiation (mean value)	Trust-based verbal	
	Individual buyers (N=39)	Cooperative (N=19)
Number of trading relations	5.6	3.4
Payment in cash (in %)	77.8	37.1
Payment in advance (in %)	4.4	57.0
Payment in rates (in %)	17.8	4.9
Non-payment (in %)	8.4	4.7
Price determined by the buyer (in %)	91.1	91.3
Price is determined by the producer (in %)	2.2	0.0
High quality kernels (in %)	46.7	87.0
Buyer acquires any type of cashew (in %)	73.3	4.3
Buyer is not flexible in the negotiations (in %)	66.6	82.6

Source: Own compilation

7.1.3 Marketing chain analysis of the melon sector

The analysis of this chain is unique when considering the type of marketing channel, final destination and the contractual arrangements. The discussion starts with an overview of the chain. Figure 7.3 shows the marketing chain of selected producers from the melon sector. The cases A, B and C relate to non-certified farmers and the cases D, E and F to the certified farmers. The contractual relationship between non-certified farmers and the trading companies is based on formal contracts. Likewise, the majority of the certified ones have a formal contract with the international buyer, but a verbal and consignment type of contract with the domestic buyers.

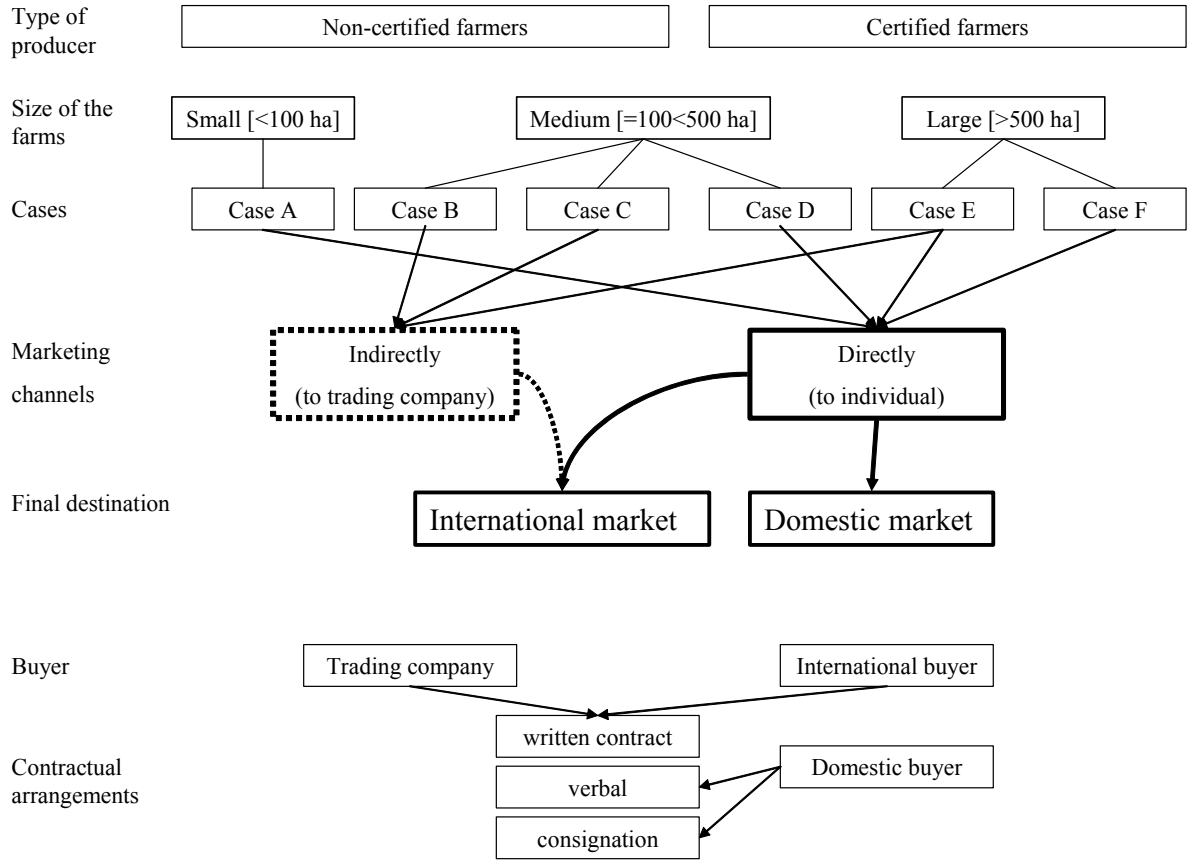

Figure 7.3: Marketing chain of the melon sector

Source: Own compilation

Marketing channel

Around 80% of certified farmers designate their melons to the international market and 20% to the domestic market. In the domestic market, fruits are mainly sold on wholesale markets in Sao Paulo and in supermarket chains. Two non-certified farmers, for instance, trade all production with wholesalers in different states in Brazil including Sao Paulo. However, one non-certified farmer is not aware about the final destination of his or her melons. In addition, the findings reveal that the volume which remains in the domestic market is usually comprised of fruits of low quality. More specifically, it derives from overproduction or/and fruits which have not met the standards (quality, size and brix[20]) indicated in the contract.

[20] Brix is used to measure the approximate amount of sugar in fruits and vegetables and to determine ideal harvesting times.

Contractual arrangements

Moreover, negotiations between Brazilian fruit farmers and international buyers are based on a type of pre-fixed contract named consignment, which depends on market oscillations (Nachreiner & Santos, 2002). Further, Gomes (2004) argues that many small and medium fruits farmers also participate in markets by engaging in informal contractual arrangements with large-scale farmers. They benefit from these relationships by receiving clear standards based on which to produce, input packages and technical assistance from production through post-harvest. Therefore, contractual ties with large producers enable many small and medium farmers to participate in markets that are more demanding than the local ones. Not only do small and medium farmers benefit from contractual ties, but also large firms which establish a range of contracts.

With the aim of understanding the contractual arrangements between farmers and buyers, all interviewees were asked to detail their own situation. The contractual arrangements vary according to the form of exports. Even though two certified farmers have a consignment or verbal type of relationship in the domestic market, they are highly dependent on daily price fluctuations. Hence there is no guarantee of payment; farmers have to build a relationship based on trust with the buyer to assure the payment. Therefore, one of them intends to trade with supermarket chains.

Moreover, a further analysis shows that two non-certified farmers deliver their total melon production to the trading company and the latter takes over all the responsibility. Evidently they depend on daily price fluctuations as well, but their payment is assured. On the contrary, the farmers who export either directly or indirectly to international markets mention to have a written contract. The procedure of settling contracts and particular details on the fruit characteristics is similar. Usually contracts are set within March and April for the coming harvesting season which comprehends the period between August and February specifying the quality, price, quantity, brix and size.

7.1.4 Summary

Coordination in the supply chain of mango and grapes and the degree of vertical coordination is increasing through certification. The results reveal that certified farmers, regardless of the fruit, shift from arm's-length market to quasi-hierarchical relationships attributed mainly to a high level of asset specificity. In other words, there is a shift from market-based global value chains

governance to more explicit coordination. The findings on the cashew nuts chain lead to a modular value chain type of governance characterized by network relationships in the case of trading with the cooperative, and market type of governance with arm's length market relations in the case of individual buyers. For the melon chain, transactions done directly and indirectly in international markets are characterized as captive value chain type of governance where quasi-hierarchical relationships dominate (buyer defines the product and control over the suppliers). In contrast, negotiations settled in domestic markets present low asset specificity and low coordination, classified as market type of governance with arm's length market relationship.

7.2 Comparative analysis of certified producers and farm' sizes

Section 7.2.1 aims to discuss the main economic factors between farmers who adopted one versus two certificates. A similar analysis from the type of certification scheme perspective is done in Section 7.2.2. Section 7.2.3 focuses on the role of the farm size for adopting certification.

7.2.1 Certified mango and grapes farmers: one versus two certificates

Data regarding the 54 certified producers are used to analyze producers with only one certificate (57% or 30) and those having two (43% or 22). Single certified refers to producers having only one and double to those having two. Results are presented in Table 7.8. Two tripled certified farmers are excluded from this analysis.

Surprisingly, single-certified mango and grapes farmers harvested more tons per ha compared to farmers with two certificates. Therefore, the total production cost per kg of grapes and mangoes is higher for double-certified than for single-certified. As a result single-certified farmers also receive higher net income per ha compared to double-certified ones. This is true for mangoes as well as for grapes. However, the price received per kg by single- and double-certified farmers differs by fruit. For grapes, the price before and after is lower for single-certified farmers than for double-certified ones; such a difference does not exist for mangoes. In terms of percentage, single-certified farmers received a 61% higher price for mangoes compared to 55% of the double ones. Grapes farmers before adopting one certificate received R$1.75, while those with two received R$2.09. After adopting certification, single-certified ones received R$2.23 and double ones R$2.70. An increase of 27% and 29% is found, respectively.

SEBRAE is considered a very important organization in supporting certification by all farmers while EMBRAPA was indicated mainly by single-certified farmers. Approximately 90% of the

farmers mention to obtain knowledge from EMBRAPA. In addition, SEBRAE is considered by 96% of the farmers as the source where they obtain knowledge and updates through training courses. Another potential source of information and updates is the social network the farmer has.

Further, single-certified farmers have invested a significantly higher amount on new infrastructure on their farms. Nevertheless, farmers with two certificates spend yearly R$2,403 for certification (including monitoring and renewal process of the certificates). The single-certified farmers spend half of this amount (R$1,213).

Table 7.8: Description of the variables: one certificate versus two certificates

Description of the variables	Number of certificates		Chi²,t test
	One cert.	Two cert.	Sig.
Investments on new infrastructure (R$) (mean value)	182,249	45,356	0.062*
Cost of certification (R$) (mean value)	1,213	2,403	0.003***
Grapes (mean value)			
Productivity (tons/ha)	24.6	19.9	0.165
Production cost (R$/kg)	0.92	1.25	0.129
Total production cost (R$/ha)	22,929	22,462	0.895
Total income (R$/ha)	43,052	42,198	0.920
Net income (R$/ha)	20,623	19,236	0.629
Price received before certifying (R$/kg)	1.75	2.09	0.425
Price received after certifying (R$/kg)	2.23	2.70	0.240
Mango (mean value)			
Productivity (tons/ha)	29.3	23.5	0.112
Production cost (R$/kg)	0.44	0.47	0.302
Total production cost (R$/ha)	13,045	10,945	0.210
Total income (R$/ha)	24,104	20,328	0.426
Net income (R$/ha)	11,058	9,392	0.920
Price received before certifying (R$/kg)	0.82	0.84	0.890
Price received after certifying (R$/kg)	1.32	1.30	0.923
One certification scheme [PIF n=5, GlobalGAP n=21, Faitrade n=4] and double [PIF&Global n=8, PIF&Fair n=14]			
*** Significant at 1% level, ** at 5% level and *at 10% level			

Source: Own compilation

In the surveyed region, farmers started to adopt certification in 2003 and 2004. There is no significant difference between the time of adoption and the type of schemes. However, the adoption of a certain certification scheme influences the decision of the farmer whether to continue to trade with the current buyer or to shift. Table 7.9 compares the number of years that farmers

obtained certification [a] and the number of years that they have been selling to a specific buyer [b]. This analysis may indicate whether certification plays a positive role in changing the buyer:

a) If a>b, it means that the producers did not change the buyer after adopting certification;

b) If a<b, it means that the producers switched to a new buyer after becoming certified and

c) If a=b, it means the producer changed to a new buyer in the same year certification was attained.

It was found that 73% and 96% of the producers with one and two certificates, respectively, change the type of buyer after having certification. Generally, this means that the producer changes from an individual buyer to a group or cooperative. 20% of the single-certified producers and only 4% of the double-certified ones, highlight to have changed the type of buyer in the same period of adoption. Finally, for 6% of the farmers with one certificate the adoption of certification does not play an important role in changing the type of buyer.

Table 7.9: Comparison between the years the producer became certified [a] and the year he/she started to sell to a specific buyer [b]

Number of certificates	Comparing [a] and [b]		
	a>b	a <b	a=b
One certificate (in %)	6.7	73.3	20.0
Two certificates (in %)	0.0	95.8	4.2
One certification scheme [n=30] and double [n=22]			

Source: Own compilation

7.2.2 Comparative analysis by certification scheme

The following analysis focuses on the selected certification schemes adopted by certified mango and grapes farmers. It looks closely to the major economic differences among each certification scheme as well as to their combinations. As Table 7.10 shows, results are omitted in some cases where the sample is not representative. Farmers having PIF and GlobalGAP are denominated by PIF&Global and those having PIF and Fairtrade by PIF&Fair.

PIF&Global certified farmers possess more irrigated areas (64 ha), followed by those with GlobalGAP (33 ha) compared to small irrigated areas of the remaining groups. Data on the productivity reveal that farmers with GlobalGAP have higher productivity for both fruits. In order to comply with the requirements, farmers need to invest in infrastructure on their farms. The findings clearly indicate GlobalGAP certified farmers as those who invested the highest amount in new infrastructure (R$245,000). PIF&Global certified farmers invested approximatly R$136,000. The investments done by the others are considerably smaller.

With respect to the production cost per kg of mango, very similar results are found for single and double-certified farmers. Thus, the total production cost, total income, the net income is higher for GlobalGAP certified farmers if compared to the other farmers. However, GlobalGAP certified mango farmers had received the highest net income. PIF&Global certified mango farmers are not far behind with regard to the net income. Besides, PIF&Global certified farmers pay certification costs of R$7,000 for both certificates, while GlobalGAP paid around R$1,700. Fairtrade and PIF&Fair farmers are responsible only for a share of the costs, since the association takes over the responsibility. PIF farmers, for instance, receive subsidies from SEBRAE.

A comparison between before and after certifying shows that PIF&Global and GlobalGAP grapes certified farmers received an increased price of R$0.50 per kg and PIF only R$0.30. However, in terms of percentage, GlobalGAP certified farmers received an increase of 27% in price, PIF&Global received 20% and PIF farmers received 17%. With respect to mango, the difference between before and after adopting certification reveals a value of R$0.40 per kg. GlobalGAP certified farmers and Fairtrade ones indeed received an increase of 57% in prices.

