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Thesis

**The Impact of the National Innovation System on
the Competitiveness of Agri-food Firms in
Developing Countries
A Case Study in Costa Rica**

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“Sad shall be the country that does not take science as a guide for its entrepreneurs and tasks. It will lag behind, will give tribute to others and its ruin will be infallible because the current situation of modern societies, the one that uses knowledge and sagacity the most will surely gain advantages over the others.” (José María Castro Madriz, first president of Costa Rica, in a speech in 1844)ⁱ

On an era of globalization and free trade mark, the challenges for developing countries, to take advantages of knowledge through innovation are harder than ever before. For this reason, as a final complement of the knowledge acquired through the Master Program in Food Technology with specialization in Innovation and Management, the main goal of this study is to understand better the role of innovation in the developing of competitiveness in developing countries. This was a journey through literature, key actors of the NIS and interesting examples of firms of the agri-food sector in Costa Rica. It was possible to have a better overview of the situation and I would like to share the main findings with the reader.

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Management Summary

1. Introduction

The opening of the domestic market and the country's integration into the global economy require new approaches for productive sectors to achieve competitiveness by better using knowledge and increasing added value of goods and services. Succeeding, or even surviving, is not easy in the agri-food sector since competition is more intense now than ever. Firms that do not keep pace with a competitive advantage will be "pushed out of the market".

Innovation is an important tool for finding competitive advantages based on new products and processes. However, developing countries face genuine obstacles to innovation. In an emerging economy, access to resources is very sensitive to the kinds of policies implemented by the state to promote economic development. From this point of view, the National Innovation System (NIS) (with its actors, interrelations and institutions) has influenced the firms' possibilities to build competitive advantages.

The main objective of this research is to conduct an exploratory study on the impact of the National Innovation System in the competitiveness of agri-food firms in developing countries.

Costa Rica is used as an example to develop the study. Important factors of the National Innovation System of Costa Rica, which are related to the acquisition of resources to develop competitive advantages, are mapped with data collected from key actors and documental information.

Using an embedded case study of 16 agri-food firms, differences in the influence caused by the NIS in three dimensions are described in the second part of the study: added value (Primary Agricultural vs. Food Processing), size (SME's vs. Large) and market penetration (non-traditional exports to reduce market vs. global commodities).

From an academic point of view, this study defines aspects for further research regarding the evaluation of alignment between the National Innovation System and the firms' performance, specifically related to the importance of the absorptive capacity of farmers in the relation to research institutions, a special NGO model found in this country, and the influence of the NIS to locally develop competitive advantages.

2. Research Design

The main objective of this study is *to identify the impact of the National Innovation System in the competitiveness of agri-food firms in developing countries, with special focus on Costa Rica.*

To achieve this objective the following questions will be addressed:

Main Questions

- Which is the impact of the NIS in the competitiveness of agri-food firms in developing countries?
- How does the NIS specifically impact three dimensions of agri-food firms (supply chain position, sizes and market penetration)?

Sub-questions

1. How is the possible NIS impact in the developing of competitive advantages?
2. How is the NIS impact in developing countries?
3. How are agri-food firms creating competitive advantages through innovation?
 - 3.1. What are the competitiveness characteristics of the agri-food sector?

This is a qualitative research based on a case study methodology. A holistic case study is used to map the NIS in Costa Rica through documental information and 11 interviews with key actors. An embedded multi-case study is used to analyze innovation in 16 agri-food firms, and the impact of the NIS is analyzed using the information collected in three dimensions: supply chain position, size and market penetration.

3. Theoretical Framework: Impact of the National Innovation System on the Creation of Competitive Advantage

Now more than ever, firms must define strategies to use their resources in the most efficient way in order to succeed in a global market environment. Since firms do not exist in isolation, competitors will respond to the new strategy implemented, making the strategic alignment process dynamic, with ongoing changes and adaptations. For this reason, firms have to develop competitive advantages to keep their position in the market. According to the Research-Based View (RBV), the potential for sustainable competitive advantage lies in valuable resources that are rare, costly to copy and difficult to substitute, and firm resources are both heterogeneous and immobile.

For firms, knowledge resources are the basis to use innovation in building competitive advantages; and this requires the definition of strategies. Using knowledge, innovation can help create competitive advantages through a proactive approach of using new knowledge to gain a strategic market position relative to competitors, for example better use of natural resources favouring their transformation into goods with greater technological content and finding dynamic ways to keep the position in the market. This knowledge includes important competence to go through the process of acquiring, using and protecting knowledge, which is defined as absorptive capacity.

The National Innovation System approach helps analyze the impact of external factors in the firms' use of innovation. The main influence of the NIS in competitive advantages is based on the development of endogenous scientific and technological capabilities, as well as their effective integration and assimilation in the economy as a key element in strengthening the productive sector. Systemic competitiveness stems from the effective operation of the "Generation and Assimilation of Knowledge" System defined as: The elements of the system, which are the institutions and organizations (universities, research institutes, companies, ministries) of the educational, scientific and productive sectors and the dynamics of the system, i.e., the pattern of flows and interactions between elements of the system. The analysis of the actors and interactions at different levels could help us understand the impact of the National Innovation System in the development of competitiveness.

Under the model explained, it is possible to underline some considerations regarding the differences between developed and developing countries. Technological innovation emerges in an economy when the various components that make up the system (educational, knowledge creation and manufacturing) are consolidated and there are proper dynamic interactions within each system and between systems. Consequently, in the context of global economy, a country with a gap in at least one of these components cannot be economically developed.

The basic difference between the innovation process in developed and developing countries is the domain of technological innovations. For the technologically competitive industrial set-up of the developed countries, the innovation system is to maintain or improve the existing technological competitiveness and growth, contrary to most developing countries where it has to be established.

4. Study Domain: The Agri-Food Sector in Costa Rica

In general terms, an increasing internationalization of firms and integration of markets are the most relevant trends in international economy. As a consequence, agricultural producers, food manufacturers and retailers operate in a changing competitive environment. New views of the food system and new strategic implications are emerging. These forces have structural, organizational and strategic consequences in a growing range of industries and a strong impact on trade patterns, specialization, Foreign Direct Investments (FDI), and global capital flows. They have also eased the globalization of food systems.

The countries of Latin America and the Caribbean (LAC) represent a wealth of natural resources; the world's greatest agro-biodiversity; and immense economic, social, and environmental diversity. Agriculture represented 5% of LAC's total GDP but the impact on the

region's economy is much higher when links with farm-input, food-processing and distribution industries are taken into account. In addition it is an important source of employment in the region.

The effects of globalization and reforms in the region have affected agriculture performance. Liberalization has spurred a giant river of investment in part of the agri-food system – downstream, in retail, food services, and second-stage processing -very different from the pre-liberalization era when there was a relative trickle of FDI which was found upstream in the chains (in farming and first-stage processing). This change has resulted in a supermarket revolution, and rapid consolidation and multinationalization in the second-stage processing sector.

The specific case of Costa Rica is assessed by the Global Competitiveness Index (GCI) as one of the most competitive economies in Latin America and the Caribbean. According to the “2008–2009 Global Competitiveness Report”, Costa Rica is at 59th position (out of 134 countries) ahead of Mexico (60th) and Brazil (64th), among others.

The structural adjustment process of Costa Rican society to the international trade conditions and economic globalization has had a special effect, which has not been entirely favourable for the primary agricultural sector. Agriculture has come to play a minor role, given the dynamism in other economic activities such as tourism, industry and services.

The traditional view of looking at agriculture as the main sustenance of the national economy, based on three or four products, which rely on traditional major capital, is coming to an end. However, agriculture is still very important in the Costa Rican economy, contributing approximately 15% of the GNP (2008), being banana, pineapple and coffee the most important products in terms of agricultural added value. The food manufacturing sector represents 42% of the manufacturing industry and approximately 6% of the GDP. The sector is heterogeneous, diversified and with different technological levels.

5. Results and Analysis

5.1 Mapping of Costa Rica's NIS

In the specific case of Costa Rica, the SWOT analysis of each subsystem identified similar gaps as those reported in the literature for developing countries (Arocena & Sutz, 2005; Spielman, 2005; G. J. Stads & Beintema, 2009). It was possible to identify how the countries' NIS is impacting the competitiveness of firms on the different subsystems:

- At the macro level there are two important ways:
 - In Costa Rica many government policies have tried to stimulate added value in different sectors but have kept the model of high productivity-low added value in the Primary Agricultural sector. Through this scheme the country is losing possibilities of generating important developments based on biodiversity and climate.
 - The NIS has created important conditions for the development of competitiveness in the agri-food sectors; however, there are still many deficiencies that act as barriers for firms in developed country to compete under equal conditions. The positive and negative aspects of the Costa Rican NIS were identified through the SWOT analysis.
- **Education Subsystem.** Positive impacts are good educational system (including basic, technical and educational levels), training and support in complementary aspects (as quality system, accreditation and innovation management), and promotion of training to apply high technologies. However negative impacts are lacks of high education, especially at doctoral level, proper structure of incentives to retain highly educated professionals into the educational system and in entrepreneurial spirit (key for increasing the dynamics and catalyzing the entrance of new businesses).

- **Knowledge Creation:** positive impacts are the creation of important institutional support capable of covering all aspects of the agri-food sector, special sub-sectoral models of R&D and creation of new models of R&D, promoting the use of high technologies and improving connection with the private sector. The most important negative impacts are the lack of good interaction between R&D entities and universities causing problems of absorptive capacity and bad communication, unclear connection between consumer needs and R&D priorities, limitation in resources (infrastructure, equipment, human resources, funds) and important deficiencies in knowledge management (protection and diffusion).
- **Private Sector:** The positive aspects are R&D funds availability for the private sector, sector organization given support in different aspects and the dynamics produced by the FDI strategy and the presence of foreign and multinational companies (with possibilities of a spill-over effect). Negative aspects are low industry R&D production, in some cases, low educational level of human resources, and lack of understanding of the importance of strategic innovation to develop competitiveness, infrastructure and information systems.
- **Intermediation Level:** the positive impact is the important institutional setting to promote the interaction and support from governmental organizations and the private sector; in the case of the agri-food sector, the Ministry of Agriculture is playing an important role. The negative impact is the interaction problems between R&D organizations and the private sector.

5.2 How firms are developing competitive advantages through innovation

This study is based on interviews with 16 agri-food firms, grouped in Primary Agricultural (PA) and Food Processing (FP) sectors (8 firms in each group). The Primary Agricultural firms were selected from representative groups of non-traditional export products. In the case of the Food Processing group, companies selected were known for their dynamics in innovation. Taking into consideration that the impact of the NIS is based on the interrelation of education and the R&D systems with the firms, the characteristics of knowledge-based resources, knowledge acquisition and their relation with other organizations were evaluated through the interviews. Subsequently, it was defined whether the firms are using innovation to create competitive advantages or not.