Table 7.10: Comparing certification schemes

Description of the variables	Type of certification scheme					Chi²,t test Sig.
	PIF	GlobalGAP	Fairtrade	PIF&Global	PIF&Fair	
Irrigated area (mean values in ha)	6.3	33.0	4.2	64.4	2.3	0.011**
Investments in new infrastructure (R$)	54,660	244,471	15,065	136,062	0.0	0.479
Cost of maintenance of the certificate (R$)	315	1,637	108	6,998	106	0.000***
Grapes (mean value)						
Productivity of grapes (tons/ha)	18.1	26.5	-	15.9	-	0.000***
Production cost (R$/kg)	0.86	0.95	-	1.31	-	0.723
Total production cost (R$/ha)	15,566	24,448	-	19,996	-	0.159
Total income (R$/ha)	30,716	47,252	-	41,285	-	0.830
Net income (R$/ha)	15,150	22,803	-	21,289	-	0.871
Price received before certifying (R$/kg)	1.7	1.8	-	2.4	-	0.329
Price received after certifying (R$/kg)	2.0	2.3	-	2.9	-	0.603
Mango (mean value)						
Productivity (tons/ha)	-	33.0	25.2	-	22.5	0.104
Production cost (R$/kg)	-	0.44	0.47	-	0.46	0.246
Total production cost (R$/ha)	-	14,584	11,733	-	10,285	0.154
Net income (R$/ha)	-	20,626	17,744	-	16,065	0.004***
Price received before certifying (R$/kg)	-	0.9	0.7	-	0.7	0.536
Price received after certifying (R$/kg)	-	1.4	1.1	-	1.1	0.269

Farmers certified with PIF [n=5], GlobalGAP [n=21], Fairtrade [n=4], PIF&Global [n=8] and PIF&Fair [n=14]
*** Statistically significant at 1% level;** at 5% level; * at 10% level

Source: Own compilation

7.2.3 Comparative analysis of different mango and grapes size farms

This section aims to verify the main differences and similarities of economic variables among small and medium size farms that belong to one of the three groups: certified, in process and non-certified. Table 7.11 shows the data regarding type of certification schemes adopted by the different sizes of producers. Analyzing the figures from the producers' size perspective, they reveal that 70% of the certified producers are small and 30% of them are medium. Small farms have less than 13 ha while medium ones have 13 ha or more. The six cases of large size farmers were excluded from this analysis. Hirsch (2005) points out that the Juazeiro/Petrolina region comprehends basically small farmers. They represent about 70% of the total farmers of the region but they have only 17% of the cultivated area. The remaining 30% is split between medium and large growers.

Table 7.11: Small and medium farm size

Type of producers	Farm's size				Total of famers	
	Small		Medium			
	Total	%	Total	%	Total	%
Non-certified farmers	120	40.4	34	11.3	154	51.9
In process of obtaining certification	59	19.9	34	11.4	93	30.3
Certified farmers	30	10.1	20	6.7	50	16.8
Total	209	70.4	88	29.6	297	100

Source: Own compilation

The productivity of medium certified and in process mango farmers is very similar. For the non-certified farmers, the productivity is a bit higher for the medium size farms. Also, results on the productivity for grapes show that the medium-sized farmers have the highest productivity, however the difference for certified farmers is much larger than those for uncertified farmers (Table 7.12).

There are major differences with regard to the net income between small and medium farmers. Mango medium size farms have a higher income compared to small ones. However, small non-certified grapes farmers have the highest net income compared to the other small-scale farmers, while medium certified ones present the highest net income per ha compared to the medium-sized farmers. An analysis of the production cost per kg reveals that mango farmers present similar figures for small and medium famrs. However, for grapes farmers the difference is larger. For instance, small and medium certified farmers have a difference in cost per kg of R$0.13.

Considering that medium farmers have more irrigated area, it is expected that they would have a higher harvested volume. Nevertheless, the total production is definitely dependent on the type of irrigation system used. The results show that medium farms, regardless of the type of farmers, have a more sophisticated system (varying from 88% to 100%). Thus, 70% of the small certified ones have also a more sophisticated system.

The prices received per kg of mango before adopting certification show that they were similar (R$0.70 and R$ 0.80), while the prices per kg of grapes range between R$ 1.40 and R$ 1.90. Small grapes farmers receive a 38% higher price after certifying while the medium ones receive 27%. In the case of mangoes, small producers receive a 62% and medium a 47% higher price due to certification.

All farmers were informed about certification through SEBRAE and EMBRAPA. The cooperatives, groups and associations do not play an important role as being the primary source of information. It indicates that these organizations are interested that more farmers become members. Although certified farmers are usually members of one of these organizations, certainly they obtain information on certification and updates after they became members. Further, SEBRAE is indicated by small and medium size farmers as a very important organization supporting certification schemes. EMBRAPA is considered very important mainly by medium farmers.

Hirsch (2005) points out that the presence of EMBRAPA in the Sao Francisco Valley is fundamental to the sustainable development of the region because of the need to diversify the production with the growth potential of planted area and irrigation infrastructure. Thus, according to the survey results, SEBRAE offers training courses which are attended by almost all farmers. It is interesting to note that all certified farmers mention to benefit from both research and training courses from EMBRAPA and SEBRAE, respectively.

Table 7.12: Comparative analysis on the land size of all type of farmers

Description of the variables	Non-certified farmers		Farmers in process		Certified farmers		Chi²,t test
	Small	Medium	Small	Medium	Small	Medium	Sig.
Grapes							
Productivity of grapes (tons/ha)	15.4	16.3	16.1	19.1	20.7	27.1	0.004***
Production cost (R$/kg)	0.93	0.83	0.81	0.89	0.92	0.85	0.000***
Total production cost (R$/ha)	16,294	13,269	14,100	16,623	19,133	23,252	0.001***
Total income (R$/ha)	26,059	28,703	24,254	35,949	30,548	48,024	0.002***
Net income (R$/ha)	9,765	15,433	10,154	19,326	11,415	24,771	0.000***
Price received before certifying (R$/kg)	1.4	1.8	1.4	1.9	1.40	1.76	0.253
Price received after certifying (R$/kg)	-	-	-	-	1.94	2.23	-
Mango							
Productivity of mangoes (tons/ha)	18.4	21.9	20.9	19.8	23.2	23.6	0.001***
Production cost (R$/kg)	0.40	0.42	0.35	0.38	0.45	0.42	0.000***
Total production cost (R$/ha)	7,500	9,483	7,413	8,604	10,440	14,161	0.000***
Total income (R$/ha)	16,158	18,317	15,118	19,165	16,636	26,450	0.158
Net income (R$/ha)	8,656	9,833	7,705	10,561	6,196	12,288	0.000***
Price received before certifying (R$/kg)	0.8	0.8	0.7	0.8	0.7	0.8	0.734
Price received after certifying (R$/kg)	-	-	-	-	1.14	1.17	-

Non-certified farmers [n=154], in process [n=93] and certified [n=50]

*** Statistically significant at 1% level;** at 5% level; * at 10% level

Source: Own compilation

7.2.4 Summary

The analysis was based on farmers with one certificate and those with two. Single-certified mango and grapes producers have higher productivity compared to double-certified ones. Notwithstanding, single-certified mango farmers receive higher income and a higher price after adopting certification. However, double-certified grapes farmers have higher net income, although they have twice the annual cost of certification. After adopting certification, 73% and 96% of the single and double-certified producers change the buyer in the next harvesting season.

The main findings based on the certification schemes adopted by certified mango and grapes farmers show that GlobalGAP certified ones have higher productivity for both fruits. GlobalGAP certified mango and grapes farmers have also more irrigated area and receive the highest net income. PIF&Global paid the highest cost of certification. GlobalGAP certified mango farmers and Fairtrade ones receive an increase of 57% in prices after adopting certification, while GlobalGAP certified grapes farmers receive an increase of 27%.

The last analysis is based on a comparison analysis among small and medium farms without certification, in process and already certified. Medium mango and grapes farmers have higher productivity than small ones. As a result they have also higher net income. Small-certified grapes farmers receive a 38% higher price after certifying while medium ones receive 27%. In the case of mangoes, small producers receive 62% and medium ones 47% higher prices per kg.

7.3 Econometric results

This section presents the description of the variables and data used in the logistic regression (Section 7.3.1). The econometric estimates for the decision of adopting two versus one certificate are discussed in Section 7.3.2. The results on the decision of adopting PIF are discussed in Section 7.3.3.

7.3.1 Description of variables and data used in the logistic regression

This section presents the variables and data used in the econometric models. For the logistic regression model, explanatory variables need to be selected according to their relevance. Generally the explanatory variables cover characteristics of the producers, characteristics of their farms, trading relations and post-harvesting. They include:

- ***Age, Education***: younger and more educated farmers are more likely to accept new ideas and adopt new production technologies. Education is expected to be positive and significantly associated with the adoption of certification, whereas age is likely to be negatively correlated (D'Souza et al., 1993; Niemeyer & Lombard, 2003);

- ***Manager***: having a manager to run a farm may indicate that there are better professional skills to manage the farm and thus, it is more likely to certify;

- ***Living_city***: living in the city or on the farm provides an indication of the potential engagement of the farmer put into farming. Wealthier farmers are more likely to live in cities than less wealthier farmers;

- ***Experience***: this study expects to find a positive correlation between years of experience and the decision to certify. The longer a farmer produces, the greater the chances to adopt certification;

- ***Bank_access***: having access to credit in commercial banks for investments on the farm increase the chances to adopt certification;

- ***Member_association***: being member in an association of producers enables farmers to access more sophisticated marketing channels and settle better contractual arrangements. Thus, they are more likely to certify;

- ***Ha***: the area in ha impacts on the harvested volume and thus, on the level of income. The higher the number of ha, the greater the chances to certify;

- ***Total labor***: the number of employees working on the farm influences positively the chances to adopt two certification schemes;

- ***Non_agricultre_income***: farmers who are engaged with other activities besides the cultivation of fruits, have lower chances to certify than those who are highly dependent on the income obtained by fruits;

- ***Type_irrigation***: the level of technology of an irrigation system, whether it is less or more sophisticated may influence the decision-making positively. Luning et al. (2002:383) assume that food quality is dependent on both dynamic properties of the food product and related to applied technological conditions;

- ***Harvesting***: farmers have different methods to proceed with the post-harvesting of fruits in the field: pallets, paper or plastic boxes. The type of post-harvesting method contributes to mantain the fruits quality. It is expected that farmers who handle mangoes in pallets have lower chances to certify, while grapes farmers are more likely if they utilize boxes;

- ***Sub_packing***: farmers utilize the packing house of the group, cooperative or association to whom they belong to after the harvesting. Farmers are more likely to certify;

- ***Transportation***: the farmer is not responsible for the transportation after the gate when the buyer comes to the farm to collect the production. Farmers have lower transaction cost and thus, higher chances to certify;

- ***Year_buyer***: the longer the relationship between farmer and buyer, the lower the incentive to certify (negative correlation);

- ***Trading_indiv***: farmers who trade with individual buyers do not receive support from a group/cooperative or association and hence have lower chances to certify.

The variables presented in this section are used to assess empirically the determinants that lead farmers to adopt certain certification schemes. Two models are estimated: (i) adoption of two versus one certificates and (ii) adoption of PIF. Table 7.13 presents the variables which were used in the logistic regression for the two models and their expected signs. Table 7.14, Table 7.15, Table 7.16 and Table 7.17 present logistic regression results (pseudo R-square, odds ratio, standard error, t-statistics, p values and 95% confidence intervals), respectively.

Table 7.13: List of variables for the econometric analysis

Variables	Description	Expected sign
Two_certific	=1 if producer adopts two certificates; 0= otherwise	
Adopting_PIF	=1 if producer adopts PIF; 0= otherwise	
Explanatory variables		
Age	Age of the producer in years	-
Education	Years of schooling	+
Manager	= 1 if a manager is running the farm; 0= otherwise	+
Living_city	=1 if producer lives in the city; 0= otherwise	+
Year_exper	Years of experience producing mango or grapes	+
Bank_access	=1 if farmer has access to credit in commercial banks; 0= otherwise	+
Member_associ	=1 if farmer is member in an association of producers; 0= otherwise	+
Ha	Ha of planted mango and grapes	+
Total_labor	Number of employees	+
Non_agric_income	=1 if producer has income from non-agriculture sectors; 0= otherwise	-
Type_irrigation	=1 if type of irrigation used is micro sprinkler and drip; 0= otherwise	+
Harvesting	=1 if post-harvesting of mango is done in pallets; 0= otherwise =1 if post-harvesting of grapes is done in boxes; 0= otherwise	- +
Sub_packing	=1 if producer subcontracts a packing house; 0= otherwise	+
Transportation	=1 if the buyer comes to the farm; 0= otherwise	-
Trading_ind	=1 if farmer trades with individual buyers	-
Years trading with a buyer	Years trading with the buyer	-

Source: Own compilation

7.3.2 Econometric estimates for the decision of adopting two versus one certificate

This analysis focuses on the 148 certified grapes and mango producers in the Juazeiro/Petrolina region. The regression estimates were done separately for each fruit aiming to assess the determinants that lead farmers decide to adopt one or more certification schemes. The adjusted Wald test for the models indicates that the models have good explanatory power at 1% level. The R^2 is 0.36 and 0.51 for the grapes and mango models, respectively. For both models, the Hosmer-Lemeshow test presents a good adequacy, the ROC curve presents adequate discrimination and

there are no omitted variables. More details on the commands are presented in Appendices 13 and 14. The regression results are presented in Table 7.14 and Table 7.15.

For both models, the variable subcontracting a packing house plays a major role in the decision to adopt two certificates. Considering that fruits are perishable, farmers who utilize the packing house from the groups, cooperatives or associations they belong to, have better conditions to maintain the fruits with high quality. Mango farmers who have less planted area have 11% lower chances to adopt a second certificate at 5% level. Although for grapes farmers, having more planted hectares impact positively, the variable is insignificant. However, factor as the total labor (insignificant in the grapes model) increases slightly the probabilities.