To analyze knowledge-based resources, firms were asked how they perceived themselves in different areas of knowledge. Firms see themselves as strong in production, quality, marketing and sales, and weak in intellectual property/legal aspects and innovation management. This perception is subjective and has an important influence on the effort the companies make to acquire knowledge and the communication with other actors. The importance of absorptive capacity on the transfer of knowledge from public institutions to SMEs or farmers was identified during the interviews.

As to whether firms are implementing organizational innovations or not, many of them are indeed applying the process innovation, especially when it is new to the firm and shows incremental innovation to improve efficiency. In the case of the PA group, priorities are related to improving production. Firms are implementing the reactive innovation, which is typical of companies in the agricultural sector of developing countries. The food processing group exhibits very interesting cases such as the dairy company that makes more than 70 new products per year or the coffee/chocolate firm that has developed new markets and is exporting the model to other countries, producing more than 100 products per year.

The analysis of the firms' responses on ways to define innovation priorities, innovation effects and competitive strengths indicated that all FP firms and three PA firms are using innovation to build competitive advantages. In addition, almost all FP firms have a clearly defined formal strategic plan, while 2 FP and 3 PA firms have an informal strategy (based on experience but without a written plan).

The analysis of the ways to access knowledge confirmed the importance of networking. All firms, except for one, mention networking explicitly or implicitly as the main source to access

knowledge. Training is an important way to improve knowledge and, in this respect, public entities (governmental, technical training and universities) are playing an important role, especially for the PA firms. The organizations that were mentioned the most in the case of FP firms were public universities, especially for quality system training and as a source of information.

The analysis of collaborative innovation in firms shows the importance of public universities especially for PA firms, which in general do not have R&D departments, and need them for technological developments.

The firms that expressed more connections and relations with other organizations of the NIS were the foliage firm and three food processing SME's. The main characteristic perceived in many of the most related companies is that they are not waiting for help; they are proactively looking for using and taking advantages of relation with other actors of the NIS. This characteristic allows to realize on the importance firms' entrepreneurial orientation as the base of taking advantages of any situation.

Because of R&D limitations in the country most firms interviewed are not defining innovation in new inventions but in new uses of knowledge.

5.3 Dimension Analysis of the NIS Impact on the Creation of Firms' Competitive Advantages

Analyzing the NIS impact according to the supply chain position, important differences were identified between the PA and the FP groups. PA firms have a close relation with public entities. Most governmental organizations were created with the idea of supporting the development of farmers and increasing productivity, which means strengthening competitiveness based on high production and low cost. One important impact on this group is FDI. The government has tried to attract "high-technology" agriculture and has consequently increased motivation of the insertion of international companies (FDI) in the flower and ornamental plants sectors. In general, a positive impact is identified at a macro level, through incentives to promote the development of a sector and to use the country's advantages in biodiversity to have competitive advantage. However, a negative influence results from the lack of proper knowledge protection.

In the Primary Agricultural group important differences were identified in market penetration, specifically between non-traditional products from small groups of farmers directed to a small market (such as chayote) and global commodities (such as pineapple). The documental study of this case permitted to understand that the country's competitive advantage in pineapple has been developed by a multinational, which defined a strategy for the introduction of a new variety into the global market. In this case, the government incentives mentioned before and the farmers' competences, which have been developed through the banana production, are used by the multinational.

In global commodities such as banana and coffee, R&D from sub-sectoral organizations has had an important role, contributing to achieve the highest productivity worldwide in both products and a rapid response to specific changes in the market such as the use of clean technology, the reduction of agrochemicals and responses to the coffee crisis of previous years. This finding shows that, in the case of global commodities, the NIS has a positive impact on the creation of competitive advantages at the country level through the institutional setting of public organizations (governmental, universities) and NGOs.

On the other in the chayote case the combination of a special variety selection (in the 70's) with government support (in the 80's) have permitted Costa Rica to create a new market for a non traditional product, as chayote. However, in spite of important R&D effort realized by different actors of the country, especially public universities, innovation does not take an important role in this sector. The lack in absorptive capacity of the sector in combination with a lack of a leader in the supply chain (who defines and establishes the direction of the chain) are important negative factors.

The impact is different in the FP group. All FP firms with lesser or higher degree of development have R&D departments, but lack infrastructure and the latest-technology equipment. In addition, the NIS mapping shows that the country has less R&D organizations related to the FP sector. For this reason, the NIS impact depends on specific needs. Important detected impacts are the support to improve quality systems, as well as accreditation and training.

Differences have been found in the SMEs. Some of their needs regarding R&D could be fulfilled by public organizations. They are actively implementing innovation management as a strategy to build competitive advantages. For this reason, SME firms are connected with other organizations and public organizations are regularly given support to help build competitive advantages. In many cases, CITA has played an important role in the support of quality systems but not such a clear role in the development of new products. A special remark is made on the influence of the “Industry Chamber”, which is an entity of the country’s manufacturing industry that promotes added value strategies to companies together with other governmental organizations. Through the effort of this Chamber and the Costa Rican Foreign Trade Promoter (*Promotora de Comercio Exterior-PROCOMER*) a consortium of SMEs was created and, using a consolidated group strategy, they try to increase their market impact in other countries. These organizations support companies in the presentation of products at international fairs, training and networking.

For large companies the relation with organization of the NIS is more reduced. They already have implemented quality systems; have international connection for some developments, and the local R&D from universities is not needed for them. Most of their new developments are adapted from external technologies. The three of them have an innovation strategy and this is used to build competitive advantages. The main relation with the NIS is through education and training of technical and professionals.

6. Conclusions and Recommendations

Following are the most important conclusions derived from the research questions:

How the NIS possibly impacts the developing of competitive advantages. The NIS impact is founded on the support to be used by firms to acquire competences and knowledge. This support is provided by elements of the system, which are institutions and organizations (universities, research institutes, companies, ministries) of the educational, scientific and productive sectors. This impact could be analyzed through the mapping of the “Knowledge Acquisition and Education” System. Mapping includes the analysis of three subsystems (education, knowledge creation and production) at three different levels: micro (refers to the individual actor’s level), meso (includes the link structure between actors) and macro (comprises the area of planning, policies, strategies and regulatory frameworks).

How the NIS impacts developing countries. Important differences in the creation of innovation were found between developed and developing countries. In general terms, the elements of the NIS (education, R&D and production) are strong and consolidated in developed countries and efforts are addressed at a meso level to improve the connection between actors. Contrarily, because of their internal conditions, developing countries present gaps in one or more of the three sub-systems which define the possibility to use innovation to be competitive.

The comparison with similar studies in other developing countries such as Taiwan and Korea shows that the proper improvement of innovation as a local development tool should be based on the strengthening of the three subsystems in a coordinated manner. In this context, important factors to be taken into account are international networking, strategies, clustering and absorptive capacity.

The mapping of the Costa Rican “Knowledge Acquisition and Education” System allowed the following conclusions:

- In spite of some specific advantages in the country, such as biodiversity, good R&D organizations in the agri-food sector and stability, Costa Rica’s NIS is similar to the one in

other Latin American countries with important gaps in the educational, knowledge creation and production subsystems and at the macro and meso levels.

- The country has special organization models that present benefits in the production and transferring of knowledge, specifically 1) the sub-sector promoters (type of NGO) that permit the use of innovation to build competitive advantages at the sector and country levels; 2) the initiative of “governmental agri-chain orientation” could help in the use of innovation to create competitive advantages through vertical integration and marketing innovation; 3) the National Institute for Agricultural Innovation and Transfer (INTA) is a new model of governmental intermediary organization that encourages coordination between S&T, the Ministries of Agriculture and the private sector.
- Important limitations include deficiencies in: (1) knowledge management as knowledge protection and access to information; (2) entrepreneurial orientation in the educational system, and (3) links between the R&D organizations and the industry sector.

How agri-food firms are creating competitive advantages through innovation.

Globalization and free trademarks have created a special competitive environment for firms in the agri-food sector. Globalization has made this market very competitive especially for Costa Rica due to its proximity to American firms and other multinationals. Firms are actively trying to learn new ways to be competitive taking into consideration their technological resource limitations. For instance, they are looking for new market segments, adapting new technologies in regional products and providing special client services.

As to whether firms are implementing organizational innovations or not, many of them are indeed applying the process innovation, especially when it is new to the firm and shows incremental innovation to improve efficiency. In the case of the PA group, priorities are related to improving production. Firms are implementing the reactive innovation, which is typical of firms in the agriculture sector of developing countries. The food processing group exhibits very interesting cases such as the dairy company that makes more than 70 new products per year or the coffee/chocolate firm that has developed new markets and is exporting the model to other countries, producing more than 100 products per year.

This study suggested that all FP firms and three PA firms are using innovation to build competitive advantages and that almost all FP firms have a clearly defined formal strategic plan, while 2 FP and 3 PA firms have an informal strategy (based on experience but without a written plan).

The analysis of collaborative innovation in firms shows the importance of public universities, especially for PA firms, which in general do not have R&D departments and need them for technological development. According to firms’ experiences, the missing actors in the system are private intermediary organizations, which play an important role in the innovation process in developed countries.

The firms that claimed more connections and relations with other NIS organizations were the foliage firm and three food processing SMEs. The main characteristic perceived in most of the related companies is that they are not waiting for help; instead, they are proactively looking for and taking advantage of relations with other actors in the NIS. This characteristic emphasizes the importance of having entrepreneurial orientation in the firms to take advantage of any situation.

NIS Impact on Firms: In the development of competitive advantages using innovation in firms, the NIS has different levels of impact according to the particularities of the firm, such as its position in the supply chain, characteristics of the market and firm size. Some specific findings in different dimensions are as follows:

- In the supply chain dimension, the influence of the NIS on the Primary Agricultural sector is based on public entities that provide support in the technological developments, especially those aimed at improving productivity by better applying agrochemicals, pest control, and clean technologies. This is possible because of the strength of the R&D organizations in the

country. In the Food Processing sector the influence is lower and more oriented towards supporting the development of the quality system and training in managerial aspects.