In addition, each more year of trading with the current buyer decreases the chances by 50% and 31% to adopt the second certificate for mango and grapes, respectively. Further analysis in the marketing chain shows that in both models, there is a negative and significant (only for mango) effect to adopt two certificates if the buyer comes with a truck to the farm to collect the production. Living in the city decreases the chances to adopt a second certification scheme by approximately 85% for both types of farmers. Once the farmer has one certification, the social network and the distance to places where courses are held no longer contribute with addicional information. Further, there are some variables which are not statistically significant. The variables whether a manager runs the farm and having a sophisticated irrigation system impact positively on the decision-making. For mango, age has a positive sign and education a negative one, whereas the opposite results were found for grapes.

Table 7.14: Logistic regression results on the decision of mango farmers to adopt two versus one certificate

Variables	Odds ratio	Robust Std. Err.	Z	P>|z|	95% CI	
Age	1.022	0.032	0.70	0.482	0.961	1.087
Education	0.996	0.081	-0.04	0.969	0.849	1.170
Manager	1.988	1.928	0.71	0.479	0.296	3.313
Living_city	0.173	0.180	-1.69	0.091*	0.022	1.325
Ha	0.806	0.045	-2.13	0.033**	0.810	0.991
Total_labor	1.061	0.023	2.71	0.007***	1.016	1.107
Type_irrig	2.747	2.141	1.30	0.195	0.596	3.661
Sub_packing	3.684	3.211	2.29	0.017***	1.501	7.469
Trans	0.184	0.171	-1.82	0.069*	0.299	1.137
Year_buyer	0.502	0.082	-4.18	0.000***	0.363	0.693
Dependent variable: farmers having one and two certificates; n=148						
*** Significant at 1% level;** 5%; * 10%						
Adjusted Wald Test		F(10, 148)=48.01 p<0.0000				
Pseudo R2		0.5122				
Hosmer-Lemeshow goodness-of-fit test		Chi2(10)= 102.63 p< 0.9852				
Area under the ROC curve		0.9378				

Source: Own calculations

Table 7.15: Logistic regression results on the certification decision of grapes farmers to adopt two versus one certificate

Variables	Odds ratio	Robust Std. Err.	Z	P>|z|	95% CI	
Age	0.985	0.025	-0.55	0.581	0.936	1.037
Education	1.020	0.064	0.33	0.745	0.901	1.156
Manager	1.087	0.970	0.09	0.925	0.189	6.245
Living_city	0.156	0.132	-2.18	0.029**	0.029	0.826
Ha	1.073	0.107	0.72	0.474	0.883	1.305
Total_labor	1.003	0.009	0.41	0.684	0.985	1.022
Type_irrig	1.860	1.266	0.91	0.362	0.490	3.062
Sub_packing	3.785	2.087	2.66	0.008***	1.824	6.490
Trans	0.261	0.360	-0.97	0.330	0.017	3.899
Year_buyer	0.694	0.145	-1.74	0.082*	0.460	1.047
Dependent variable: farmers having one and two certificates; n=148						
*** Significant at 1% level;** 5%; * 10%						
Adjusted Wald Test		F(10, 148)=31.71 p<0.0008				
Pseudo R2		0.3649				
Hosmer-Lemeshow goodness-of-fit test		Chi2(10)= 142.15 p< 0.3417				
Area under the ROC curve		0.8905				

Source: Own calculations

7.3.3 Econometric estimates for the decision of adopting PIF

This analysis considers 252 grapes and mangoes farmers. It looks at the determinants that lead farmers to adopt PIF. Table 7.17 and Table 7.16 present the results. The adjusted Wald test indicates that the model is significant. The Hosmer-Lemeshow test shows that the model presents a good fit. The area under the ROC curve is 0.76 revealing that the models have adequate discrimination. The link test also presents a suitable result which means that the model does not have relevant omitted variables (Appendices 15 and 16).

The results show that younger mango and grapes farmers have 4% higher chances to adopt PIF at 5% level. Also, more educated farmers who live in the city present a positive and significant influence. Grapes farmers having access to credit in commercial banks, present 122% higher chances. Nevertheless, the dependence on the income obtained from non-agricultural sectors and the total labor decrease the chances to adopt PIF.

Mango farmers, who utilize pallets in the post-harvesting process in the field, have 68% lower

chances to adopt PIF. Grapes farmers, for instance, proceed with the post-harvesting in paper or plastic boxes, increasing significantly their probability. Although both results are insignificant, it is interesting to note that trading with individual buyers has a negative effect, while being a member of an association has a positive one.

Table 7.16: Logistic regression results on the decision of mango farmers to adopt PIF

Variables	Odds ratio	Robust Std. Err.	Z	P>|z|	95% CI	
Age	0.969	0.0145	-2.09	0.036**	.941	0.997
Education	1.210	0.0466	4.97	0.000***	1.122	1.305
Living_city	2.497	0.876	2.61	0.009***	1.255	4.968
Experience	1.061	0.0386	1.61	0.107	0.987	1.140
Bank_access	1.575	0.541	1.32	0.186	0.803	3.089
Member_assoc	1.116	0.433	0.28	0.776	0.521	2.391
Total_labor	0.983	0.007	-2.12	0.034**	0.969	0.998
Type_irrig	0.727	0.264	-0.88	0.381	0.356	1.483
Non_agric_inc	0.311	0.126	-2.86	0.004***	0.140	0.698
harvesting	0.321	0.128	-2.84	0.004***	0.147	0.703
Trading_ind	0.442	0.285	-1.26	0.206	0.125	1.566
Dependent variable: non-certified and PIF certified farmers; n=252						
*** Significant at 1% level;** 5%; * 10%						
Adjusted Wald Test		F(11, 252)=43.47 p<0.0000				
Pseudo R2		0.1617				
Hosmer-Lemeshow goodness-of-fit test		Chi2(11)= 244.98 p< 0.3989				
Area under the ROC curve		0.7634				

Source: Own calculations

Table 7.17: Logistic regression results on the decision of grapes farmers to adopt PIF

Variables	Odds ratio	Robust Std. Err.	Z	P>|z|	95% CI	
Age	0.968	.0140042	-2.23	0.025**	0.941	0.996
Education	1.201	.0462129	4.77	0.000***	1.113	1.295
Living_city	2.537	.9020662	2.62	0.009***	1.264	5.093
Experience	0.948	.0710207	-0.71	0.477	0.818	1.098
Bank_access	2.227	.7998685	2.23	0.026**	1.101	4.502
Member_assoc	1.347	.4902528	0.82	0.413	0.660	2.749
Total_labor	0.983	.0085331	-1.92	0.055*	0.966	1.000
Type_irrig	0.609	.2179039	-1.39	0.166	0.302	1.228
Non_agric_inc	0.337	.1368754	-2.68	0.007***	0.152	0.747
harvesting	3.460	1.892639	2.27	0.023**	1.184	10.108
Trading_ind	0.485	.3084847	-1.14	0.255	0.139	1.686
Dependent variable: non-certified and PIF certified farmers; n=252						
*** Significant at 1% level;** 5%; * 10%						
Adjusted Wald Test		F(11, 252)=38.18 p<0.0000				
Pseudo R2		0.1560				
Hosmer-Lemeshow goodness-of-fit test		Chi2(11)= 253.16 p< 0.2386				
Area under the ROC curve		0.7667				

Source: Own calculations

7.3.4 Summary

Data from the survey of 148 certified mango and grapes farmers were used in a logit model to determine the variables associated with the decision of adopting one or more certificates. The second model, included 252 PIF certified mango and grapes farmers and non-certified ones. It aimed at assessing the relevant variables which influence the decision-making on whether to adopt PIF or not. The results from the first model revealed that utilizing the packing house from the group, cooperative or association plays the major role in the decision to adopt two certificates. In addition number of employees working on the farm has also a positive effect. Variables such as 'years trading with the buyer' and 'living in the city' have a negative and significant influence on the decision making. Transportation and planted ha is only negatively significant for mango farmers. Analyzing the models on the decision of adopting PIF, the results show that younger, more educated farmers who reside in the city have more chances to adopt PIF. In the grapes case, farmers having access to credit and post-harvest in boxes have also higher chances. Mango farmers post-harvesting in pallets decrease substantially their chances for PIF.

8 Summary, conclusions and recommendations

8.1 Summary, conclusions and recommendations

Brazilian fruit exports generated US$370 million as a result of the production of 35,000 tons of fruits, harvested on 2,000 ha, in 2004. Mango and grapes are the major fruits exported from the Juazeiro/Petrolina region, while melon and cashew nuts are the major products from the Mossoró/Serra do Mel region. However, Brazilian exports still have a huge potential to grow: only 2% of the total produced volume had been exported in 2004 (IBRAF, 2004). In recent years, several certification schemes have been implemented. These are specifically the Integrated Fruit Production (PIF), GlobalGAP, Fairtrade and Organic certification schemes. It is not clear, however, to what extent these certification schemes offer an opportunity to the farmers to increase their access to international markets or whether they might have the effect of a non-tariff trade barrier.

At the same time, in developed countries, particularly in the European Union and the United States, demand for higher levels of food safety has led to the implementation of certification programs that address more types of safety-related attributes and impose stricter standards. Certification systems play an important role in any market that is burdened with a high degree of information asymmetry and quality uncertainty. Thus, producers and exporters of fresh fruit and vegetables from developing countries like Brazil are increasingly required to demonstrate the safety and traceability of their produce up to the consumption stage. The producers also have to show that they have taken all possible precautions in terms of food and environmental safety along the chain, assured via a certification scheme.

This thesis, therefore, aims at conducting an economic analysis in the Brazilian fruit chain with particular focus on four sectors: mangoes and grapes in the Petrolina/Juazeiro region, cashew nuts and melons in the Serra do Mel/Mossoró region. These are also the four main fruits exported to the US and to the EU. Specific key questions addressed in the study are:

1) To assess the differences and similarities between certified, non-certified and those farmers in process of being certified. The characteristics of farmers and their farms including size, specialization and productivity, are investigated along with their perceptions about the costs and the benefits of certification and their future expectations.

2) To understand the functioning of the marketing chain of these four sectors. The objective is to identify the existing type of global value chain governance in the fruit sectors and provide a theoretical explanation for the reasons they arise. This will generate a better understanding of different forms of inter-firm coordination.

3) To identify the determinants which lead producers to adopt certification. The objective is to identify the variables which determine the probability of farmers adopting one, two or even three certification schemes.

4) To verify the impact of certification on different producers' size. The objectives are to compare the certified and non-certified farmers of small and medium sizes and to identify whether small-scale farmers are possibly excluded from participation in certification schemes.

5) To assess the importance, the similiarities and the differences between selected certification schemes (PIF, GlobalGAP, Organic and Fairtrade).

To answer these questions, a survey of 303 mango and grapes farmers was conducted in the Juazeiro/Petrolina region in the Northeast of Brazil in 2006. In addition, a survey of 85 cashew nuts farmers and six case studies with melon farmers were conducted in the Serra do Mel/Mossoró region. The surveyed farmers are certified by one or more of the existing certification schemes for a few years now. Some farmers are in the process of getting certified. Non-certified farmers serve as a control group. The surveyed farmers are either of small, medium or large size. Details on the survey design, data collection as well as background information on the importance of the fruit production in Brazil are given in Chapter 4.

To analyze the primary data, a conceptual framework of the marketing chain is first developed in Chapter 3. Theoretical and empirical approaches on the farmers' decision to adopt certification in agro-food products are identified. While many authors have discussed empirical approaches to agro-food products, only few studies have focused on the theory as shown from the literature review in Chapter 2. Analyses on the marketing chain focus largely on the identification of the decision-makers in the chain. Papers applying the transaction cost approach discuss the characteristics of contracts, negotiations and transportation between farmers and buyers. Studies on the costs and the benefits of implementing a certain certification scheme provide a deeper understanding on important determinants that lead farmers to certify. For this survey, different approaches contribute to identify and categorize the determinants to adopt a certification scheme.

The comparative analysis of the four certification schemes which exist in the fruit sector in Brazil has shown that GlobalGAP and the Integrated Fruit Production (PIF) are similar certification schemes. However, they differ with respect to the number of requirements and their distribution over various stages (e.g. production, post-harvesting). In addition, PIF certification requires a book keeping system opposed to GlobalGAP. But since, GlobalGAP auditors accept the book keeping provided by PIF, farmers aiming to adopt GlobalGAP face an easier process when they have already PIF.

Contrary to PIF and GlobalGAP, Fairtrade certification concentrates on producers' organizations and cooperatives where small-scale farmers belong to and not on individual farmers. In addition, a lot of attention is paid to the labor and environmental conditions, besides the guarantee of a minimum price for farmers. With respect to organic certification, the requirements are not directed to a particular product or crop and their level of compliance is not indicated. Major emphasis is put on the production system. Organic and Fairtrade certification do not have an own book keeping for records. All four programs are subject to monitoring but with different frequency. PIF certified farmers are monitored three times a year, GlobalGAP requires monitoring twice a year and Organic and Fairtrade certified producers are monitored once a year.

Some descriptive statistics are shown from the comparative analyses between certified and non-certified farmers of grapes, mango, melon and cashew nuts from the survey areas in Chapter 6. An analysis of the characteristics of the farmers concludes that certified farmers are generally not better educated than non-certified ones, with the exception of melon farmers. The high dependence on the income from fruit production combined with a sophisticated irrigation system leads to higher net income for all certified farmers. In addition, certified farmers of the four types of fruits have higher productivity, more land allocated to the specific fruit and more years of experience in the field. Mango and grapes certified and in process farmers have invested high amounts in new infrastructure. On the contrary, all melon certified farmers have concentrated more on reconstruction. In the case of cashew nuts, the investments are relatively small. Despite the higher costs per ha, they receive net income which is slightly higher for the certified farmers but slightly lower for the farmers in process.