- In the Primary Agricultural segment, FDI has significantly influenced the ornamental and flower sector producing a spill-over effect on local producers. This subsector currently has a meaningful participation in the country's exports.
- For the Primary Agricultural sector, in the case of non-traditional products with low market penetration, the influence has been focused on the support from public entities (governmental organizations and public universities) in the creation of technological knowledge in order to improve productivity (definition of quality parameters, reduction of sicknesses and better marketing). However, an important barrier has been the absorptive capacity of the firms, which are not taking advantage of the knowledge produced. In the case of global commodities, through the support from "sub-sector promoters", public universities and governmental organizations, it has been possible to consolidate competitive advantage at the country level, based on high productivity and the rapid response to changes in the market. In this case, the country has worked very effectively in some sectors such as banana, coffee and more recently pineapple.
- Important differences were found in Food Processing firms regarding the NIS impact between SMEs and large companies. Governmental and sector entities have developed training programs on innovation management and marketing that have been used by SMEs in the creation of dynamic competence to respond to changes in the market. In some cases, R&D public organizations support the creation of new products. The main NIS impact for large companies is proper training of human resources according to market needs; there is little connection with public R&D organizations in relation to the development of innovations.

This study was concluded with the following recommendations:

- Analyze in more detail the characteristics of this interesting organizational model identified in Costa Rica: Sub-sector promoter, agri-chain approach, and INTA.
- Map the models of intermediary organization present in the agri-food sector of developing countries and analyze the characteristics of intermediation needed in the agri-food sector in the demand articulation, networking, and innovation management processes.
- Study in more detail the effect of absorptive capacity on the relationship between R&D and small farmers.
- Evaluate successful developmental tools that have been used by developed countries:
 - The critical success factor of the spill-over effect of FDI on agri-food firms in developing countries.
 - The characteristics needed in developing countries for incubators and support of "high added value" start-ups in the agri-food sector.
- Evaluate options to increase the entrepreneurial orientation in the educational system.

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1. Introduction

The opening of the domestic market and the country's integration into the global economy require new approaches for productive sectors to achieve competitiveness by better using knowledge and increasing added value of goods and services. Specifically in the agri-food sector to succeed or even to survive is not easy since competition within the sector is more intense than ever. Some of the most significant indicators of these changes are the technological disruptions related to the development and diffusion of genetically modified organisms, the restructuring of markets characterized by rapid concentration among retailers, and the reorientation of trading activities involving the so called globalisation of markets and firms (Menard & Valceschini, 2005). As a consequence new views of the food system and new strategic implications are emerging and agricultural producers, food manufacturers and retailers operate in a changing competitive environment (Senauer & Venturini, 2005). Consumers with complex eating patterns demand differentiated and diversified food products. Moreover, there are new market trends such as an increased interest towards the transparency of the food chain, healthy foods, organic foods and local foods that may provide business opportunities for small-scale producers. Into this scenario firms that do not catch up with a competitive advantage will be “pushed out from the market”(Forsman, 2004).

Innovation appears in a prominent place and explicitly integrated into visionary strategic exercises and, advanced communities around the world are using it to encourage the business development and sustained socio-economic growth. The competitive impact of firm efforts differs between countries at the same level, between countries at different stages of development and also among sectors in a single country (Guillén, 2000). Developing countries face genuine obstacles to innovation and this is precisely why they remain underdeveloped. These obstacles derive from inappropriate business and governance climates and insufficient education (Aubert, 2004). In an emerging economy, access to resources is very sensitive to the kinds of policies that the state implements to promote economic development (Guillén, 2000).

From this point of view the National Innovation System approach (in its actors, interrelations and institutions) is an important tool to evaluate the influence of the Country in the possibility of building competitive advantages by firms. The understanding of this influence could help countries to establish better ways to align the efforts of different actors and institutions with the real needs of firms.

For these reason the *main objective of this work is to conduct an exploratory study on the impact of the National Innovation System in the competitiveness of agri-food firms in developing countries, with special focus on Costa Rica.*

To achieve this objective two questions are answered: Which is the impact of the NIS in the competitiveness of agri-food firms in developing countries? and how is this influence considering three dimensions: supply chain position (Primary Agriculture vs. food manufacture), size (SME's vs. Large) and market penetration (no traditional exports to reduce market vs. global commodities).

The research is based on a case study in Costa Rica. For the development of the study three aspects are considered: the factors of the NIS that have to be taken into account to evaluate the impact in the development of competitive advantages, the characteristics of this factors in developing countries and the characteristics of agri-food firms in the use of innovation to create competitive advantages.

The mapping of the important factors of the National Innovation System of Costa Rica is realized through interviews of key actors and documental information; the way in which agri-food firms are using innovation to create competitive advantages is analyzed by using a multi-

case of 16 agri-food firms. The impact of the NIS in the creation of these advantages is evaluated in a cross analysis of three dimensions.

From a practical point of view this research is an important contribution for the efforts that Costa Rica government is doing to define strategies by sector of the new National Innovation System. From an academic point of view this work defines ways to analyze the influence of NIS through different dimensions in developing countries and identify aspects for further studies in the evaluation of alignment between National Innovation Systems and firms' performance, specifically related with the importance of absorptive capacity of farmers in the relation with research institutions, a special model of NGO found in this country and, the influence of the NIS in the development of competitive advantages at the country level.

For a better understanding of the case this report is organized in the following way: Chapter 2 presents the research design used to support the case. In Chapter 3 are introduced the most important aspects from theory needed to understand the case; first some concepts on innovation and its relation with competitive advantage, followed by characteristics of the NIS, beginning with the theoretical foundation of the relation of NIS with competitiveness and later with special consideration for developing countries. Chapter 4 presents the study domain, with the characteristics of competitiveness in the agri-food sector, worldwide and in Latin America, and ending with the specific details of Costa Rica. In Chapter 5 the main results are presented and discussed, beginning with the mapping of the important elements of the NIS, followed with the analysis of innovation in the interviewed firms and ending with analysis of the previous section in the definition of impact of the NIS in the different dimensions. Finally Chapter 6 presents the most important conclusions, findings and recommendations of this study.

1.1 Definitions

Absorptive capacity: “The ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends”. Cohen and Levinthal in (Tidd & Bessant, 2009)

Competitive advantage: it refers to superiority over rivals in a particular market. It is a kind of unique position vis à vis competitors. Traditional types of competitive advantage are low-cost advantage and differential advantage. In the present study, competitive advantage is approached from the standpoint of resource-based logic. A firm can achieve a competitive advantage if it follows value-added strategies that, on the one hand, are based on resources that are valuable, rare, costly to copy and difficult to substitute and, on the other hand, are not imitable by competitors. The study also takes the view that the nature of the competitive advantage in small businesses is relative rather than absolute. In addition, competitive advantage is looked at mainly from a differentiation perspective (Forsman, 2004).

Innovation: There are many different definitions. In the broadest sense the term comes from the Latin *innovare* meaning “to make something new”. According to Tidd & Bessant (2009), innovation is a process of turning opportunities into new ideas and of putting these into widely used practice.

Resources: can be defined as assets that firms use to develop and implement their strategies. Resources are often classified into homogenous categories such as:

- financial capital: consists of all the monetary resources a firm may need to implement its strategies
- physical capital: refers to a firm's plant and equipment, geographical location, access to raw materials or necessary technology
- human capital: is an attribute of single individuals referring to their experience, intelligence, insights and relationships
- organizational capital: is an attribute of collection of individuals including a firm's culture and reputation; formal and informal planning, and controlling and co-ordinating systems (Forsman, 2004).

Other important classification is:

- **Knowledge-based resources:** are the ways in which firms combine and transform the tangible input resources. Knowledge permits the firm to predict more accurately the nature and commercial potential of changes in the environment and the appropriateness of strategic and tactical actions. Without such knowledge, an organization is less capable of discovering and exploiting new opportunities inherently difficult to imitate, thus facilitating sustainable differentiation (Wiklund & Shepherd, 2003).
- **Property-based resources:** typically refer to tangible input resources (Wiklund & Shepherd, 2003).

Resource-based view: In the 1990s, a resource-based perspective became the dominant view in studying competitive strategies. The core of the RBV is that the potential for sustainable competitive advantage lies in valuable resources that are rare, costly to copy and difficult to substitute and that firm resources are both heterogeneous and immobile (Barney 1991, 2001).

National Innovation System (NIS): Although no universally accepted definition exists, NIS is generally recognized as comprising the complex functions and interactions among various actors and institutions in a country level. The performance of NIS largely depends on how these actors, which include government, enterprises, universities, public and private research institutes, bridging institutes, and other contributing institutions, function and interact with each other to develop and apply innovative knowledge (Chang & Shih, 2004).

Strategy: “A series of goal-directed decisions and actions that match an organization's skills and resources with the opportunities and threats in its environment, to meet the needs of markets and to fulfill stakeholder expectations” (Omta & Folstar, 2005).

Spillover effect: This is defined as an exchange of ideas among individuals. Recently, some economists have suggested an important link between national economic growth and the concentration of people and firms in cities. The high concentration of people and firms and organizations in cities creates an environment in which ideas move quickly from person to person and from firm to firm. That is, dense locations, such as cities, encourage knowledge spillovers, thus facilitating the exchange of ideas that underlies the creation of new goods and new ways of producing existing goods (Carlino, 2001).

2. Research design

This chapter explains the research design selected for the development of the study. In first section the research objective shows the problem that is going to be solved; it is phrased into questions and sub-questions. Section 2.2, through the research framework, defines the strategy selected to analyze the case, and explains what is going to be studied to achieve the objective and the main steps of the research. Finally Section 2.3 describes what the main sources of information are and explains in detail the processes of collecting and analyzing data.

2.1 Research objective and questions

Considering to succeed or even to survive for firms in the agri-food sector depends on having competitive advantages, based on innovation, the main objective of this work is *to identify the impact of the National Innovation System in the competitiveness of agri-food firms in developing countries, with special focus on Costa Rica.*

Research Questions

To achieve this objective the following questions will be addressed:

Main questions

- Which is the impact of the NIS in the competitiveness of agri-food firms in developing countries?
- How does the NIS specifically impact three dimensions of agri-food firms (supply chain position, sizes and market penetration)?

Sub-questions

1. How does the NIS potentially impact the development of competitive advantages?
2. How does the NIS impact developing countries?
3. How are agri-food firms creating competitive advantages through innovation?
 - 3.1. What are the competitiveness characteristics of the agri-food sector?

The results of sub-questions 1 and 2 provide the basis to define the characteristics of the National Innovation System related with development of competitive advantages in developing countries. The answer on question 3 defines the relation between the firm, its internal characteristics and the relation with innovation and competitive advantages for the agri-food sector.

2.2 Research Framework

This study is a qualitative research; according to Creswell (2009), a qualitative research is a mean for exploring and understanding the meaning individuals or group ascribe to a social or human problem. The research framework (Figure 2.1) presents the different steps of the study: to achieve the research objective, a theoretical framework is built from the study of literature related with competitive advantages, innovation and innovation systems, including consideration for developing countries (A). The information collected built the base to understand the impact of the NIS in competitiveness. The mapping of the NIS in Costa Rica is establish combining document research with interviews with key actors of the NIS (B); all this information is used to analyze the influence of the NIS in the competitiveness of firms of the agri-food sector (C).

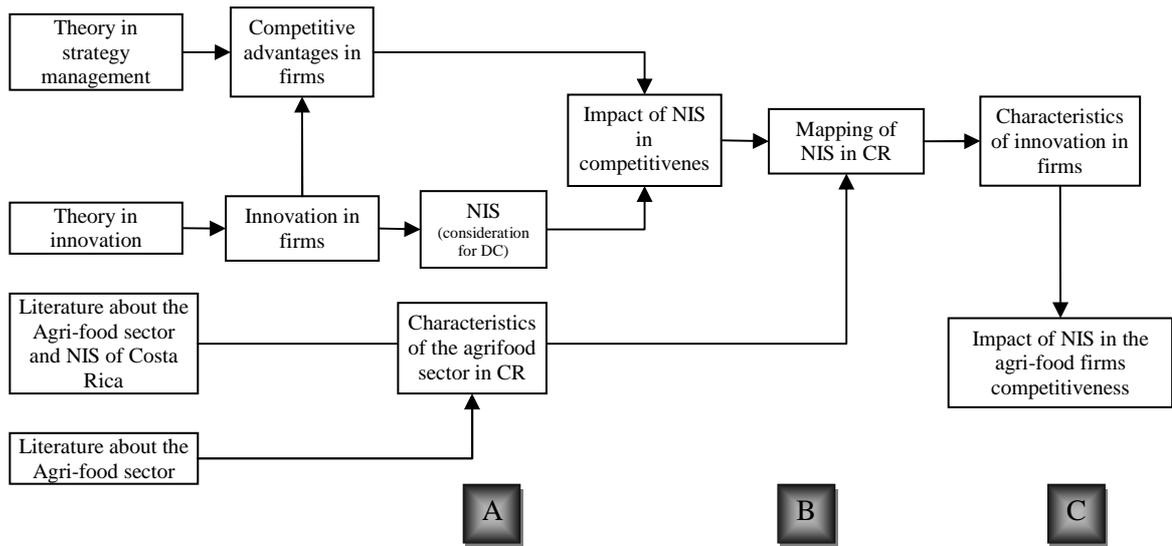


Figure 2.1 Research framework

The study will be based in a case study methodology (Creswell, 2009; Yin, 2006). A holistic case study is used to build the mapping of the NIS in Costa Rica. An embedded multi-case is used to analyze innovation in firms and the impact of the NIS.

The conceptual model presented in Figure 2.2 is the basis of this research. As seen from the figure, external factors from the National Innovation System and internal factors of the firm have influence in the development of knowledge-based resources. Through its capacity of understanding and applying knowledge (absorptive capacity) the firm uses the resources to create competitive advantages through innovation. These concepts are explained in more details in chapter 3.

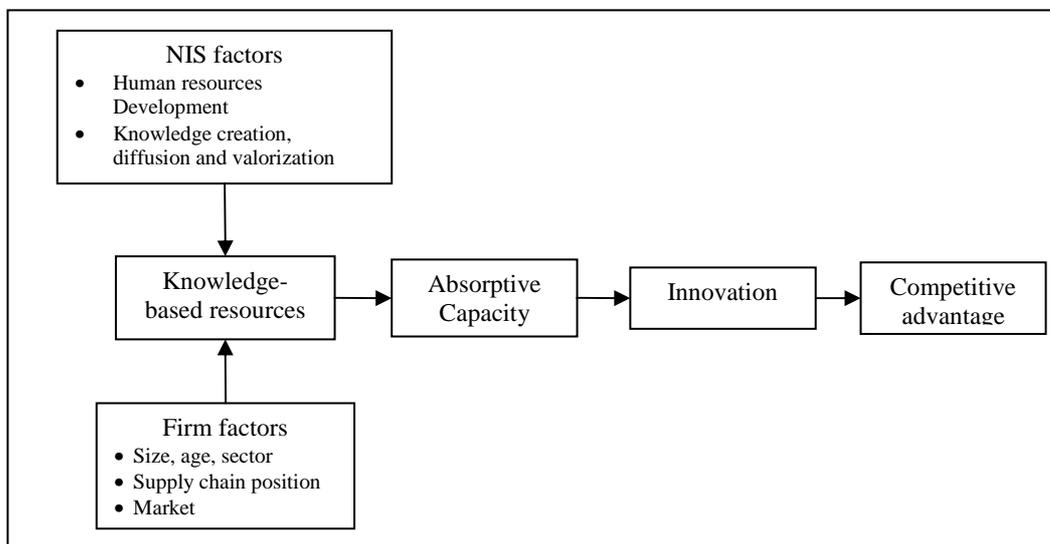


Figure 2.2 Conceptual Model

Following it is presented the data collection procedures used and how the data is analyzed and validated.

2.3 Data collection and analysis

The sources of information and the methods to access these sources for each step of the research are summarized in Table 2.1. The main sources of information are desk research and interviews. Two different types of interviews are realized in Costa Rica: to key actors of the NIS and to firms of the agri-food sector.

Table 2.1 Detail of the data collection of this study

Type of Information	Sources	Access to the source	Location of the source
Competitive advantages in firm	Literature	Desk Research Content Analysis	Library Electronics journals Scientific databases
Innovation in the agri-food sector	Literature	Desk Research Content Analysis	Library Electronics journals Scientific databases
Definition of factors of NIS related with competitive advantages	Literature	Desk Research Content Analysis	Library Electronics journals Scientific databases
Characteristics of the NIS in Costa Rica	Literature 11 interviews	Desk Research Content Analysis Interview to key actors	Library Electronics journals Scientific databases Costa Rica Documents
Characteristics of innovation in firms	Interview to 8 Primary Agriculture Firms and 8 Food manufacture Firms	The selection of firms was based on the report “technical competitiveness in 100 companies of the agriculture sector in CR” and a list of Food Industry organization (CACIA) and an interview with the director of the Food Technology Research Centre (CITA)	CACIA Cámara Nacional de Industria (CR) University of Costa Rica (Agronomy School-CITA)
Influence of NIS in competitive advantage of agri-food firms in CR	Database of results	Database of results Content analysis Interviews	Document collected

Data collection and analysis of the mapping of the NIS: The results of the theoretical framework are used to define the important aspects of the NIS that are going to be evaluated. The mapping of the important factors of the NIS is focus in the “Generation and Assimilation of Knowledge” System. To have a clear view of this system information was collected from three levels: macro (general policies and activities in innovation), micro (organization related with education and knowledge creation) and meso (most important types of interrelations Knowledge creation-Industry). This system is divided in three sub-systems at the micro level (education, knowledge creation and private sector) and 1 subsystem at the meso level (intermediation). A SWOT analysis is made for each subsystem. The data is collected from desk research and specific interviews with 11 key actors of the NIS. They were selected from the three sectors: government, universities and private sectors organization. The interviewees were selected according to its experience and knowledge about the relationship between the different actors of the system (education, R&D and Private sector). It was important in this case to be sure that they had a perception of innovation in the agri-food sector. The details of the characteristics of the interviewees and the main topics discussed with each one are presented in Table 2.2; Appendix 1 presents more details of the organizations related with each interviewee.

Table 2.2 Interviews to key actors of Costa Rica National Innovation System

Sector	Interviewee characteristics	Topics discussed
University	Director of University Knowledge Transfer Office Member of the National Innovation Committee	<ul style="list-style-type: none"> • Characteristics of U-I relation • Main activities of Proinnova • Main results of Atlas of Innovation • Special research on innovation in exporter firms
	Special researcher on U-I interaction	<ul style="list-style-type: none"> • Results of studies in U-I interaction (data of last 10 years in the University of Costa Rica) • Most important conclusion of the study
	Coordinator of Cathedra “Innovation and Business development”	<ul style="list-style-type: none"> • Main details of its research in innovation in firms • Characteristics of NIS • Role of private sector in NIS policies
	Director Agronomy Department	<ul style="list-style-type: none"> • Details of research in agriculture sector • New project on entrepreneurship-incubation UCR • Importance of especial NGO (e.g. CORBANA, LAICA)
	Coordinator Research Project “Competitiveness Research in agricultural sector”	<ul style="list-style-type: none"> • Characteristics of innovation in the export agriculture sector • Details of study in technological competitiveness in agriculture firms
University-Government	Director Food Technology Research Centre-CITA	<ul style="list-style-type: none"> • Relation U-I • Research Needs of food manufacture sector • Gaps in the sector
Government	Participation in a Costa Rican NIS analysis workshop	<ul style="list-style-type: none"> • Characteristics of the National Innovation System of Costa Rica • Gaps and needs in the development of the new structure of the NIS
NGOs	Research Directors of CORBANA (banana) and LAICA (sugar) Special sub-sectoral promoter organizations	<ul style="list-style-type: none"> • Characteristics of R&D in the organization • Innovation in the sectors • Mechanisms of knowledge transfer • Examples of developments
	President Parquetec-Incubator Member of the National Innovation Committee	<ul style="list-style-type: none"> • Results of Atlas of innovation • Experience of incubators • Needs in the sector • Characteristics of entrepreneurship in developing countries
Industry	Staff Member of the Food Industry Chamber (CACIA)	<ul style="list-style-type: none"> • Innovation in the food manufacture sector • Activities of the Chamber • GAPS in the sector
	Project Director Industry National Chamber	<ul style="list-style-type: none"> • Innovation in the industry sector • Details of the project: promotion of innovation

Data collection and analysis of firms: Considering that this is an exploratory research on innovation it was decided to select specific firms from the Primary Agriculture and Food Processing sector. There were used the following selection criteria: the firm should have international market, use innovation and be representative of different subsectors. The firms from the Primary Agriculture sector were selected from a list of 25 firms built with the collaboration of the coordinator of the Research project in Technological competitiveness in the agriculture sector. The eight firms finally interviewed from the list were defined by firm acceptance of realizing the interview. The 8 firms from the food manufacture sector were selected, with the criteria of high dynamic in innovation, from a list built in collaboration with the director of the Food Technology Research Centre (CITA) and the project director of the Industry Chamber. The characteristics of firms are presented in Table 2.3

Table 2.3 Important characteristics of interviewed firms

Group	Details of companies selected
Primary Agriculture	<ul style="list-style-type: none"> • 1 firms of a product were Costa Rica is first exporter worldwide but have low impact in economy. Importance for social development of a region of the country. • 4 firms of “ornamentals and flowers”: this group have important impact in CR exportation and implies use of high technology • 3 firms of pineapple sector: Costa Rica is first exporter worldwide and pineapple is second exportation product of the country (they were selected one start-up, a large firm with experience and a multinational)
Food Processing	<ul style="list-style-type: none"> • 1 dairy company. One of the most diversity companies of the world in dairy with near 500 products. 70 new products/year • 1 Multinational in “corn products”. Because of the regional characteristics of the products, the technology is developed in the region (mainly in Mexico). The multinational have more than 37 patents • 1 selected as one of the most innovative in the country, last years • 3 SME’s with high dynamic in innovation • 2 companies directly linked with Primary Agriculture (gourmet vegetables and minimally process)

The interview was structured using the conceptual model on Figure 2.2. The list of questions is presented in Table 2.4. The questions about knowledge resources and innovation were addressed to define the characteristics of innovation in the firms and this information with the characteristics of competitiveness is used to establish if the firms are using innovation to create competitive advantages. The questions about the relation with organizations of the country are going to be used to analyze the NIS impact.