The higher net income partly derives from the price premium paid for the certified fruits. Mango and grapes farmers receive an increase of price per kg by 58% and 28%, respectively. Cashew nuts farmers receive the highest rates: 82% per kg of nuts and 62% per kg of kernels. Melon producers do not receive a price premium after adopting certification, but it enables them to remain in the

market. Besides the price premium, farmers also consider environmental issues as important benefits. Mango and grapes farmers mainly aim at decreasing the use of pesticides and agro-toxics, and cashew nuts farmers focus on having a more holistic approach to environmental issues through their environmental plan. More specifically, they aim at avoiding burning and promote adequate soil management. Melon farmers also mention having an environmental plan but with a different focus set on the care of preservation areas. Further, all farmers of the four sectors plan to continue producing fruits in the long run. Mango and grapes certified farmers aim at increasing exports to new markets (e.g. Japan and the US).

In the Juazeiro/Petrolina region, organizations like SEBRAE and EMBRAPA play a significant role in providing information with regard to certification. Besides, these organizations are also important in supporting training courses and developing research. Interesting to note is that farmers, after adopting certification become members in a group, cooperative or association which provide updates on important certification issues. In the Serra do Mel/Mossoro region, the social network is the main source of information for cashew nuts farmers, and the buyers for melon farmers.

The descriptive analysis is being complemented by some econometric models in Chapter 6. The LOGIT model is used three times: first, for identifying the determinants of the adoption decision of certification and second, for determining the factors relevant for adopting two versus one certification scheme, and third, for testing the main factors that lead farmers to adopt specifically PIF. Several tests are performed to check the robustness of the models. To assure that the data is homogeneous, relevant variables are tested against heteroscedasticity using the Hausman test. In addition, the presence of multicollinearity among the variables is checked through correlation tables and also tests with regard to model specificities are done.

The logistic estimates consider certified mango, grapes and cashew nuts farmers and in process to obtain certification as one group and non-certified farmers as another. The estimates of the all fruits model show that only education has a positive and significant effect on the decision to adopt certification. But there are a number of significant variables which have a negative impact. Thus, the chances to certify decrease when farmers are dependent on the income from non-agricultural activities, are living in rural villages and not on the farm and, trade with an individual buyer using a verbal trust-based arrangement. The estimates on grapes and mango models consider whether the farmer is a mango or grapes grower as part of the variables set. For instance, farmers who are mango growers, have 59% lower probability to certify. Grapes farmers have 119% higher chances

to certify. More educated and more experienced farmers are more likely to certify. On the other hand, small farms, dependency on income obtained from non-agricultural activities, the share of the current irrigated area, and the trust verbal-based contract arrangement contribute to decreasing the chances of adoption. In the cashew nut estimates, education is the one with the strongest positive and significant impact on the decision-making of the producers, followed by the variable number of family members of the household and dependency on the income obtained from non-agriculture activities.

Chapter 7 gives an overview of the grapes and mangoes marketing chains revealing that certified producers generally trade with groups, cooperatives or associations while non-certified farmers trade with individual buyers. Groups, associations or cooperatives are responsible for the collection of the production at the farms, for storage, classification and transportation to the final buyer. In addition, they trade and settle contractual agreements with international buyers. These results show that certified farmers have achieved a higher level of coordination and vertical integration along the chain. On the contrary, the majority of the non-certified farmers trade directly with individual buyers.

The types of governance have been used to illustrate the way power operates in the fruit value chain. On the one hand, non-certified farmers of grapes and mangoes operate in the market-based global value chain. On the other hand, the results reveal that certified farmers, regardless of the fruit, shift from arm's-length market to quasi-hierarchical relationships attributed mainly to a high level of asset specificity, i.e. a shift from market-based global value chain governance to a relational value chain. This is achieved through a close dialogue between more or less equal partners with a more explicit coordination, which shows the importance of the competitive strategies such as certification in driving changes.

The cashew nut marketing chain shows that non-certified farmers trade mainly with individual buyers and certified farmers with cooperatives. The trading with the cooperatives is described by a modular value chain type of governance characterized by network relationships. However, trading with individual buyers is classified as a market type of governance with arm's length relations. Although the cooperative contribute to upgrade mostly certified farmers, there is still potential in the region to shift farmers to an upper level of coordination. However, to reach this higher level of coordination, investments are needed in this sector mainly in modern equipments and new technologies such as irrigation systems.

Although some melon farmers are not certified, they have indirect access to international channels through trading companies. The contractual relationships between non-certified farmers and trading companies as well as between certified farmers and the international buyer are all based on written contracts. According to the concepts of governance, transactions done directly and indirectly with international buyers are characterized as a captive type of governance where quasi-hierarchical relationships dominate [buyer defines the product and controls over the suppliers]. The results confirm that the sector is well-coordinated along the chain up to the international buyer. In contrast, selling melons in the domestic market presents a high risk of payment failure. The lack of guarantees through formal contracts with national buyers and the dependence on daily price fluctuations contribute to making the conditions to trade in the country unstable.

Farmers who have adopted one certification scheme sometimes also adopt a second or a third one. Therefore, Chapter 7 also deals with the analysis of the adoption process depending on the number and the kind of schemes. The findings reveal that single-certified mango and grapes producers have higher productivities compared to double-certified ones. Notwithstanding, the income of farmers with one certificate is higher than that of the remaining group. Single certified mango farmers after adopting certification received a 61% higher price compared to double ones who received 55%. Thus, single certified grapes farmers note a price increase of 27%, while double ones receive 29%. The comparative analysis hardly shows differences between having one or two certificates. The cost of certification is also twice higher for double-certified farmers compared to single-certified ones.

Econometric estimates on the decision of mango and grapes farmers to adopt two or one certificate show that utilizing the packing house from the group, cooperative or association plays the major role in the decision to adopt two certificates. In addition, the number of employees working on the farm has also a positive effect. Variables such as ‘years trading with the buyer’ and ‘living in the city’ have a negative and significant influence on the decision-making. ‘Transportation’ and ‘planted ha’ is only negatively significant for mango farmers. In addition, econometric results on the decision of adopting PIF show that younger and more educated farmers who reside in the city have more chances to adopt PIF. In the grapes case, farmers having access to credit and post-harvest in boxes have also higher chances. Mango farmers post-harvesting in pallets decrease substantially their likelihood of adopting certification.

With respect to the size of the farms, there is a concern that small producers’ participation in the international fruit and vegetable trade could be diminishing as a result of the increasing prevalence

of certification and standards in the sector. Based on a comparative analysis between small and medium farms, medium farmers of mango have higher productivity than small ones. Hence, medium sized farms possess more irrigated area and have a more sophisticated irrigation system, they also achieve a higher income compared to small ones. Nevertheless, this study shows that small producers of mangoes and grapes receive a higher price per kg after certifying compared to medium ones. For instance, small and medium mango farmers receive a 62% and a 47% higher price, while small and medium grapes ones receive 38% and 27%, respectively. It can be concluded, that evidence on marginalization of small farmers is not found in this study.

8.2 Policy recommendation

The reasons motivating farmers to vertically integrate are the reduction in transaction costs resulting from the economies of scale and the need to ensure consistent quality supply through the adoption of certification. The low number of certified mango and grapes farmers in the Petrolina/Juazeiro region compared to the number of farmers harvesting fruits, indicates that the fruit sector has a huge potential to grow and expand. Targeted support from the government and private sector will likely contribute to an increased competitiveness of the fruit sector.

Based on the findings from this study, certification is considered a catalyst to increase exports, with farmers benefiting in economic and environmental terms. On the one hand, farmers have an incentive to upgrade and are able to access the international market with certification. Mango and grapes producers having a certificate are more likely to find customers in the international markets. Thus, certification is indeed a passport to access international markets. On the other hand, certification excludes less capable growers from the market, meaning that the increasing level of requirements *per se* selects the farmers who are able to comply. But also the access to information may also restrict farmers from participation in certification programs. Thus, organizations supported by government should assure that information is available and that certification is a transparent and a voluntary process. Adopting two certificates does not necessarily pay off, but in some cases it might open the market to specific countries.

In Juazeiro/Petrolina region, it is important that organizations like EMBRAPA, SEBRAE and others which support small farmers, promote and give incentives to farmers to participate in training courses, workshops and discussions with experts. They should also provide updates related to certification, disseminate information on new varieties and help finding solutions for plagues and diseases in the orchards. Information should equally reach farmers living in rural

villages and on the farm. Unfavorable factors are the distance from the rural village to the city center, where usually training courses and workshops are held, and the lack of adequate facilities. In this line, organizations should promote regional and local meetings.

In the Mossoró/Serra do Mel region, there is an increasing need to inform e.g. cashew nuts farmers about the advantages to adopt certification and the opportunities with respect to market access, environmental benefits, and price premium. Organizations in the region, like SEBRAE and EMATER could contribute with courses and the cooperatives, with social gatherings.

Although the major importer of melons is the EU, the status of pest-free zone of the fruit fly *Anastrepha Grandis* enables farmers from Brazil to also access the US market. The melon sector in Brazil is highly concentrated with a few farmers possessing advanced technology and control over the marketing channels. Contractual arrangements between international buyers and farmers as well as between trading companies and farmers are well-developed. However, arrangements with domestic buyers still open margin for improvement.

Support to upgrade and increase efficiency along the chains is highly important mainly for non-certified farmers. This would be possible via vertical integration, cooperation and coordination, including the use of written contracts, among the actors in the chain. Upgrading along the value chains can help moving towards quality standards, increased international access, and better contractual arrangements.

Promoting the establishment of new associations, groups or cooperatives of small non-certified farmers contributes to development of the fruit sector. As has been found, farmers trade mostly with individual buyers and they become members of an organization once they certify. Hence, particularly small non-certified farmers are disadvantaged when negotiating over price and quality with individual buyers. Groups, cooperatives and associations, however, enhance communication and information-sharing among members and are helpful in identifying the problems and needs of producers in implementing certification. In addition, joining a group contributes to improve the efficiency of management, to increase the fruit quality, and to reduce the costs of certification.

The Brazilian government and the private sector could promote the consumption of certified fruits via campaigns on the TV or fairs in strategic geographical locations. Domestic consumers should become aware of the environmental benefits of certified products. In particular, focus should be

given to the benefits of consuming healthier fruits. In addition, promoting the consumption of certified fruits would give incentives to more farmers to adopt certification.

8.3 Limitations of the study and further research needs

Several weaknesses and limitations of the methodology of the study could be identified and should be considered to avoid misinterpretation of the results leading to wrong conclusions. The first point relates to the geographical and climate conditions of the survey regions, which are unique in the country. Therefore, the land size which defines a producer as small, medium or large varies when comparing to farmers who harvest the same fruit in different regions of the country. In this survey the respective definitions of SEBRAE are adopted.

Another point is the composition of the sample. The stratum of certified producers does not always specify the type of certification scheme a farmer belongs to. Thus, the distribution of the farmers among the different schemes is not representative. Additionally, the majority of the population size is composed of small size producers, so that more questionnaires are applied to them. Medium and large-scale producers are therefore considered to a lower extend.

The cashew nuts sector presents peculiar characteristics. The sampled producers are all concentrated in a small area, do not have access to irrigation systems and hence are highly dependent on rain. In addition, cashew nuts farmers in general have significant difficulties in remembering the production cost. Therefore, the results on net income were not possible to calculate.

The melon cases give an overview of the sector in the region. Considering farmers and traders, it is possible to identify to which extent they comply with standards, how they make decisions and how their level of compliance is. However, the case studies were not selected randomly, but are expressly based on their marketing channel to access either national or international markets. The difficulty in accessing the farms was outstandingly high. To collect these six cases, a time of two months period was needed. Two adversities are to be mentioned in this context: the harvesting period kept managers and owners busy, and there were restrictions to enter the farm. In order to have permission to enter the farm, the manager of COEX kindly arranged the contacts and an easy access to reach the farms was assured.

A value chain analysis should incorporate the behavior of traders and consumers, however only the level of the producers is considered in this study to receive information about the traders and

consumers. Apart from these limitations related to the field research and the sampling, some methodological shortcoming need to be mentioned. For analyzing the survey of cross-sectional data, the binary logistic model is used to assess the determinants which lead farmers to adopt certification. However, these are the following: (i) having a relative small number of observations on certified farmers [the low number of certified farmers in the regions limits further data collection]; (ii) inability to estimate the impact of variables with regard to each certification scheme on the farm level; (iii) inability to include many important variables due to endogeneity, and (iv) missing valid instrumental variables. Another limitation of this study refers to the fact that certified farmers are not able to distinguish the cost of compliance and the price received with respect to each certification scheme. Therefore, this study considers the results sometimes based on the combinations of schemes and not related to individual schemes.