Table 2.4 Information collected from firm interviews

Factor	Information asked
Firm characteristics	<ul style="list-style-type: none"> • Industry sector, Subsector, age, size, market, # employees, % professional
Competitive advantages	<ul style="list-style-type: none"> • Definition of position in relation to competitors. • Most important competitive strengths of the company. • How easy is to imitate the competence that differentiates your main products from competitors? • Needs to be more competitive.
Innovation	<ul style="list-style-type: none"> • Types of innovation: (Product/service, process, organization, market). Define the Novelty: new to : the company, local market, international market. • Effects of innovation in the development of the firm. • Tools used by company to identify promising areas for innovation. • Priorities to innovate. • Innovation strengths of the firm. • Most important barriers to innovate. • Others organization that participate in the innovation process. • Mechanisms to protect innovation results.
Knowledge-based resources	<ul style="list-style-type: none"> • Competence of the firm in: production, quality, R&D, marketing and sales, financial management, sustainability and environment, intellectual property and legal aspects, accreditation and certification process, Innovation management. • Mechanisms of technological knowledge acquisition. • Mechanisms of “decision-making and market sales” knowledge acquisition. • Special competence in management.
Relation with NIS	<ul style="list-style-type: none"> • Opinion of most important factors that promote or inhibit innovation in CR. • Most important organizations that support the innovation process of the company. • Needs to facilitate the innovation process of the firm in CR. • Organization that have an important role to improve the knowledge (technological, market and organizational) of the company.

An interview protocol was used for asking question and recording answered during the interview. The protocol includes the following:

- The interview is conducted with one of the members of the head manager team of the organization, preferably the general manager.
- The meeting is defined in advance asking for an interview of not more than one hour.
- The interview is realized in the location of the firm.
- There is a printed version of the interview and this document defines the direction of the interview.
- Data are collected by written in special space defined for each question.

Appendix 2 presents the detail of questions in English and one example of the Spanish document used.

The information obtained from interviews is analyzed in a multi-case study. First it is defined if firms are using innovation to create competitive advantages, second it is analyzed their relation with other actors of the NIS.

Analysis of the NIS impact in firms' competitiveness: The main results of the NIS mapping, the characteristics on innovation on firms and data of the agri-food sectors are used to analyze the impact of the NIS in the creation of competitive advantages.

To validate the information collected of firms and Costa Rican NIS, the information is confronted to information from previous study in developing countries and confirmed with the interviews realized with key actors of the NIS.

3. Theoretical framework: Impact of National Innovation system in the creation of competitive advantage

This Chapter defines the factors of the National Innovation systems that have an influence in the development of competitive advantages. First section presents the important aspects that related innovation and the creation of competitive advantages. Section 3.2 presents consideration in the relation of competitiveness and the NIS and section 3.3 discusses relevant aspect to consider for developing countries.

3.1 Innovation as a tool to built competitive advantage

Nowadays, more than ever, firms have to define strategies to allow them to use their resources in the most efficient way to success in a global market environment. Because firms are not alone, competitors are going to response to the strategy's firm making the process of strategic alignment dynamic, with continuous changes and adaptations (Fortuin, Batterink, & Onno Omta, 2007). *Competitive strategy* is concerned then, with how a firm competes in the market, that is, how it achieves and maintains a position of competitive advantage.

To define their competitive advantages firms own resources and capabilities, in terms of what are capable of doing, provide a more stable basis for a strategy than the needs of external business environment. The Resource Based View (RBV), developed in 1990's, emphasizes exploiting the differences between firms as a key to long-term competitiveness and success; the core is that the potential for sustainable competitive advantage lies in valuable resources that are rare, costly to copy and difficult to substitute and that firm resources are both heterogeneous and immobile (J. Barney, 1991; J. B. Barney, 2001). Moreover, the more dynamic a firm's external environment is, the more likely internal firm factors play a significant role in the long term strategy foundation (Forsman, 2004).

In order to create competitive advantage, a firm needs to understand the interaction between resources or, more specifically, how individual resources available to a firm or firm-specific assets work together. Resources can be separated into those that are knowledge based and those that are property-based. Property-based resources typically refer to tangible input resources, whereas knowledge-based resources are the ways in which firms combine and transform these tangible input resources. Knowledge permits the firm to predict more accurately the nature and commercial potential of changes in the environment and the appropriateness of strategic and tactical actions. Without such knowledge, an organization is less capable of discovering and exploiting new opportunities inherently difficult to imitate, thus facilitating sustainable differentiation (Meyer, Wright, & Pruthi, 2009; Mrinalini & Nath, 2008; Wiklund & Shepherd, 2003).

Into the use of knowledge, innovation can help in the creation of competitive advantages through a proactive approach of using new knowledge to gain a strategic market position relative to its competitors for example through a better use of natural resources favouring its transformation in goods with greater technological content and, finding dynamic ways to keep the position in the market (OECD, 2005).

Since the strategic point of view, innovation is more complex than just invention. Invention is the conversion of new knowledge in new products, processes or services. Innovation typically involves creativity but is not identical to it: innovation involves acting on creative ideas to make some specific and tangible difference in the domain in which the innovation occurs. Innovation implies the process of putting the invention into use (Fortuin, 2006; Johnson, 2008). This process involves many different external and internal variables that have been taken into account to success.

The process described before requires that the organization has the capacity for learning, implementing new knowledge, disseminating new knowledge internally and making use of new resources, including new technologies. In other words, an organization "needs prior related

knowledge to assimilate and use new knowledge”; this is defined as *absorptive capacity*. Absorptive capacity is a function of the organization’s existing resources, existing tacit and explicit knowledge, internal routines, management competences and culture. This seems to be related to levels of education, source of knowledge acquisition (college, university, consultant, peers, etc.) and experience (Gray, 2006).

Understanding how innovation could be used to create competitive advantage, using the National Innovation System approach next section analyzes the importance of the relation with other actors.

3.2 Competitiveness and National Innovation System

National Innovation System is a dynamic, evolutionary process with a complex interactive network among various actors of the research and technology (R&T) manufacturing, and education systems, supported by government policy measures to facilitate technological innovations for economic growth. It is sensitive to the socioeconomic and political culture of a particular country and it is also susceptible to the process of globalization. Being dynamic in nature, it varies across the countries depending upon their technological capabilities, industrial development, S&T support system, education system and economic development, complemented with focused policy measures for innovation (Spielman, 2005).

Countries and governments play an important role in the guidelines that promote the kind of competitiveness that is going to be the base of the economic development. In general terms there could be two ways to orient competitiveness (Lascaris, 2002):

- Rising productivity and wages to support modernization in scientific and technological progress.
- Participation in a sustained export production based on cheap labor, successive devaluations of the currency, and/or over exploitation of natural resources, referred to as “spurious” competitiveness.

The first one is seen as the way of real development having more influence in the social improvement of the country; on the other hand through the “spurious” competitiveness is very difficult to promote real development because it has lower social impact and implies environmental deterioration.

In both cases the technological capacity of a country is a strategic element of their platform of competitiveness. One company, one country or industry sector is technological capable when it can have accessibility and make proper use of required technologies to perform competitively in the market.

The main influence of the NIS in the development of competitive advantages is based in the development of endogenous scientific and technological capabilities, as well as the integration and assimilation of them effectively in the economy as a key element in strengthening the productive sector (Lascaris, 2002).

Systemic competitiveness stems from the effective operation of the “Generation and Assimilation of Knowledge” System defined as:

- The elements of the system, which are the institutions and organizations (universities, research institutes, companies, ministries) of the educational, scientific and productive sectors.
- The dynamics of the system, i.e., the pattern of flows and interactions between elements of the system. It is proposed on the basis of a systemic nature of relationships that must be met in a country to ensure that appropriate knowledge will be a factor in competitive production. This pattern is called “structural desired situation”.

The system is composed of sub-systems of education, production and knowledge creation. As is shown in Figure 3.1 these subsystems provide an interaction and interdependence such that the

effective functioning of each depends on the possibility of effective operation of the other, and consequently, the system generation and assimilation of knowledge as a whole, which is a scientific-educational-productive system.

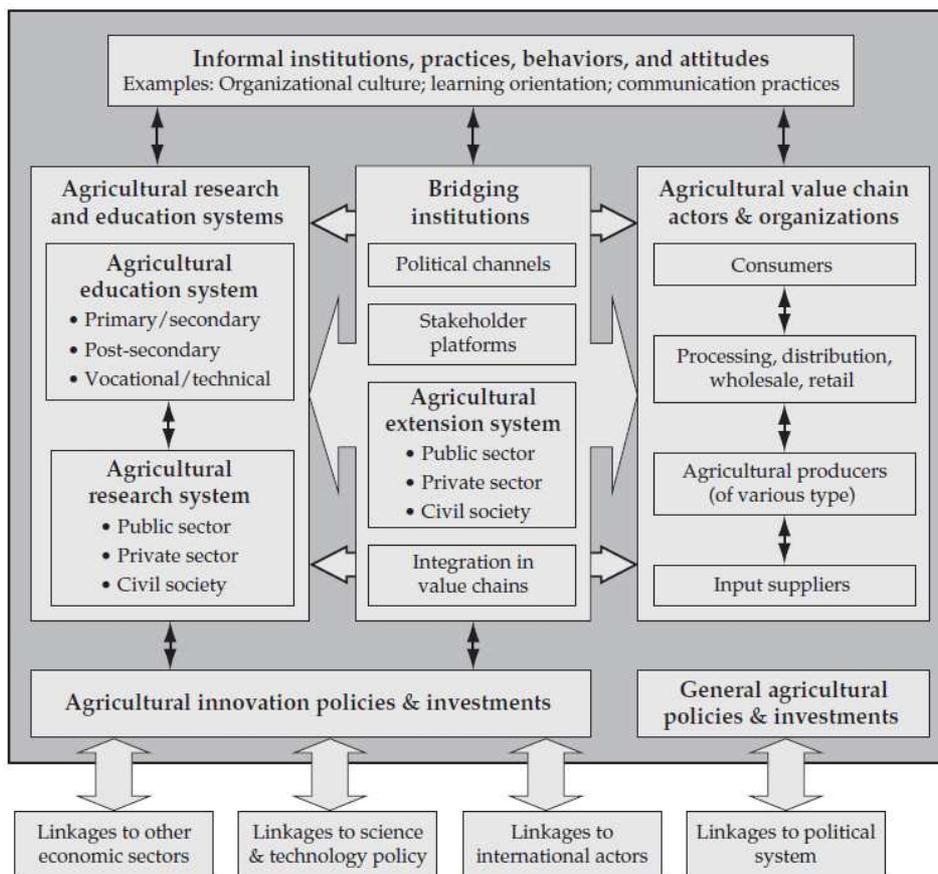


Figure 3.1 Illustration of Innovation system of the agri-food sector (Spielman, 2005)

Structural competitiveness is a complex phenomenon resulting from the dynamics of these systems with each other and the environment. Aspects relating to the competitive structure and organization of production have been developed by some authors on the basis of four levels (Lascaris, 2002):

1. **Micro level:** refers to the level of individual actors within the integrated areas of research and development, educational, and productive, as companies, universities and research centres.
2. **Meso-level:** includes the structure of linkage between these three sectors, government and social actors, and the support to the performance of players at the micro level of individual sectors
3. **Macro-level** "means the area of planning, policies, strategies and regulatory frameworks, in relation to the subject under study, pointing to the construction of the platform management and sustainability of competitiveness based on knowledge. At this level, the government creates the conditions required for each specific sector to play its role in building competitiveness.
4. **Meta-level:** incorporates mainly the capital of the country, including factors such as capacity for integration and social strategy.

Into the "Generation and Assimilation of Knowledge System" effective functioning of technological innovation requires a dynamic interaction between systems and between levels:

1. The system acquires identity as such on the meso level; in this level it is conceptualized and designed the organic articulation and structural order needed between systems.
2. It operates at the micro level of each system. The operation of the micro-level of each one depends on its strength, organization and interrelations with the rest of the structural system.
3. Its effective functioning derives of joint actions in the micro and meso levels, which are made possible by conditions on the macro and meta levels.

Compliance strategies and policies defined at the meso-level that include, development strategies by sector, to link business areas, and operational support to its action, allows achieving the micro level:

- The generation of scientific knowledge and technology that meets requirements of the productive dynamics.
- The learning process by business, which is essential for the assimilation of knowledge.
- The training of human resources required for the production and generation of knowledge.

As a conclusion the analysis of the actors and interactions, at different levels, could help to understand the influence of the National Innovation System in the development of competitiveness.

3.3 Consideration for developing countries

Under the model explained in last section it is possible to underline some considerations in differences between developed and developing countries. Technological innovation emerges in an economy when the various components that make up the system (educational, knowledge creation and manufacturing) are consolidated and, there are proper dynamic interactions within each system and between systems. Consequently, in the context of the global economy, a country with a gap in at least one of these components cannot be economically developed (Lascaris, 2002).

The basic difference between the innovation process in developed and the developing countries is the domain of technological innovations. For the technologically competitive industrial set-up of the developed countries, the innovation system is to maintain or improve the existing technological competitiveness and growth, contrary to most developing countries where it has to be established. In developed countries, generation, transmission and utilisation of advanced knowledge have a central role, by means of several processes where creation of capabilities and opportunities for using them in innovative ways reinforce each other (Mrinalini & Nath, 2008).

In developing countries it has been found gaps at different levels. At the macro level structural and organizational problems of the economy have a decisive influence on the ability to use science and technology. Low political priority to science and technology causes low allocation of funds for R&D and this is underpinned by the perception that the right strategy to propel economic growth is to import technologies. Industrialized countries spend between 2% and 3% of GDP on science and technology, (while in developing countries is less than 1%) with 50 times more researchers per capita, and subsidize between 20% and 40% of private spending in this area under various modalities (Lascaris, 2002; Spielman, 2005; G.J Stads, Hartwich, Rodríguez, & Enciso, 2008).

From this point of view of knowledge creation, developing countries industry has, in absolute and relative terms, a reduced ability to make R&D and universities and research institutes have the largest investigative capacity. It means that internationally competitive technologies have to be developed from universities. For this reason it is needed a strong and effective synergistic link between these sectors. However R&D organization have important weaknesses because of lacks in funds, proper personal and infrastructure; in addition there is not an effective spaces of university/industry interaction and the fact that is many developing country universities have not incentive schemes for teachers, as well as a regulatory and administrative handling expeditious of contractual revenues (Lascaris, 2002; G.J Stads et al., 2008).

In general terms flows of information within national systems of innovation are fragmented, and in some cases there is an absence of linkages between science and enterprises. Weak or absent linkages challenge the capacities of firms to overcome (technology-related) problems and draw firms towards solutions that mostly rely on acquisition of embodied technology.

Barriers to accumulate capabilities by enterprises are high and difficult to tackle, particularly in the case of highly qualified human capital, local and international linkages- and, tacit knowledge incorporated in organizational routines.

Because of that, developing countries adopted the path of industrialization through import of technology from the developed countries, and then mostly they adopted either the process of technological self-reliance through import substitution or an export promotion growth. With the prevalent socioeconomic conditions, the government shouldered the major responsibility of industrial development with its direct intervention (Arocena & Sutz, 2005).

In the case of Latin America, although it is difficult to detect the existence of NIS in a strict sense, innovation - formal, informal and even interstitial - is part of real life in the continent. Latin American NISs are moulded by an insertion, in the international economy, that is characterised by specialisation on production based on natural resources, with comparatively low and mainly imported technological added value (Arocena & Sutz, 2005).

In such context, Innovation Systems look more fragmented than systemic, show a low density of national innovative relations, and depend essentially on innovation coming from abroad.

A comparison of industrial innovation surveys in several countries leads to some conclusions (Spielman, 2005):

- i. National spending in innovation is quite low; in the great majority of the countries, investing in R&D is below the threshold of 1% of GDP that UNESCO considered as a minimum three decades ago.
- ii. Innovative firms are characterised by performing indoors R&D, so analyzing how Latin American industrial firms do R&D becomes a central element for the study of really existing innovation.
- iii. Industrial innovation is highly informal; even if a fair proportion of industrial firms perform product and process innovation, R&D activities are not clearly and formally articulated with the enterprise strategy.
- iv. In spite of the above, entrepreneurial innovation is not necessarily of a low level of complexity; for example, the proportion of professionals in R&D is consistently higher than in other firm activities.
- v. Innovative firms have a comparatively important number of qualified technicians; their number and their salaries are, besides size, the only indicators related to level of innovation performance that the surveys show.
- vi. Firms need qualified personnel to be able to innovate, a result that even if reasonably expected, stems with remarkable accuracy from empirical findings.
- vii. The lack of qualified personnel in medium and small enterprises is not compensated by external advice. Some studies suggest that, among such firms, those that establish relations with universities and research institutes are the firms with highly qualified personnel, well related with their colleagues in academy: even to know what to ask and how to ask it, some level of training is necessary. It is more than possible, then, that the small firms asking for advise detected in the surveys are not precisely the ones that need to compensate their technical weakness through external help.
- viii. Firms consider the ideas for innovation as well as the concrete implementation of innovations mainly as an internal affair.
- ix. Concerning external relations of firms, the less important organizations are universities and public research centres, which belong to the national set of institutions, while innovation in national firms is frequently based on ties with foreign firms.
- x. The acquisition of capital goods for innovation from other firms, if we include it as an “external relationship”, appears to be the strongest for all countries. This is also valid

regarding the future: augmenting the investment in machinery and equipment was by far the most frequent answer to the question about plans for future innovation. In all cases, machinery and equipment for innovation were overwhelmingly foreign.

- xi. Micro-innovative strengths, that really exist, often remain isolated and encapsulated, thus weakening remarkably their potential contribution to the competitiveness of national economies.

4. Study Domain: The agri-food sector in Costa Rica

This chapter covers the most important factors of the agri-food sector in Costa Rica, needed to make the analysis of the NIS impact in firms of this sector. Going from general to specific, section 4.1 begins with a review of the global situation; section 4.2 presents the situation in the Latin American context, and section 4.3 ends with the characteristics for Costa Rica.

4.1 *Global situation of the agri-food sector*

In the context of a changing world (an accelerated urbanization, rising inequality, human migration, globalization, changing dietary preferences, climate change, environmental degradation, a trend of bio-fuels uses and population growth) the challenges of agriculture in the twenty-first century are diverse and complex, and the response involves economic, social, environmental and technological interventions.

In general terms, an increasing internationalization of firms and integration of markets are the most relevant trends in international economy. Several forces are combined to drive these trends as the decline in barriers to international trade and investment flows, and the advances in transport and communication technologies. In addition, the growing importance of new economies as India and China, has meant the growth of labour force related to international trade (1.2 billion people), which creates significant pressure on the working markets around the world. This new economies are entering in the production and sale of goods and services of high value added due to the considerable increase of professionals in the fields of science and technology. Moreover, they can produce almost anything that a developing country produces, but at much lower price¹ (Monge Gonzalez & Hewitt, 2008; Senauer & Venturini, 2005).

As a consequence agricultural producers, food manufacturers and retailers operate in a changing competitive environment. New views of the food system and new strategic implications are emerging. These forces have structural, organizational and strategic consequences in a growing range of industries and a strong impact on trade patterns, specialization, foreign direct investments (FDI), and global capital flows. They have also eased the globalization of food systems (Senauer & Venturini, 2005).

After 80's the agriculture sector had to face other important fact; not only did they need to focus on a much-expanded agenda, but also there was increasingly a more fundamental questioning of the nature of the role of the public sector in agricultural research. A key change that is making all the more pertinent is the emergence of private sector research. This occurred partly as a result of improved intellectual property protection regimes and the technical advances associated with biotechnology. But also significant are the opportunities that economic and trade liberalization and globalization are now presenting for private investments in agro-industries such as seed production (Hall, Clark, Sulaiman, Sivamohan, & Yoganand, 2000).

With this new interest in the private sector, national policy makers have increasingly the difficulty of integrating multiple sets of agendas, having to choose between serving, for example, the commercial needs of the agricultural sector while simultaneously serving the interests of society at large. In this way agricultural policy is no longer one-dimensional. It is faced with a far broader and more complex (and potentially conflicting) situation (Hall *et al.*, 2000).