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Appendices

Appendix 1: Map of the Northeast region of Brazil

Source: IBGE (2005)

Appendix 2: Questionnaire applied for mango and grapes producers with and without certification

Number of the questionnaire:_____
Name of the producer: _____
Number of the plot:_____
City:_____
Date: _____

I – Characteristics of the farm and of the producer

1.1. Who is the head of the family?
( ) male
( ) female

1.2. Is the head of the family also the manager of the farm?
( ) yes
( ) no

1.3. Gender of the manager
( ) female
( ) male
( ) not applicable

1.4. Age of the head of the family
( ) years

1.5. Age of the manager
( ) years
( ) not applicable

1.6. People living on the farm (to fill with the numbers of people):

The owner's family ( ) yes ( ) no

Where does the ower's family live? ( ) city ( ) rural area

Family of workers ( ) yes ( ) no
( ) how many families?
( ) men
( ) women
( ) kids (age above 18)
( ) kids (age bellow 18)

Family of caratakers ( ) yes ( ) no
( ) how many families?
( ) men
( ) women
( ) kids (age above 18)

( ) kids (age bellow 18)

1.7. How many family members are working on the fruit culture?
( ) none
( ) the owner male
( ) the owner female
( ) sons
( ) daughters

1.8. What is the size of the land?___ ha
How many ha area effectively irrigated?____
How many ha are potencial to irrigated?_____
What is the type of irrigation system used?_____

1.9. Does the land belongs to the:
( ) family
( ) rented
( ) ownership from the government
( ) other situation. Which?_____

1.10. Does the family depend only on the income generated by the fruits?
( ) yes
( ) no
if not, which are the main sources of income? _____

1.11. Did you use own resources to invest on the farm?
( ) no

	2005	2004	2003	2002
If yes,	R$	R$	R$	R$

1.12. Do you have access to credit at commercial banks?
( ) no
( ) yes, which bank?_____

1.13. Did you invest loans obtained from commercial bank to invest on the farm?
( ) no

	2005	2004	2003	2002
If yes,	R$	R$	R$	R$

1.14. What is the level of education of the head of the family and/or the manager?

Options	Head	manager
Does not know how to read and to write		
Only knows to write the name		
Fundamental school incomplete		
Fundamental school complete		
Secondary school incomplete		
Secondary school complete		
Undergraduate degree incomplete		
Undergraduate degree incomplete		
Posgraduate studies		

1.15. How many workers are employed with?

_____ Permanent workers with social benefits
_____ Permanent workers without social benefits
_____ Temporary workers with social benefits
_____ Temporary workers without social benefits

1.16. What are you producing, since when and how many ha? (quantity in kg in 2005):

Fruit	since	Ha	volume
Grapes			
Mangoes			
Papaya			
Banana			
Guava			
Coconuts			
Watermelon			
Melon			

II – Cost of information

2.1 Are you in process to obtain certification?

Fruits	PIF		Eurepgap		Fairtrade	
	since	no	since	no	since	no
Grapes						
Mangoes						

2.2 Which fruit is already certified?

Fruits	PIF		Eurepgap		Fairtrade	
	since	No	since	no	since	no
Grapes						
Mangoes						

2.3. Did you hire any workers due to certification?
( ) no
( ) yes, how many?_____

2.4 How long did it take to certify?
Technique implementation: _____ months
Infraestructure: _____months

2.5 How would you classifed the level of bureaucracy of this certificate?

Option	PIF	Eurepgap	Fairtrade
Does know			
Very bureaucratic			
Acceptable			
Little bureaucratic			
Not bureaucratic			

2.7 In your opinion, was certification a voluntary or enforced process?
( ) does not know
( ) yes, PIF enforced, by whom?_____
( ) no, PIF was voluntary
( ) yes, Eurepgap enforced, by whom?_____
( ) no, Eureggap was voluntary
( ) yes, Fairtrade enforced, by whom?_____
( ) no, Fairtrade was voluntary

2.8 Do you know why certification is needed? (choose 1, 2, 3, etc according to level of importance):
( ) no, I have no idea
( ) no, I need to fill many documents, but I do know why
( ) it is an excuse to make the farmers spend more money
( ) the domestic consumers are not aware about certification and therefore, are not willing to pay more
( ) more or less, is to register all stages of the production
( ) yes, it is requirement of the market seeking food safety
( ) yes, it is a guarantee that fruits are produced safely, according to the international standards
( ) other reason_____

2.9 Who had required or requires you certification? (choose 1, 2, 3, etc according to level of importance):

Options	PIF	Eurepgap	Fairtrade
No one, I adopted because I wanted			
The final client			
The cooperative or association to whom I sell the harvesting			
The trader			
The wholesaler in Brazil			
The middlemen in Brazil			
Organizations like SEBRAE, EMBRAPA, etc			

2.10 Why did they required certification? (choose 1, 2, 3, etc according to main answer):

Options	PIF	Eurepgap	Fairtrade
It is requirement of the final consumer			
In my opinion, it is non-trade barrier			
Due to concerns with food safety			
Due to concerns on environmetal issues			
Due to concerns on social welfare			

2.11 How were you informed before adopting certification? (choose 1, 2, 3, etc according to main answer):

Options	PIF	Eurepgap	Fairtrade
EMBRAPA			
SEBRAE			
CODEVASF			
Association of producers			
City Hall			
Neighbour			
Trader			
Internet			
TV			
Technique support			
Other			

2.12 What is the level of importance of the following organizations in supporting certification? (select with "x"):

Options	Extremely important	Important	little important	No importance
Does not know				
EMBRAPA				
SEBRAE				
Cooperative				
Association of producers				
Cooperative				
Group of producers				
City Hall				
ONG				
other				

III – Certification cost

3.1Cost of certification:

Options	R$
Auditoring by a Brazilian certifying company	
Auditoring by a foreign certifying company	
Monitoring	
Tests of agrochemical residues	
Test of water	
Test of leaves	
Other costs	

3.2 Where do you do the tests?

Tests	This city	Next city	ITEP	Another city
Test of agrotoxics residues				
Test of water				
Test of soil				
Test of leaves				
Other				

3.3 What did you need to build new and reconstruct at your farm due to certification? (fill the blanks witht the amount):

Options	New infrastructure		Reconstruction	
	yes	R$	Yes	R$
Signallig plates				
Office				
Loggings				
Caretaker house				
Deposit of fertilizers				
Deposit of agrochimic				
Deposit of tools				
Refectory				
Toiletes				
Agrochemical mixture place				
Deposit of emergency				
Deposit of empty agrochemicals packages				
Packing house				

3.4 What is the production cost per kg?

Options	Cost per Kg (R$)
Grapes	
Mangoes	

3.5 Indicate what has been the support from EMBRAPA:

( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) development of research
Financial	( ) provides indirect financial resources
	( ) provides direct financial resources

3.6 Indicate what has been the support from Non-Governmental Organization (ONG):
( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) development of research
	( ) technical visits
	( ) pre-auditoring
Financial	( ) provides indirect financial resources
	( ) provides direct financial resources

3.7 Indicate what has been the support from SEBRAE:
( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) technical visits
	( ) pre-auditoring
Financial	( ) Program "bonus certification"
	( ) tests of agrochemical residues
	( ) provides indirect financial resources
	( ) provides direct financial resources

3.8 Indicate what has been the support from CODEVASF:
( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) technical visits
	( ) access to new technologies
Financial	( ) provides indirect financial resources
	( ) provides direct financial resources

3.9 Indicate what has been the support from the COOPERATIVE OR ASSOCIATION:
( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) development of research
	( ) technical visits
Financial	( ) pre-auditoring
	( ) provides indirect financial resources

IV - Benefits to certify

4.1 Did you increase the volume exported due to certification?
( ) no, the volume exported was the same
( ) yes, the volume increased due to certification
( ) yes, the volume exported increased but due to olther reasons. Which?_____

If yes, how much was the increase of exports?

Fruits	PIF	Eurepgap	FAIRTRADE
	%	%	%
Grapes			
Mangoes			

4.2 How many hectares have you designated to cahsew nuts, before and after adopting certification?

Fruits	PIF		EurepGAP		FAIRTRADE	
	before	after	before	after	before	after
	ha	ha	ha	ha	ha	ha
Grapes						
Mangoes						

4.3 Did you receive a price premium due to having certification?
( ) yes
( ) no

4.4 Did you have any expectation to receive a price premium?
( ) yes
( ) no

4.5 What was the price received before and after adopting certification? (Price in R$, per kg):

Fruits	PIF		EurepGAP		FAIRTRADE		Other	
	before	after	before	after	before	after	before	after
	price	price	price	price	price	Price	price	Price
Grapes								
Mangoes								

4.6 Were you aware about decreasing environmental damages at your farm? (Choose 1 for the fist option, 2 for the second, etc):
( ) I am not concern about this issue
( ) to follow the rules described by the manual of each certification scheme
( ) It is so complicated to conciliate fruit production and environment
( ) do not contaminate water wells and recycle empty agrotoxics packages
( ) to avoid burns
( )_____

4.7 Which of the following options did you consider important while you decided to certify? (Choose 1 for the first option, 2 the second, etc):
( ) nothing, I do not care about environment
( ) the production is organic, i.e., does not require pesticides
( ) conservations and adequate soil management
( ) to have an environmental plan
( ) to decrease the use of pesticides
( ) do not contaminate water wells
( ) to give an adequate destination of empty packages of agrotoxics
( )_____

4.8 Which of the following options did you use to sell your production before certifying? (Fill in % in 2005):

Options	PIF	Eurepgap	Fairtrade
US			
EU			
Other			
Domestic market			

4.9 Which of the following options did you use to sell your production after certifying? (Fill in % in 2005):

Options	PIF	Eurepgap	Fairtrade
US			
EU			
Other			
Domestic market			

4.10 Which are the advantages of having certification? (Choose 1 for the first more important, 2 for the second, etc):

Options	PIF	Eurepgap	Fairtrade
Do not know which could be the benefits			
There are no benefits			
To have a better farm organization			
To receive a price premium			
To follow the welfare requirements (do not have child labor, etc)			
To seek the welfare of workers			
The concern of food security			
To decrease environmental damages			
To decrease the use of pesticides and agro toxics			
The possibility to export to new markets			
To remain in the market			
To settle better negotiations			
To decrease the production cost			
To improve the quality of the fruit			
To have a differentiated product			
Other reason: which one?			

4.11 What are the main disadvantages of having certification? (Choose 1 for the most important, 2 the second, etc):

Options	Without certif.	PIF	Eurepgap	FAIRTRADE
Only disadvantages				
I do not see any disadvantage				
To compete with producers without certification in the market				
Do not receive a price premium due to certified fruit				
´The cost of compliance are too high				
To have restricted use of certain products				
There is no return for such an afford				

4.12 Which are the main reasons that lead you to adopt certification? (Choose 1 for the most important, 2 the second, etc):

Options	PIF	Eurepgap	FAIRTRADE
To remain in the market			
The expectation to receive a price premium			
To protect and conserve the environment			
To produce a product with higher quality			
To have a certified fruit is a requirement from the buyer			
The facility to have support from SEBRAE, EMBRAPA			
Due to the farm size: opportunity to increase the volume exported			
Other reason: which one?			

4.14 Why did you decide for non-adopting certification? (Choose 1 for the most important, 2 the second, etc):

( ) financial condition
( ) lack of information
( ) lack of support of organizations like SEBRAE, EMBRAPA, CODEVASF and VALEXPORT
( ) difficulties to fil the requirements
( ) due to the farm size, the investment is too high
( ) I had problems with the buyer
( ) I do not intend to remain in the market many years
( ) Ido not intend to comply with any certification scheme
( ) other reason, which one?_____

V – Trading

5.1 Do you have a packing house?

( ) no
( ) yes, since when?_____

5.2 How do you do the post harvesting process?
( ) in the packing house
( ) in the field in pallets
( ) in the field:_____

5.3 In case you do not have an own packing house, how do you proceed?
( ) Utilize a subcontracted one
( ) _____

5.4 How does the transportation of the fruits work?
( ) I take with my truck the production to the cooperative
( ) I take with my truck the production to the association
( ) Someone from the cooperative comes to my farm to take the production
( ) Someone from the association comes to my farm to take the production
( ) someone from the packing comes with a truck to the farm to take the production
( ) the buyer comes directly to my farm to take the production
( ) other, _____

5.5 To whom to you sell your production? (Write the starting year and the percentage in 2005):

Options	Since when?
Exporter company	
Association of producers	
Cooperative	
Group	
To the middlemen	
To a wholesaler	

5.8 Why did you decide to trade with individual buyers? (Fill 1 for the first answer, 2 for the second, etc)
( ) I do not have another option to sell
( ) I have infrastructure
( ) I have better market access
( ) I have higher flexibility in the contracts
( ) it is more profitable
( ) Other reason. Which?_____

5.9 Why did you decide to trade with the cooperative/group or association?
( ) I do not have other option to trade with
( ) Access to market
( ) due to the guarantee of selling
( ) due to contractual conditions
( ) information access
( ) because my neighbour does
( ) recommendation of EMBRAPA, SEBRAE or other organization
( ) I did not have other option to sell
( ) other. Which?_____

5.10 What is the final destination of your production (before certifying) (Fill in %):

	International makets			Domestic markets				
Fruits	EU	US	other	CEAJESP	CEAP	Local market	middleman	other
Grapes								
mangoes								

5.11 What is the final destination of your production (after certifying) (Fill in %):

	International makets			Domestic markets			
Fruits	EU	US	other	CEAJESP	CEAP	Local market	middleman
Grapes							
mangoes							

5.12 Why did you decide to trade your products in the domestic market? (Choose 1 for the first answer, 2 for the second, etc):

( ) do due easier access
( ) I had contractual problems with former buyers
( ) excess of supply
( ) a crop disease
( ) climate conditions
( ) the exchange rate was low
( ) the quality required was not reached
( ) Other reason, which?_____

5.13How is the relationship between you and your buyer? (Fill Y=yes or N=no):

Type of arrangement	Domestic market			
	CEAJESP	Trading comp.	Local market	middleman
CONTRACT				
Percentage of the production you trade:				
Since when do you trade with				
Is the price fixed in the contract?				
Has the price minimum guarantee?				
Is the price consignated?				
Is the volume estipulated in the contract?				
Is the contract one harvest season?				
Is the quality estipulated?				
Does the buyer require certification?				
Have the clauses been met by the buyer?				
Is the client flexible when something unexpected happened?				
Did have a contract cancelled				
INFORMAL: ONLY VERBAL				

Percentage of the production you trade:				
Since when do trade with				
Is the payment done immediately?				
Is the payment done in advance?				
Is the payment done is partially?				
Is the price determined by the buyer?				
Is the price determined by you?				
Does the buyer buy any type of fruit?				
Is the client flexible in the negotiations?				
Does the buyer require that you have certification?				
Did you experience a case of non-payment?				
INFORMAL TRUST-BASED				
Percentage of the production you trade:				
Since when do trade with				
Is the payment done immediately?				
Is the payment done in advance?				
Is the payment done is partially?				
Is the price determined by the buyer?				
Is the price determined by the final industry?				
Is the price determined by you?				
Does the buyer buy any type of fruits?				
Is the client flexible in the negotiations?				
Does the buyer require that you have certification?				
Did you experience a case of non-payment?				

5.14 How is relationship between you and your buyer? (Fill Y=yes or N=no):

	Cooper.	association	Group
CONTRACT			
Percentage of the production you trade:			
Since when do you trade with			
Is the price fixed in the contract?			
Has the price minimum guarantee?			
Is the price consignated?			
Is the volume estipulated in the contract?			
Is the contract one harvest season?			
Is the quality estipulated?			
Does the buyer require certification?			
Have the clauses been met by the buyer?			
Is the client flexible when something unexpected happened?			
Did have a contract cancelled			
INFORMAL: ONLY VERBAL			

Percentage of the production you trade:			
Since when do trade with			
Is the payment done immediately?			
Is the payment done in advance?			
Is the payment done is partially?			
Is the price determined by the buyer?			
Is the price determined by you?			
Does the buyer buy any type of fruit?			
Is the client flexible in the negotiations?			
Does the buyer require that you have certification?			
Did you experience a case of non-payment?			
INFORMAL TRUST-BASED			
Percentage of the production you trade:			
Since when do trade with			
Is the payment done immediately?			
Is the payment done in advance?			
Is the payment done is partially?			
Is the price determined by the buyer?			
Is the price determined by the final industry?			
Is the price determined by you?			
Does the buyer buy any type of fruits?			
Is the client flexible in the negotiations?			
Does the buyer require that you have certification?			
Did you experience a case of non-payment?			

VI– Future expectation

6.1 How many do you have expectation to remain in the same market?
_____ Years
( ) undetermined

6.2. Are you planning to export to other markets?
( ) no
( ) yes. Which ones?_____

6.3 How many years to you expect to continue to produce fruits?
_____ years
( ) undetermined

6.4 Which varieties are you cultivating at the currently? (Select with an"x"):

Variety	Tommy Atkins	Palmer	Haden	Keitt	Rosa	Espada	Other
Mango							
grapes	Benitaka	Itália	Red Globe	Brasil	Patrícia	Rebier	Vitoria

6.5 Do you intend to change any variety?
( ) no

Variety	Tommy Atkins	Palmer	Haden	Keitt	Rosa	Espada	Outra
Mango							
Variety	Benitaka	Itália	Red Globe	Brasil	Patrícia	Rebier	Vitoria
grapes							

Appendix 3: Questionnaire applied for cashew nuts producers with certification

Questionnaire number:_____
Name of the producer:_____
Number of the plot:_____
Data: _____

I – Characteristics of the farm and of the producer

1.1. Who is the head of the family?
( ) male
( ) female

1.2. Is the head of the family also the manager of the farm?
( ) yes
( ) no

1.3. Gender of the manager
( ) female
( ) male
( ) not applicable

1.4. Age of the head of the family
( ) years

1.5. Age of the manager
( ) years
( ) not applicable

1.6. People living on the farm (To fill with the numbers of people):

The owner's family ( ) yes ( ) no

Where does the ower's family live? ( ) city ( ) rural area

Family of workers ( ) yes ( ) no
( ) how many families?
( ) men
( ) women
( ) kids (age above 18)
( ) kids (age bellow 18)

Family of caratakers ( ) yes ( ) no
( ) how many families?
( ) men
( ) women
( ) kids (age above 18)
( ) kids (age bellow 18)

1.7. How many family members are working on the fruit culture?
( ) none
( ) the owner male
( ) the owner female
( ) sons
( ) daughters

1.8. What is the size of the land?___ ha
How many hectares area effectively irrigated?____
How many hectares are potencial for irrigation?_____
What is the type of irrigation system used?_____

1.9. Does the land belongs to the:
( ) family
( ) rented
( ) ownership from the government
( ) other situation. Which?_____

1.10. Does the family depend only on the income generated by the fruits?
( ) yes
( ) no
if not, which are the main sources of income? _____

1.11. Did you use own resources to invest on the farm?
( ) no

	2005	2004	2003	2002
If yes,	R$	R$	R$	R$

1.12. Do you have access to credit at commercial banks?
( ) no
( ) yes, which bank?_____

1.13. Did you invest loans obtained from commercial bank to invest on the farm?
( ) no

	2005	2004	2003	2002
If yes,	R$	R$	R$	R$

1.14. What is the level of education of the head of the family and/or the manager?

Options	head	manager
Does not know how to read and to write		
Only knows to write the name		
Fundamental school incomplete		
Fundamental school complete		
Secondary school incomplete		
Secondary school complete		
Undergraduate degree incomplete		
Undergraduate degree incomplete		
Posgraduate studies		

1.15. How many workers are employed with?
_____ Permanent workers with social benefits
_____ Permanent workers without social benefits
_____ Temporary workers with social benefits
_____ Temporary workers without social benefits

1.16. What are you producing, since when and how many hectares? (quantity in kg in 2005):

Product	since	hectares	volume
Cachew nuts			
Kernel			

II – Information cost

2.1 Do you have organic certification?
( ) yes, since when?_____
( ) no

2.2. Did you hire any workers due to certification?
( ) no
( ) yes, how many?_____

2.3 Why did you delay so many years to decide for adopting certification? (choose 1, 2, 3, etc according to the level of importance):

Option	ranking
There was no requirements from the buyer	
Lack of information	
There was no guarantee of higher prices	
There was no accredited certifying company	
The cost to certify are too high	
There was no technical support	
I have no interest to follow market trends	
Other	

2.4 How would you classifed the level of bureaucracy of this certificate?

Options	ranking
Does know	
Very bureaucratic	
Acceptable	
Little bureaucratic	
Not bureaucratic	

2.5 In your opinion, was certification a voluntary or enforced process?
( ) does not know
( ) yes, enforced, by whom?_____
( ) no, it was voluntary

2.6 Do you know why certification is needed? (choose 1, 2, 3, etc according to level of importance):
( ) no, I have no idea
( ) no, I need to fill many documents, but I do know why
( ) it is an excuse to make the farmers spend more money
( ) the domestic consumers are not aware about certification and therefore, are not willing to pay more
( ) more or less, is to register all stages of the production
( ) yes, it is requirement of the market seeking food safety
( ) yes, it is a guarantee that fruits are produced safely, according to the international standards
( ) other reason_____

2.7 Who is requiring to you certification? (choose 1, 2, 3, etc according to level of importance):

Options	ranking
No one, I adopted because I wanted	
The final client	
The cooperative or association to whom I sell the harvesting	
The trader	
The wholesaler in Brazil	
The middlemen in Brazil	
Organizations like SEBRAE	
ONG	
Cooperative	

2.8 Why did they required certification? (choose 1, 2, 3, etc according to main answer):

Options	ranking
It is requirement of the final consumer	
In my opinion, it is non-trade barrier	
Due to concerns with food safety	
Due to concerns on environmetal issues	
Due to concerns on social welfare	

2.9 How were informed about organic certification before the adoption? (choose 1, 2, 3, etc according to main answer):

Options	ranking
EMBRAPA	
SEBRAE	
Cooperative	
Associations of producers	
EMATER	
EMPARN	
City Hall	
Neighbour	
Trader	
Internet	
TV	
Technique support	
Other	

2.10 What is the level of importance of the following organizations in supporting certification? (select with "x"):

Options	Extremely important	Important	little important	No importance
Does not know				
EMBRAPA				
SEBRAE				
Cooperative				
Association of producers				
EMATER				
EMPARN				
Group of producers				
City Hall				
ONG				
other				

III – Certification cost

3.1 Where do you do the tests?

Tests	This city	Next city	Onother city	Does not do any test
Test of...				
Test of				

3.2 What did you need to build new or reconstruct at your farm due to certification? (fill the blanks witht the amount):

Options	New infrastrucure		Reconstruction	
	yes	R$	yes	R$
Shed				
Artesian wells				
Tools				

3.3 What is the cost of certification?

Opcoes	R$
Renew auditoring	
Monitoring	
Other	

3.5 What is the production cost per kg?

	Cost per Kg (R$)	Does not know
Cashew nuts		
Kernel		

3.6 Indicate what has been the support from EMBRAPA:
( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) development of research
Financial	( ) provides indirect financial resources
	( ) provides direct financial resources

3.7 Indicate what has been the support from Non-Governmental Organization (ONG):
( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) development of research
	( ) technical visits
	( ) pre-auditoring
Financial	( ) provides indirect financial resources
	( ) provides direct financial resources

3.8 Indicate what has been the support from SEBRAE:
( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) development of research
	( ) technical visits
	( ) pre-auditoring
Financial	( ) Program “revitalization of mini factories on cashew nuts”
	( ) tests of agrochemical residues
	( ) provides indirect financial resources
	( ) provides direct financial resources

3.9 Indicate what has been the support from EMATER:
( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) development of research
	( ) technical visits
	( ) pre-auditoring
Financial	( ) provides indirect financial resources
	( ) provides direct financial resources

3.10 Indicate what has been the support from EMPARN:
( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) development of research
	( ) technical visits
	( ) pre-auditoring
Financial	( ) provides indirect financial resources
	( ) provides direct financial resources

3.11 Indicate what has been the support from the COOPERATIVE:
( ) none

Material	( ) informative material
Technical	( ) training courses
	( ) development of research
	( ) technical visits
Financial	( ) pre-auditoring
	( ) provides indirect financial resources

IV - Benefíts to certify

4.1Did you increase the volume exported due to certification?
( ) no, the volume exported was the same
( ) yes, the volume increased due to certification
( ) yes, the volume exported increased but due to olther reasons. Which?_____

4.2 How many hectares have you designated to cahsew nuts, before and after adopting certification?

	Organic certification	
Fruit	before	after
	Ha	ha
Cashew nuts		

4.3 Did you receive a price premium due to having certified fruit?
( ) yes
( ) no
( ) don not know

4.4 Did you have any expectation to receive a price premium?
( ) yes
( ) no
( ) do not know

4.5 What was the price received in R$ in 2005? (Average price, per kg):

	Organic certification
Cashew nuts	
Kernel	

4.6 Were you aware about decreasing environmental damages at your farm? (Choose 1 for the fist option, 2 for the second, etc):
( ) I am not concern about this issue
( ) to follow the rules described by the manual of organic certification
( ) It is so complicated to conciliate fruit production and environment
( ) to do the basic: _____
( ) to avoid burns
( )_____

4.7 Which of the following options did you consider while you decided to certify? (Choose 1 for the first option, 2 the second, etc):
( ) nothing, I do not care about environment
( ) the production is organic, i.e., does not require pesticides
( ) conservations and adequate soil management
( ) to have an environmental plan
( ) to decrease the use of pesticides
( ) do not contaminate water wells
( ) to give an adequate destination of empty packages of agrotoxics
( )_____

4.8 Which of the following options did you use to sell your production before certifying? (Fill in % in 2005):

Options	Cashew nuts	kernel
Cooperative		
US		
Europe, which countries?		
Other, which one?		
Domestic market		

4.9 Which of the following options did you use to sell your production after certifying? (Fill in % in 2005):

Options	Cashew nuts	kernel
Cooperative		
US		
Europe		
Domestic market		
Other		

4.10 Which are the advantages of having certification? (Choose 1 for the first more important, 2 for the second, etc):

Options	Organic certification
Do not know which could be the benefits	
There are no benefits	
To have a better farm organization	
To receive a price premium	
To follow the welfare requirements (do not have child labor, etc)	
To seek the welfare of workers	
The concern of food security	
To decrease environmental damages	
To decrease the use of pesticides and agro toxics	
The possibility to export to new markets	
To remain in the market	
To settle better negotiations	
To decrease the production cost	
To improve the quality of the fruit	
To have a differentiated product	
Other reason: which one?	

4.11 What are the main disadvantages of having certification? (Choose 1 for the most important, 2 the second, etc):

Options	Organic certification
Only disadvantages	
I do not see any disadvantage	
To compete with producers without certification in the market	
Do not receive a price premium due to certified fruit	
´The cost of compliance are too high	
To have restricted use of certain products	
There is no return for such an afford	
Other reason: which one?	

4.12 Which are the main reasons that lead you to adopt certification? (Choose 1 for the most important, 2 the second, etc):

Options	Organic certification
To remain in the market	
The expectation to receive a price premium	
To protect and conserve the environment	
To produce a product with higher quality	
To have a certified fruit is a requirement from the buyer	
The facility to have support from SEBRAE, EMBRAPA, etc	
Due to the farm size: opportunity to increase the volume exported	
Other reason: which one?	