And this scenario conflicts are all too abundant. Examples are the need to develop capacity in frontier areas of science, while also supporting adaptive research for traditional and subsistence sectors; the need to support, but not compete with, the private sector; the need to support the competitiveness of the private sector in global markets such as export horticulture, but not to displace small-scale producers; the need to achieve all of the above but without losing sight of

¹ For example, in the textile sector, while an hour of work in China costs between \$ 0.41 and \$ 0.69 in Mexico it costs \$ 2.30, in Peru \$ 1.63, in South Africa \$ 2.17 and in Costa Rica \$ 2.38

the old agendas of increasing food production, without damaging the environment and without being socially divisive; and the need to contribute to poverty reduction without disadvantaging vulnerable groups such as women. And all of these goals need to be achieved in the face of ever shrinking financial support from the public purse (Hall *et al.*, 2000).

The main changes in the private sector are the following: (1) processed foods are increasingly important in agricultural trade as opposed to trade in traditional agricultural commodities; (2) food manufacturing is characterized by one of the greatest degree of trans-nationality and foreign production by food multinationals; (3) despite the increasing role of multinationals, local players remain more important in the food industry when compared with most manufacturing industries; (4) an important process of international expansion and organizational change of the retail industry is taking place; (5) there has been a significant increase in the relevance of cross border merge and acquisitions of retailers; (6) a very small number of major retailers is playing a relevant and increasing role in the process of globalisation of food systems, and, (7) private label foods are a large and growing global phenomenon (Senauer & Venturini, 2005).

It is also important to note that developing countries in some aspects are taking advantage of this growth. Over the past decade, processed food exports of these countries have exceeded those from the developed regions. While the growth in the value of processed food exports during the former decade was fuelled mainly by exports from developed countries, processed food exports from developing countries played a more important role over the latter decade (Senauer & Venturini, 2005).

However, developing countries face a number of risks associated with trade. Perhaps the best known is declining terms of trade, as the world prices of the primary commodities they export tend to fall over time relative to the price of the manufactures they import. Most developing countries are price-takers in the majority of international markets in which their national trade, but their activities are concentrated in a small number of markets. They cannot influence world market prices (mainly because of the small relative size of their market contribution), but at the same time are severely affected by changes in these prices, especially when these changes are dramatic or unexpected. Related to this are supply side risks, especially the sensitivity of output to climatic variability. Droughts and excess rain creating flooding can cause serious damages to agricultural output (FAO, 2003).

Another new type of risk is emerging in the face of increasingly integrated global markets (one facet of globalization). This can be represented by distinguishing comparative from competitive advantage. Comparative advantage captures the potential provided by a country's resource endowment to derive gains from trade. Competitive advantage considers why certain producers, in particular multinational firms, are able to exploit the rents from comparative advantage. Trade in agricultural commodities is dominated by large, typically multinational, companies that are present in all or critical stages of the commodity chain. At one extreme is contract farming where corporations control production, at the other are supermarkets that control purchasing, and often multinationals control the distribution chain between production and final sale. The risk arises because small producers, and even some large producers in small countries, are the weakest links in the chain; a related issue here is the increasing tendency for large multinational companies to capture the benefits of comparative advantage by virtue of their monopsony position (FAO, 2003).

The last two paragraphs give an introduction for the situation of agri-food sector in Latin America that is going to be discussed in next section.

4.2 The agri-food sector in Latin America

As was explained in last section globalization had had a very important impact in developing country and that is the case for Latin America.

The countries of Latin America and Caribbean (LAC) represent a wealth of natural resources; the world's greatest agro-biodiversity; and immense economic, social, and environmental

diversity. Nonetheless, LAC countries exhibit much commonality, including significant urban populations, high ethnic diversity, and increasing inequality and poverty. Another shared factor is that many LAC countries have reformed or are in the process of reforming their economies through structural adjustment programs (G. J. Stads & Beintema, 2009).

In 2005, agriculture represented 5% of LAC's total GDP, but this average masks important differences across countries. In Trinidad and Tobago, for instance, agriculture accounted for just 1 percent of national GDP, whereas the share was 20 percent or higher in Nicaragua and Paraguay. Agriculture's impact on the region's economy is much higher when linkages with farm-input, food-processing, and distribution industries are taken into account. Although data is limited to certain countries and years, results of studies undertaken by the Inter-American Institute for Cooperation on Agriculture (IICA) indicate that the sector contributes a much higher share of GDP than is reflected in the official data. Such data for Costa Rica or Uruguay in 2006, for instance, was estimated to be between 30 and 35 percent of these countries' national output compared with official shares of just 9 percent each. Strong forward linkages to the agribusiness and food services sectors exist in many of the region's countries; examples include soybean oil and derivatives in Argentina, Brazil, and Paraguay; fruit and salmon in Chile; cut flowers in Colombia and Ecuador; beef production in Uruguay; and bananas in Ecuador (G. J. Stads & Beintema, 2009).

Agriculture is also an important source of employment in the region. In 2006, the agricultural sector employed more than 30 percent of the national labor force in Bolivia, El Salvador, Guatemala, Paraguay, and Peru, and when looked at from a rural perspective, these shares rose to more than 50%. In contrast, agriculture accounted for just 5 percent of Uruguay's total labor force and only 1 percent of Argentina's. Compared with other regions, agricultural growth and economic growth more generally have not reduced rural poverty in LAC, which remains high despite a 31 percent increase in agricultural production during 1995–2005. Overall, agricultural employment has not provided a pathway out of poverty, and as a result subsistence agriculture remains prevalent in the region's poorest countries. Nevertheless, agriculture in LAC is highly complex and dynamic, with farm households, traditional production systems, and sophisticated enterprises operating side by side. Nonetheless, all sectors are challenged by emerging threats like climate change, inequality, changing consumption patterns, natural resource management, food safety demands, and increased urbanization (G. J. Stads & Beintema, 2009).

The reforms mentioned before have affected agricultural performance and farmers. In general, prior to the reforms, the trade regime in the region was characterized by strong import substitution and an anti-export bias. Most countries adopted an explicit trade reform policy, the central objective of which was to reverse the negative consequences of protectionism, especially its inherent anti-export bias. The principal policy mechanism in common was to be a reduction in average protection economy-wide. Once exchange rates were adjusted and quantitative restrictions reduced, the next common goal was to adjust tariffs in a manner that their levels and range were decreased (FAO, 2003; G. J. Stads & Beintema, 2009).

A large number of sub-regional agreements have been established over recent decades for the purpose of removing trade barriers among LAC countries. Such agreements include the Southern Common Market (MERCOSUR), the Andean Community, the Central American Common Market (CACM), and the Caribbean Community and Common Market (CARICOM). Similar free trade agreements have been, or are close to being, signed with the United States and Canada (The North American Free Trade Agreement or NAFTA), as well as with the European Union and a number of Asian countries. Political integration in LAC, on the other hand, is still in its early stages. In May 2008, 12 South American Heads of State agreed to the establishment of a Union of South American Nations (UNASUR) to promote the integration of political, economic, cultural, environmental, energy, and infrastructure policy. Similar initiatives are currently under development for both Central America and the Caribbean (G. J. Stads & Beintema, 2009).

This liberalization has spurred a giant river of investment in part of the agri-food system – downstream, in retail, food services, and second-stage processing -very different from the pre-liberalization era when there was a relative trickle of FDI which was found upstream in the chains (in farming and first-stage processing). This change has resulted in a supermarket revolution, and rapid consolidation and multinationalization in the second-stage processing sector (FAO, 2003).

The expansion of trade increased the profitability of exporting and that drew FDI into the agri-food export sectors. This in turn drove two very important changes (FAO, 2003):

- a rapid consolidation and increase in the scale of packing, processing and exporting firms and growers in the commodity sectors (cereals, orange juice, soy, sugar), in some product sectors (e.g. dairy products), but less so in most fruits and vegetables;
- a rapid multinationalization of the agri-food export industries, with huge FDI mainly via mergers and acquisitions.

Different conditions have promoted two predominant styles of external insertion. One of them is seen in Mexico and the Caribbean basin. It is characterised by the exports of assembled manufactured goods to the US markets, their profitability being closely related with the wage differentials. Those goods are produced by transnational firms which keep their activities of higher added value outside the region; important progress has been made in terms of international competitiveness but without being able to extend that dynamism to the rest of the economy. The other style of international insertion is shown by South America, where the production and elaboration of natural resources predominates, based on their abundance and using mostly mature technologies. In the continent as a whole, structural heterogeneity and polarisation of productive activities are greater than in the past; foreign trade has grown but several endogenous productive chains have been dismantled, and the growth of exports did not generate a process of export-led economic development (Arocena & Sutz, 2005).

Within the agricultural sector of each country reforms affected subsectors differently. A useful way to assess the diverse effects within agriculture of trade reforms is to distinguish between the effects on the producers of exports, the producers of import-competing goods, and the small-scale producers of home or non-tradable goods. Winners have been the export-oriented sectors, commercial farmers and hired workers. Increased labour income as a result of the output mix has been one of the positive effects of the reform process from a welfare point of view. Import competing producers, however, probably lost in the short-run. Their long-run welfare depends on their capacity to increase productivity and/or change cropping patterns, which for some farmers and regions were very limited. Certainly low-income consumers (and farmers are consumers too) benefited from trade liberalization as lower protection reduced the price of food relative to wage rates (FAO, 2003; Spielman, 2005).

However these changes bring the spectra of exclusion of small farmers and firms; increases in imports of cheaper staples, while helping urban consumers, meant that there were depressing effects on the economies of the zones where mainly small farmers produced staples such as cereals, beans, potatoes. The general tendency (such as in Mexico, Chile, Guatemala) was to find ways to continue protection and to subsidize farmers, although with great variety over countries and with a gradual tendency to reduce these policies over time. Latin American farmers who stayed, and continue to stay, in basic staples will be protected/subsidized, find a place in the handful of grain niche markets or get bigger and more mechanized (FAO, 2003; Markelova, Meinzen-Dick, Hellin, & Dohrn, 2009).

In general terms in Latin America, FDI has had special effect in supermarket and domestic agri-food systems: the share of supermarkets in the national retail sectors of three quarters of the Latin American economy increased from about 15-20 percent in 1990 to 60 percent in 2000. For the poorest one-quarter of the LA countries, it increased from 5 percent to about 30 percent over the same decade, and is still rising. Competition for growing markets and increased FDI in the sector, mainly from the leaders Wall-Mart, Carrefour, and Ahold (which are also the top supermarkets in the world), has driven the process. Supermarkets are clearly dominant in urban

(even town) food markets, and within those, in the most dynamic parts of those markets. Half or more of dairy products and a minority but growing share of fruits and vegetables are being sold through supermarkets. Moreover, whereas urban markets were considered as promising markets for the poor; to sell to these markets now means mainly selling to supermarkets (FAO, 2003).

The changes in procurement systems – with the large increase in scale and the increase in system coordination via private standards of quality and safety – are a double edged sword. On the one hand, they increase the market. But on the other hand, they remove the distinction between the export economy and the domestic economy, because standards and even products from the competition are being injected into the local market from the global market by the supermarkets. The supermarket brings global rules of the game and global competitors into the backyard of the local small farms and firms (FAO, 2003).