V – Trading

5.1 How many workers are employed to help in the post harvesting process?
_____ permanent workers with social benefits
_____ permanent workers without social benefits
_____ temporary workers with social benefits
_____ temporary workers without social benefits

5.2 How do you transport the product *in natura* to its final destination?
( ) I take with my truck the production to the cooperative
( ) I take with my truck the production to the association
( ) Someone from the cooperative comes to my farm to take the production
( ) Someone from the association comes to my farm to take the production
( ) the buyer comes directly to my farm to take the production
( ) other, _____

5.3 How do you transport the processed cashew nuts to its final destination?
( ) I take with my truck the production to the cooperative
( ) I take with my truck the production to the association
( ) Someone from the cooperative comes to my farm to take the production
( ) Someone from the association comes to my farm to take the production
( ) the buyer comes directly to my farm to take the production
( ) other, _____

5.4 To whom to you deliver your production? (Write the starting year and the percentage in 2005):

Options	Cashew nuts		kernel	
	Since:	%	Since:	%
Exporter company				
Association of producers				
Cooperative				
Group				
To the middlemen				
To a neighbour				
To a wholesaler				

5.5 Why did you decide to trade individually? (Fill 1 for the first answer, 2 for the second, etc)
( ) I do not have another option to sell
( ) I have infrastructure
( ) I have better market access
( ) I have higher flexibility in the contracts
( ) it is more profitable
( ) Other reason. Which?_____

5.6 Why did you decide to trade with the cooperative?
( ) I do not have other option to trade with
( ) Access to market
( ) due to the guarantee of selling
( ) due to contractual conditions
( ) information access

( ) because my neighbour does
( ) recommendation of EMBRAPA, SEBRAE or other organization
( ) other. Which?_____

5.7 Why did you decide to trade your products in the domestic market? (Choose 1 for the first answer, 2 for the second, etc):
( ) do due easier access
( ) I had contractual problems with former buyers
( ) excess of supply
( ) a crop disease
( ) climate conditions
( ) the exchange rate was low
( ) the quality required was not reached
( ) Other reason, which?_____

5.8 How is relationship between you and your buyer? (Fill Y=yes or N=no)

Type of arrangement	Espec. client	Neigh.	Midd.	Wholes.	Coop.
CONTRACT					
Percentage of the production you trade:					
Since when do you trade with					
Is the price fixed in the contract?					
Has the price minimum guarantee?					
Is the price consignated?					
Is the volume estipulated in the contract?					
Is the contract one harvest season?					
Is the quality estipulated?					
Does the buyer require certification?					
Have the clauses been met by the buyer?					
Is the client flexible when something unexpected happened?					
Did you have a cancelled contract?					
INFORMAL: ONLY VERBAL					
Percentage of the production you trade:					
Since when do trade with this buyer					
Is the payment done immediately?					
Is the payment done in advance?					
Is the payment done is partially?					
Is the price determined by the buyer?					
Is the price determined by the final industry?					
Are you determining the price?					
Does the buyer buy any type of cashew nuts?					
Does the buyer buy any type of kernel?					
Is the buyer flexible in the negotiations?					
Does the buyer require that you have certification?					
Did you experience a case of non-					

payment?					
INFORMAL: TRUST-BASED					
Percentage of the production you trade:					
Since when do trade with					
Is the payment done immediately?					
Is the payment done in advance?					
Is the payment done is partially?					
Is the price determined by the buyer?					
Is the price determined by the final industry?					
Is the price determined by you?					
Does the buyer buy any type of cashew nuts?					
Does the buyer buy any type of kernel?					
Is the buyer flexible in the negotiations?					
Does the buyer require that you have certification?					
Did you experience a case of non-payment?					

VI– Future expectation

6.1 How many do you have expectation to remain in the same market?
_____ Years
( ) undetermined
( ) do not know

6.2 Are you planning to export to other markets?
( ) no
( ) yes. Which ones?_____

6.3 How many years to you expect to continue to produce cashew nuts?
_____ years
( ) undetermined
( ) do not know

6.4 Which varieties of cashew nuts trees do you have currently?

Variety	dwarf	giant	Other
Cashew			

Appendix 4: Case studies guide for melon farmers

I – CHARACTERISTICS OF THE FARM AND SOCIAL INDICATORS:

1) Provide some data regarding your farm. Production, area in hectares, type of melon, number of workers, type of irrigation system used, who runs the farms, gender and years of schooling:

2) Do you take loans from commercial banks to invest on the farm? Explain.

II – INFORMATION COST:

3) Since when and which type of certificates do you have? Why did you choose them? Do you intend to adopt others (which one and when)?

4) How did you know about this specific scheme?

5) How do you get updates?

III – COSTS TO CERTIFY

6) What was necessary to build and to reconstruct due to certification? Do you have any estimation of the amount invested? Do you investe in training courses for workers? Do you increase the area harvested?

7) What is the annual cost of maintenance of the schemes? How many times a year is done the monitoring? Is this a national or international certifying company?

IV – BENEFITS TO CERTIFY

8) Did you receive a price premium due to certification?

9) Does the volume exported increased due to certification?

10) Did you have to hire more workers due to certification?

11) Mention what you consider as advantages and disadvantages of having certification:

12) Do you have any concern regarding environmental issues? What have been done with respect to preservation?

V- MARKETING CHAIN

13) Could you explain the trading process. What is the final destination of the fruit?

14) How is the relationship between you and the other producers who deliver their production to you? (Explain if it is with contract, clauses, verbal, etc):

15) Why did you choose to buy fruit from other farmers?

16) How is the relationship between you and the final buyer? (Explain, it if is with contract, clauses, verbal, etc):

17) Why did you choose for this specific buyer? Since when are you trading?

VI – FUTURE EXPECTATIONS

18) What have been the main concerns of the buyers regarding certification? Do you expect any changes in rules, norms, and laws?

19) What are your future perspectives regarding certification, changing buyers, new varieties of melon, etc:

Appendix 5: Comparison of GlobalGAP, PIF and Faitrade according to the similar requirements

GlobalGAP					PIF						Fairtrade			
Control point of criteria	Major	Minor	Recom-mended	total	Control point of criteria	Manda-tory	Recom-mended	Forbbi-den	Allowed with restriction	total	Control point of criteria	Mini-mum	Pro-Gress	total
-	-	-	-	-	-	-	-	-	-		Social development	8	9	17
-	-	-	-	-	-	-	-	-	-	-	Economic development	10	2	12
-	-	-	-	-	Producers organizations	1	1	0	0	2	-	-	-	
traceability/record keeping and internal self-inspection	4	1	0	5	traceability and book-keeping records	3	1	0	0	4	Records on land, agrochemical, crop rotation	1	0	1
varieties and rootstocks/site history and site management	4	7	5	16	propagative material/ implementation of the orchards	6	5	1	1	13	-	-	-	-
soil and substract management	1	3	6	10	soil management	3	2	1	1	7	Soil management and preservation	6	0	6
Fertilizer use	2	15	4	21	plant nutrition	1	1	1	1	4	-	-	-	-
irrigation	1	0	15	16	irrigation	1	1	1	0	3	-	-	-	-
crop protection	15	43	6	64	integrated crop protection and management	8	8	7	3	26	Crop protection: agrochemicals	7	10	17
harvesting/produce handling	18	15	7	40	harvest/post-harvest/packing process	15	15	6	5	41	-	-	-	-
environmental issues, waste, pollution management, recycling and re-use	0	1	14	15	natural resources	1	2	1	0	4	Environmental issues	11	12	23
worker health, safety and welfare	4	14	9	27	technical assistance, workers and training for producers	4	6	1	0	11	Labor conditions	12	17	29
Total	49	99	66	214	Total	43	42	19	11	115	Total	55	50	105

Source: Own compilation based on EurepGAP checklist (2004), Normative N. 11 and 12 and FLO (2007)

Appendix 6: Descriptive statistics for the binary variable in the all fruits model, by sample and sub-sample categories

Variables	Sample (n=388)		Adopters (n=174)		Non-adopters (n=214)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Y (dep. Variable)	0.450	0.498				
Gender	0.891	0.311	0.885	0.319	0.897	0.304
Education	7.579	4.559	8.517	4.809	6.817	4.204
Type_irrigation	0.494	0.500	0.507	0.491	0.411	0.493
Level_special	3.579	3.827	2.798	2.399	4.215	4.586
Irrigated_area	0.791	0.320	0.794	0.336	0.772	0.308
Non_agric_inc	0.278	0.448	0.172	0.378	0.364	0.482
Living_village	0.400	0.491	0.390	0.488	0.420	0.495
Year_experience	6.201	4.275	6.787	4.514	5.724	4.019
Trust_relat	0.750	0.433	0.718	0.451	0.775	0.418

Source: Own compilation

Appendix 7: Descriptive statistics for the binary variable in mango and grapes models, by sample and sub-sample categories

Variables	Sample (n=303)		Adopters (n=148)		Non-adopters (n=156)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Y (dep. Variable)	0.490	0.501				
Mango	0.739	0.439	0.662	0.474	0.814	0.390
Grapes	0.313	0.464	0.391	0.489	0.237	0.426
Gender	0.891	0.312	0.891	0.311	0.891	0.312
Education	8.554	4.434	9.297	4.561	7.865	4.196
Manager	0.210	0.409	0.220	0.418	0.200	0.400
Size	0.690	0.463	0.600	0.491	0.780	0.419
Non_agri_income	0.184	0.038	0.121	0.327	0.243	0.430
Years_exper	7.217	3.912	7.756	3.904	6.679	3.862
Type_irrigation	0.633	0.482	0.702	0.458	0.570	0.496
Irrigated_area	0.757	0.247	0.745	0.246	0.769	0.247
Trust_relat	0.772	0.420	0.709	0.455	0.826	0.379

Source: Own calculations

Appendix 8: Descriptive statistics for the binary variable in cashew nuts model by sample and sub-sample categories

Variables	Sample (n=85)		Adopters (n=25)		Non-adopters (n=60)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Y (dep. Variable)	0.290	0.458				
Gender	0.890	0.310	0.840	0.374	0.920	0.279
Education	0.210	0.411	0.400	0.500	0.130	0.343
Family_HH	3.552	1.769	4.200	1.658	3.288	1.757
Variety	0.541	0.501	0.520	0.509	0.550	0.501
Non_agri_income	0.611	0.490	0.440	0.506	0.683	0.469
Level_special	6.788	5.473	2.800	2.692	8.450	5.490
Share_current_area	0.868	0.495	1.080	0.587	0.779	0.426
Years_trad_ind	3.047	4.317	2.480	6.028	3.283	3.400

Source: Own calculations

Appendix 9: Logistic results for the all fruit model

Linktest

```
Logit estimates                                   Number of obs   =        388
                                                  LR chi2(2)      =      48.11
                                                  Prob > chi2     =     0.0000
Log likelihood = -242.82268                       Pseudo R2       =     0.0901

------------------------------------------------------------------------------
 type_produc | Coef.   Std. Err.   z    P>|z|     [95% Conf. Interval]
-------------------------------------------------------------------------------
_hat         1.022345  .18728     5.46   0.000     .6552829    1.389407
_hatsq      .0356036   .1547698   0.23   0.818    -.2677397    .3389468
_cons      -.0139218   .1271277   -0.11  0.913    -.2630875    .2352439
------------------------------------------------------------------------------
```

Goodness-of-fit test

```
Logistic model for type_produc, goodness-of-fit test

  (Table collapsed on quantiles of estimated probabilities)

       number of observations =       388
             number of groups =         9
     Hosmer-Lemeshow chi2(7) =         6.64
                 Prob > chi2 =         0.4672
```

ROC curve

```
Logistic model for type_produc

number of observations =      388
area under ROC curve   =   0.6911
```

Correlation table

```
               | type_p~c   gender educat~n trust_~t type_i~n level_~i irriga~a
-------------------------------------------------------------------------------
 type_produc   |   1.0000
      gender   |  -0.0194   1.0000
   education   |   0.1856* -0.0376   1.0000
 trust_relat   |  -0.0658  -0.0479   0.0670   1.0000
type_irrig~n   |   0.1855* -0.0202   0.3517*  0.1905*  1.0000
level_spec~i   |  -0.1843*  0.0268  -0.1689* -0.1086  -0.1502   1.0000
irrigated_~a   |   0.0341   0.0052  -0.0814  -0.1656* -0.0832   0.0335   1.0000
non_agric_~e   |  -0.2131*  0.0313  -0.0753  -0.0266  -0.2351*  0.3075*  0.0428
  rural_area   |  -0.0360  -0.0001   0.1672*  0.0030  -0.1123  -0.2666* -0.0750
years_expe~e   |   0.1238   0.0339   0.2423* -0.0230   0.2347* -0.2500* -0.0391

               | non_ag~e rural_~a years_~e
-------------------------------------
non_agric_~e   |   1.0000
  rural_area   |  -0.1254   1.0000
years_expe~e   |  -0.1976*  0.1973*  1.0000
```

Appendix 10: Logistic results for the grapes model

Linktest

```
Logit estimates                                   Number of obs   =        303
                                                  LR chi2(2)      =      50.18
                                                  Prob > chi2     =     0.0000
Log likelihood = -184.85432                       Pseudo R2       =     0.1195

------------------------------------------------------------------------------
type_produ~r | Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_hat            1.004751   .1636595    6.14   0.000     .6839843    1.325518
_hatsq        -.1029156   .1145981    -0.90   0.369    -.3275238    .1216926
_cons          .0604289   .1423262     0.42   0.671    -.2185253    .3393831
------------------------------------------------------------------------------
```

Goodness-of-fit test

```
Logistic model for type_producer, goodness-of-fit test

  (Table collapsed on quantiles of estimated probabilities)

       number of observations =       303
             number of groups =        10
     Hosmer-Lemeshow chi2(8) =         6.59
                 Prob > chi2 =         0.5813
```

Correlation table

```
               | type_p~r   grapes   gender educat~n  manager     size non_ag~e
---------------+---------------------------------------------------------------
type_produ~r   |   1.0000
grapes         |   0.1650   1.0000
gender         |   0.0025  -0.0834   1.0000
education      |   0.1640  -0.0172  -0.0232   1.0000
manager        |   0.0281   0.2080* -0.2084*  0.0703   1.0000
size           |  -0.1868  -0.2080* -0.0512  -0.0417   0.0499   1.0000
non_agric_~e   |  -0.1591   0.0448   0.0300   0.1267   0.0661   0.1355   1.0000
years_expe~e   |   0.1348  -0.1925*  0.0683   0.0711   0.0291  -0.0594  -0.0461
type_irrig~n   |   0.1400   0.3514* -0.0239   0.1912*  0.1921* -0.4063* -0.0439
irrigated_~a   |  -0.0477  -0.0744  -0.0206  -0.0986   0.0853   0.0349  -0.0425
 trust_relat   |  -0.1464  -0.0401  -0.0383   0.0236   0.1460  -0.0920   0.0761

                     | years_~e type_i~n irriga~a trust_~t
---------------------+--------------------------------------------------------
years_expe~e         |   1.0000
type_irrig~n         |  -0.0014   1.0000
irrigated_~a         |   0.0730  -0.0146   1.0000
 trust_relat         |  -0.0866   0.1915* -0.2097*  1.0000
```

.

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Appendix 11: Logistic regression results for the mango model

Linktest

```
Iteration 0:   log likelihood = -209.94273
Iteration 1:   log likelihood = -185.45862
Iteration 2:   log likelihood = -184.76226
Iteration 3:   log likelihood = -184.75858
Iteration 4:   log likelihood = -184.75858
Logit estimates                                   Number of obs   =        303
                                                  LR chi2(2)      =      50.37
                                                  Prob > chi2     =     0.0000
Log likelihood = -184.75858                       Pseudo R2       =     0.1200
------------------------------------------------------------------------------
type_produ~r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _hat |   .9990823   .1611267     6.20   0.000     .6832798    1.314885
     _hatsq |  -.0321152    .126077    -0.25   0.799    -.2792217    .2149912
      _cons |   .0192728   .1463211     0.13   0.895    -.2675113     .306057
------------------------------------------------------------------------------
```

Goodness-of-fit test

```
Logistic model for type_producer, goodness-of-fit test

  (Table collapsed on quantiles of estimated probabilities)

       number of observations =       303
             number of groups =        10
     Hosmer-Lemeshow chi2(8) =      5.72
                Prob > chi2 =         0.6785
```

ROC curve

```
Logistic model for type_producer
number of observations =      303
area under ROC curve   =   0.7353
```

Correlation table

```
             | type_p~r    mango   gender educat~n  manager     size non_ag~e
-------------+---------------------------------------------------------------
type_produ~r |   1.0000
mango        |  -0.1716   1.0000
gender       |   0.0025   0.0819   1.0000
education    |   0.1640   0.0591  -0.0232   1.0000
manager      |   0.0281  -0.2268* -0.2084*  0.0703   1.0000
size         |  -0.1868   0.2030* -0.0512  -0.0417   0.0499   1.0000
non_agric_~e |  -0.1591   0.0310   0.0300   0.1267   0.0661   0.1355   1.0000
years_expe~e |   0.1348   0.2217*  0.0683   0.0711   0.0291  -0.0594  -0.0461
type_irrig~n |   0.1400  -0.3267* -0.0239   0.1912*  0.1921* -0.4063* -0.0439
irrigated_~a |  -0.0477   0.0606  -0.0206  -0.0986   0.0853   0.0349  -0.0425
 trust_relat |  -0.1464   0.0181  -0.0383   0.0236   0.1460  -0.0920   0.0761

             | years_~e type_i~n irriga~a trust_~t
-------------+---------------------------------------------------------------
years_expe~e |   1.0000
type_irrig~n |  -0.0014   1.0000
irrigated_~a |   0.0730  -0.0146   1.0000
 trust_relat |  -0.0866   0.1915* -0.2097*  1.0000
```

Appendix 12: Logistic regression results for the cashew nuts model

Linktest

```
Logit estimates                                   Number of obs   =         85
                                                  LR chi2(2)      =      24.62
                                                  Prob > chi2     =     0.0000
Log likelihood = -38.833364                       Pseudo R2       =     0.2407

------------------------------------------------------------------------------
   type_prod       Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------------------------------------------------------------------------
       _hat       1.062045   .3652957     2.91   0.004      .346078    1.778011
     _hatsq       .0399968   .1696437     0.24   0.814    -.2924987    .3724923
      _cons      -.0307077   .3456671    -0.09   0.929    -.7082028    .6467874
------------------------------------------------------------------------------
```

Goodness-of-fit test

```
Logistic model for type_prod, goodness-of-fit test

  (Table collapsed on quantiles of estimated probabilities)

      number of observations =        84
            number of groups =         8
     Hosmer-Lemeshow chi2(6) =         2.39
                Prob > chi2 =         0.8809
```

ROC curve

```
Logistic model for type_prod

number of observations =       85
area under ROC curve   =   0.8298
```

Correlation table

```
             | type_p~d   gender educat~n family~H non_ag~e number~x share_~a
-------------------------------------------------------------------------------
type_prod    |   1.0000
gender       |  -0.1135   1.0000
education    |   0.2974* -0.1024   1.0000
family_HH    |   0.2374   0.0430   0.0008   1.0000
non_agric_~e |   0.2570   0.1942  -0.0007   0.0119   1.0000
number_cro~x |   0.1416  -0.0374   0.0890  -0.0897   0.1465   1.0000
share_curr~a |  -0.0487   0.0536  -0.1244   0.1354   0.0241  -0.0314   1.0000
years_trad~d |  -0.0853  -0.0319  -0.0795   0.0464   0.0732   0.1632   0.1287
variety_anao |  -0.1883   0.1952  -0.0637  -0.2913*  0.0731   0.0438  -0.0543

              | years_~d variet~o
-------------------------------------------------------------------------------
years_trad~d  |   1.0000
variety_anao  |  -0.1701   1.0000
```

Appendix 13: Logistic regression results on the decision of mango farmers to adopt two certification schemes

Linktest

```
Logit estimates                                   Number of obs   =        148
                                                  LR chi2(2)      =      67.83
                                                  Prob > chi2     =     0.0000
Log likelihood = -31.685119                       Pseudo R2       =     0.5170

------------------------------------------------------------------------------
one_certific |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        _hat |   1.142728   .2672105     4.28   0.000     .6190056    1.666451
      _hatsq |  -.0490151   .0409989    -1.20   0.232    -.1293715    .0313413
       _cons |   .0363639    .367573     0.10   0.921    -.6840659    .7567936
------------------------------------------------------------------------------
```

ROC curve

```
Logistic model for two_certific

number of observations =      148
area under ROC curve   =   0.9378
```

Goodness-of-fit test

```
Logistic model for one_certific, goodness-of-fit test

       number of observations =       148
 number of covariate patterns =       148
           Pearson chi2(136) =       102.63
                 Prob > chi2 =         0.9852
```

Correlation table

```
             | one_ce~c      age educat~n  manager living~y ha_mango
-------------+------------------------------------------------------------------
one_certific |   1.0000
         age |  -0.0575   1.0000
   education |   0.0772   0.0581   1.0000
     manager |   0.1036  -0.4765   0.0828   1.0000
 living_city |   0.1461   0.0973  -0.0083   0.0053   1.0000
    ha_mango |  -0.0721  -0.1506   0.2644   0.0497   0.1973   1.0000
total_labor  |  -0.1330  -0.1762   0.2370   0.0635   0.1369   0.5329
type_irrig~n |  -0.0054   0.0282   0.2474   0.1709   0.4385   0.1398
 sub_packing |  -0.4354   0.1613  -0.3235  -0.1640  -0.0098   0.1797
     trans_M |   0.0974   0.0750   0.0007  -0.2018  -0.2680  -0.0241
  year_buyer |   0.2191  -0.2591   0.2031   0.1359  -0.1863   0.3323

             | total_~r type_i~n sub_pa~g  trans_M year_b~r
-------------+-------------------------------------------
 total_labor |   1.0000
type_irrig~n |   0.1206   1.0000
 sub_packing |   0.1701  -0.0229   1.0000
     trans_M |  -0.1157  -0.3707  -0.0644   1.0000
  year_buyer |   0.3594  -0.1803  -0.2674   0.2879   1.0000
```

Appendix 14: Logistic regression results on the decision of grapes farmers to adopt two certification schemes

Linktest

```
Logit estimates                                   Number of obs   =        148
                                                  LR chi2(2)      =      47.91
                                                  Prob > chi2     =     0.0000
Log likelihood = -41.643448                       Pseudo R2       =     0.3652

------------------------------------------------------------------------------
one_certific |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        _hat |   .9534115   .3066844     3.11   0.002     .3523211    1.554502
      _hatsq |   .0198993   .1049785     0.19   0.850    -.1858547    .2256533
       _cons |  -.0156761   .3496407    -0.04   0.964    -.7009593    .6696071
------------------------------------------------------------------------------
```

ROC curve

```
Logistic model for two_certific

number of observations =      148
area under ROC curve   =   0.8905
```

Goodness-of-fit test

```
Logistic model for one_certific, goodness-of-fit test

       number of observations =       148
 number of covariate patterns =       148
            Pearson chi2(136) =       142.15
                  Prob > chi2 =         0.3417
```

Correlation table

```
             | one_ce~c      age educat~n  manager living~y ha_gra~s
-------------+------------------------------------------------------------------
one_certific |   1.0000
         age |  -0.0575   1.0000
   education |   0.0772   0.0581   1.0000
     manager |   0.1036  -0.4765   0.0828   1.0000
 living_city |   0.1461   0.0973  -0.0083   0.0053   1.0000
   ha_grapes |  -0.0192  -0.0462   0.0927   0.0936   0.3699   1.0000
total_labor  |  -0.1330  -0.1762   0.2370   0.0635   0.1369   0.6291
type_irrig~n |  -0.0054   0.0282   0.2474   0.1709   0.4385   0.3479
 sub_packing |  -0.4354   0.1613  -0.3235  -0.1640  -0.0098   0.0890
     trans_G |   0.1318  -0.0514   0.0204   0.1838   0.2525   0.6467
  year_buyer |   0.2191  -0.2591   0.2031   0.1359  -0.1863   0.0311

             | total_~r type_i~n sub_pa~g  trans_G year_b~r
-------------+---------------------------------------------
 total_labor |   1.0000
type_irrig~n |   0.1206   1.0000
 sub_packing |   0.1701  -0.0229   1.0000
     trans_G |   0.0375   0.3239  -0.1269   1.0000
  year_buyer |   0.3594  -0.1803  -0.2674  -0.1461   1.0000
```

Appendix 15: Logistic regression results on the decision of mango farmers to adopt PIF

Linktest

```
Logit estimates                                   Number of obs   =        252
                                                  LR chi2(2)      =      54.85
                                                  Prob > chi2     =     0.0000
Log likelihood = -140.51116                       Pseudo R2       =     0.1633

------------------------------------------------------------------------------
adopting_PIF |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        _hat |   .9220435   .1843424     5.00   0.000     .5607391    1.283348
      _hatsq |  -.0995823   .1365982    -0.73   0.466    -.3673099    .1681453
       _cons |   .0696968   .1823769     0.38   0.702    -.2877553     .427149
------------------------------------------------------------------------------
```

ROC curve

```
Logistic model for adopting_PIF

number of observations =      252
area under ROC curve   =   0.7634
```

Goodness-of-fit test

```
Logistic model for adopting_PIF, goodness-of-fit test

       number of observations =       252
 number of covariate patterns =       252
           Pearson chi2(240) =       244.98
                 Prob > chi2 =         0.3989
```

Correlation table

```
             | adopti~F      age educat~n living~y experi~M bank_a~s member~a
-------------+---------------------------------------------------------------
adopting_PIF |   1.0000
         age |  -0.1252   1.0000
   education |   0.2473   0.1302   1.0000
 living_city |   0.1354   0.0094   0.0331   1.0000
experience_M |   0.0089   0.1389  -0.0182  -0.0584   1.0000
 bank_access |   0.0608  -0.1087  -0.1668  -0.2454   0.1808   1.0000
member_ass~a |   0.0359   0.0361  -0.0455  -0.0813  -0.0945   0.0568   1.0000
 total_labor |   0.0168  -0.1304   0.1071   0.1627  -0.0215   0.0435  -0.0705
type_irrig~n |   0.0605  -0.1156   0.2183   0.4468  -0.2303  -0.2749  -0.1329
non_agric_~e |  -0.1482   0.0285   0.0686  -0.1216  -0.0816   0.0774   0.0768
harvest_pa~M |  -0.1662   0.2394   0.0726   0.0073   0.4822  -0.1122  -0.3194
 trading_ind |  -0.0608   0.0054   0.0918   0.0467  -0.0103  -0.1604   0.0195

             | total_~r type_i~n non_ag~e harv~t_M tradin~d
-------------+---------------------------------------------
 total_labor |   1.0000
type_irrig~n |   0.2018   1.0000
non_agric_~e |  -0.0639  -0.0519   1.0000
harvest_pa~M |  -0.0543  -0.0570  -0.1112   1.0000
 trading_ind |  -0.2279  -0.0393   0.0540   0.0253   1.0000
```

Appendix 16: Logistic regression results on the decision of grapes farmers to adopt PIF

Linktest

```
Logit estimates                                   Number of obs   =        252
                                                  LR chi2(2)      =      55.74
                                                  Prob > chi2     =     0.0000
Log likelihood =  -140.0658                       Pseudo R2       =     0.1660

------------------------------------------------------------------------------
adopting_PIF |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        _hat |   .8619462   .1678454     5.14   0.000     .5329753    1.190917
      _hatsq |  -.2370001   .1298717    -1.82   0.768    -.4915438    .0175437
       _cons |   .1740629   .1828055     0.95   0.341    -.1842293     .532355
------------------------------------------------------------------------------
```

Goodness-of-fit test

```
Logistic model for adopting_PIF, goodness-of-fit test

       number of observations =       252
 number of covariate patterns =       250
           Pearson chi2(238) =       253.16
                 Prob > chi2 =         0.2386
```

ROC curve

```
Logistic model for adopting_PIF

number of observations =      252
area under ROC curve   =   0.7667
```

Correlation table

```
             | adopti~F      age educat~n living~y experi~G bank_a~s member~a
-------------+------------------------------------------------------------------
adopting_PIF |   1.0000
         age |  -0.1252   1.0000
   education |   0.2473   0.1302   1.0000
 living_city |   0.1354   0.0094   0.0331   1.0000
experience_G |   0.0969  -0.2064   0.0538   0.0983   1.0000
 bank_access |   0.0608  -0.1087  -0.1668  -0.2454   0.0096   1.0000
member_ass~a |   0.0359   0.0361  -0.0455  -0.0813   0.0837   0.0568   1.0000
 total_labor |   0.0168  -0.1304   0.1071   0.1627   0.5000   0.0435  -0.0705
type_irrig~n |   0.0605  -0.1156   0.2183   0.4468   0.2429  -0.2749  -0.1329
non_agric_~e |  -0.1482   0.0285   0.0686  -0.1216   0.0234   0.0774   0.0768
harvesting~G |   0.1831  -0.1770   0.0649   0.1427   0.7139  -0.1550   0.1039
 trading_ind |  -0.0608   0.0054   0.0918   0.0467  -0.1896  -0.1604   0.0195

             | total_~r type_i~n non_ag~e harves~G tradin~d
-------------+---------------------------------------------
 total_labor |   1.0000
type_irrig~n |   0.2018   1.0000
non_agric_~e |  -0.0639  -0.0519   1.0000
harvesting~G |   0.2515   0.2768  -0.0173   1.0000
 trading_ind |  -0.2279  -0.0393   0.0540  -0.1031   1.0000
```