There are important implications of the above changes for small farms and firms and thus income and employment opportunities. Because supermarkets have taken over most of the retail sector in the region, small farms and firms now have to deal with them, and in some cases is difficult. The main point is that there is a huge potential for the supermarket and fast-food revolutions to exclude – or create markets for – small farms and firms. This potential is much greater than the export market one, simply because the export market is smaller than the domestic market for Latin American farmers, and because small farmers are more able to access, and in general more focused on, the domestic food market (FAO, 2003).

Moreover, the extremely rapid rise of fast-food chains in Latin America raises the same sorts of consolidation and multinationalization issues as in the supermarket sector. There are 1581 McDonalds in 2001 in Latin America, and 500 Kentucky Fried Chicken and Pizza Hut outlets in Mexico. This constitutes the start of a fast food revolution. The effects on the agri-food system are similar to if not more intense than are the effects of the supermarket revolution. Similar changes are also apparent in second stage processing (defined as processed food products for final consumers, such as yoghurts and cheese, breads and noodles) (G. J. Stads & Beintema, 2009).

Into this context the role of substantial empirical evidence supports the argument that investment in agricultural research and development (R&D) has contributed to economic growth, agricultural development, and poverty reduction in LAC over the past 50 years. New technologies resulting from R&D investments have enhanced the quantity and quality of agricultural outputs, while at the same time enhancing sustainability, reducing consumer food prices, providing rural producers with access to market opportunities, and improving gender-based allocations and accumulations of physical and human capital within households. In many countries, these outcomes have lead to higher incomes, greater food security, and better nutrition. Some countries in the temperate northern and southernmost parts of LAC have a distinct advantage over their tropical counterparts when it comes to adopting technologies generated in high-income countries with similar agro-climatic conditions (G. J. Stads & Beintema, 2009).

The current structure of agricultural research systems varies widely across the countries of LAC. According to the Stads *et al* (2009) study, the large- and medium-sized countries in their survey sample generally have the more advanced national systems, whereas agricultural R&D in most of the smaller countries is carried out by a mere handful of agencies. Unsurprisingly, the systems in countries like Argentina, Brazil, and Mexico are significantly more complex.

Awareness of the need for regional and international partnerships in agricultural research has grown in recent decades. Networks have proved to be a successful method of collaborating and sharing information, and they facilitate specialization. For example The Regional Fund for Agricultural Technology (FONTAGRO) is an alliance of 14 LAC countries, together with Spain, to support research and innovation in the agricultural sector. More specifically, FONTAGRO aims to contribute to reducing poverty, promoting competitiveness, and encouraging the sustainable management of natural resources. FONTAGRO is sponsored by the

International Development Bank (IDB) and IICA and encourages cooperation in S&T among member countries and centers of Excellence; IICA, which is headquartered in Costa Rica, was established in 1940 to promote agricultural science in the Americas and to coordinate, promote, and facilitate sustainable agricultural development in LAC. IICA works throughout the region and with a number of regional and international organizations, including the centers of the CGIAR. In 2006, the CGIAR invested more than 14 percent of its US\$426 million budget to generating science-based solutions to problems of agricultural development in LAC. Although total allocations to the region have increased over time, their relative share has remained unchanged in recent years. Of the current 15 CGIAR centers, three are headquartered in the LAC region: The International Center for Tropical Agriculture (CIAT) in Colombia, the International Maize and Wheat Improvement Center (CIMMYT) in Mexico, and the International Potato Center (CIP) in Peru. In addition, 10 other CGIAR centers have established more than 20 offices in the region. Several other international and regional organizations have a presence and conduct agricultural research in LAC (G. J. Stads & Beintema, 2009).

Data indicate that, overall, the involvement of the private sector in agricultural research in LAC is comparatively high compared with other developing regions, such as Africa and the Middle East, but low compared with a number of countries in the Asia-Pacific region, such as Indonesia and the Philippines. Aspects of LAC agriculture are technologically advanced by world standards, as well as being serviced by a sophisticated system of private input supply, postharvest handling, and processing. Private firms now supply much of the improved animal genetics and seeds used by LAC farmers. Furthermore, some of the region's countries have legislated tax relief for privately performed R&D, and many countries stipulate private-sector involvement in research projects under competitive funding mechanisms. The private sector in Chile, for example, is well known for its considerable expansion of fruit, salmon, and wine production in recent decades. This progress has been achieved with substantial public support, not for direct private research but for the importation of foreign technologies and the subsidization of agribusinesses (Spielman, 2005; G. J. Stads & Beintema, 2009).

4.3 The agri-Food sector in Costa Rica

As a Latin American country, Costa Rica is immersed into the situation explained in last section, and this section presents specific characteristics of the country; the first paragraphs show some details of Costa Rica in general, followed by the description of the agri-food sector in Costa Rica.

Costa Rica is a democracy. Its population is around 4.5 million, in an area of 51100 square kilometres. The unique development strategy followed by the country since its return to democracy in 1948, with a strong social component and the abolition of the army, has been as diverse as education, public governance, and product and export diversification (Goldstein, 2001; Porter & Schwab, 2008).

In 1981, Costa Rica became one of the first countries in Latin America to default on its international debt payments. In response, the government adopted a very aggressive export promotion strategy in conjunction with the United States Agency for International Development (USAID) to promote non-traditional export (NTE). Because of the stagnation of traditional exports such as coffee, sugar, and beef, the NTE strategy seeks to diversify into other crops and other products that presently offer more dynamic market conditions (Rosset, 1991).

The new incentives, in combination with the characteristics of the country, made Costa Rica one of the most inviting foreign investment sites among the nations grouped under the Caribbean Basin Initiative ²(CBI) legislation of 1983. As a direct result of these efforts, no traditional exports from Costa Rica skyrocketed (Clark, 1995). The last 15 years Costa Rica has been

² Caribbean Basin Initiative (CBI) in the United States: President Reagan intended this Initiative to foster political stability in the Caribbean region through stimulating economic growth via the establishment of new export industries. The centerpiece of the legislation provided member countries with duty-free entry of certain exports into the United States (Clark, 1995)

particularly successful in nurturing its high-tech sector with high-tech exports accounting for 30% and 40 % of total and industrial exports in 2006, respectively, and with a 13 percent rise in the 2001–2005 period. The development of the high-tech sector has been boosted by the establishment in Costa Rica of an important group of multinationals in the 1990s, with Intel at the forefront, investing first in a large assembly and testing plant, and later in a software development centre. Another cluster that has been targeted and developed in a similar spirit of promoting higher value added industries is that surrounding the eco-tourism industry. Building on Costa Rica's extraordinary biodiversity (accounting for 5 percent of the world's total biodiversity), natural beauty, and pristine environment, the tourism sector has experienced an impressive dynamism in recent years, representing 6.3 percent of total GDP and 6.5 percent of total employment in 2007 (Goldstein, 2001; H. González, 2001; Kohlmann, Mitsch, & Hansen, 2008; Porter & Schwab, 2008).

Costa Rica is assessed by the Global Competitiveness index (GCI) as one of the most competitive economies in Latin America and the Caribbean. According to "The Global Competitiveness Report 2008–2009" at 59th position (out of 134 countries), it comes in ahead of Mexico (60th) and Brazil (64th) (Porter & Schwab, 2008).

The structural adjustment process of Costa Rican society to the international trade conditions and economic globalization has had a special effect, and not entirely favourable for the primary agricultural sector. Agriculture has become to play a minor role, given the dynamism to other economic activities such as tourism, industry and services.

The traditional view of looking at agriculture as the main sustenance of the National economy, based in three or four products which rely on traditional major capital, is coming to an end. All farmers, large medium and small, are in urgent need of finding new value sources that allow them the articulation in this new scenario with a similar dynamic than the high-tech and tourism industries. The crisis of the agri-food sector is based in important factors (Macaya & Cruz, 2006b):

- There is a lack of attention to agriculture and their organizations in policy and government action.
- There is a weakness in institutional activities conduction and consolidation of the private sector.
- Inability of the public sector to give correct and effective answers to the threats and opportunities of the liberalization trade processes and the new concept of sustainable development.
- Use of uncompetitive technologies, leading to inefficient utilization of productive resources (high production costs, low yields and low physical qualities of their products) and less in line with market requirements.
- Low levels of vertical integration of production that contributes to agro-industrialization.
- Low levels of organization of producers and lack of managerial capacity, which reduce the option of defining advantage to enter new market (internal or external) and seize the opportunities that the environment provides as organic agriculture and agro tourism.
- Degradation of natural resources, especially the irrational use of soil and water, which generates significant social costs.
- Low support in production technology, marketing, added-value processing, business training.
- Infrastructure problems: routes, ports, airports, storage infrastructure, credit and high input costs among others.

However, agriculture is still very important into the Costa Rican economy contributing about 15% of the GNP; being banana, pineapple and coffee the most important in terms of agricultural added value. For 2007 year, about 8% of the land was devoted to farming. The coffee was the first seed with 99.000 ha, followed by cultivation sugar cane (53.300 ha), the rice (48.439.04 ha), banana (42.790 ha), pineapple (approximately 40,000 ha) and orange (25.000 ha). Agriculture sector has an important social role as employment creation and reduction of

poverty, especially in rural areas. Into this context the creation of added value products using the added value chain is one of the clear solutions of the sector (Roldán, 2008; SEPSA, 2008).

The Food manufacture sector represents 42% of manufacture industry and near 6% of GDP. The sector is heterogeneous, diversify and with different technological levels. Beverage, meat and dairy are the subsector with most participation in the added value generation. There are more than 1200 firms in the sector, mainly SME's (44% of the total), representing 40000 employees. 40% of the exportations are for the Central American market, followed by the USA market (26%) and Europe (13%) (CACIA, 2009).

The study conducted by Durán, et al (2008) permits to have an overview of the technical competitiveness in primary agriculture export firms. The study consisted in an evaluation of twelve important technical parameters of competitiveness in 453 no traditional export agriculture Costa Rican companies. With these parameters it was defined a technical competitiveness index (TCI). As it is shown in Figure 4.1, according to the results, quality is the parameter with the lowest value in most sectors. Majority of companies consulted said that they make quality control only at the end of the process, the rejected % before exporting is high and this implied higher production costs. The human resources are one of the higher costs in the region and many of the agriculture activities are labour intensive. In many cases companies prefer low cost human resources (with lower education) and management is focused more in time and uses of tools than effectiveness and quality. Education has been defined as one of the comparative advantages of the country in the region, however to obtain real advantages of this factor, education has to be used to improve quality culture and reduce cost.

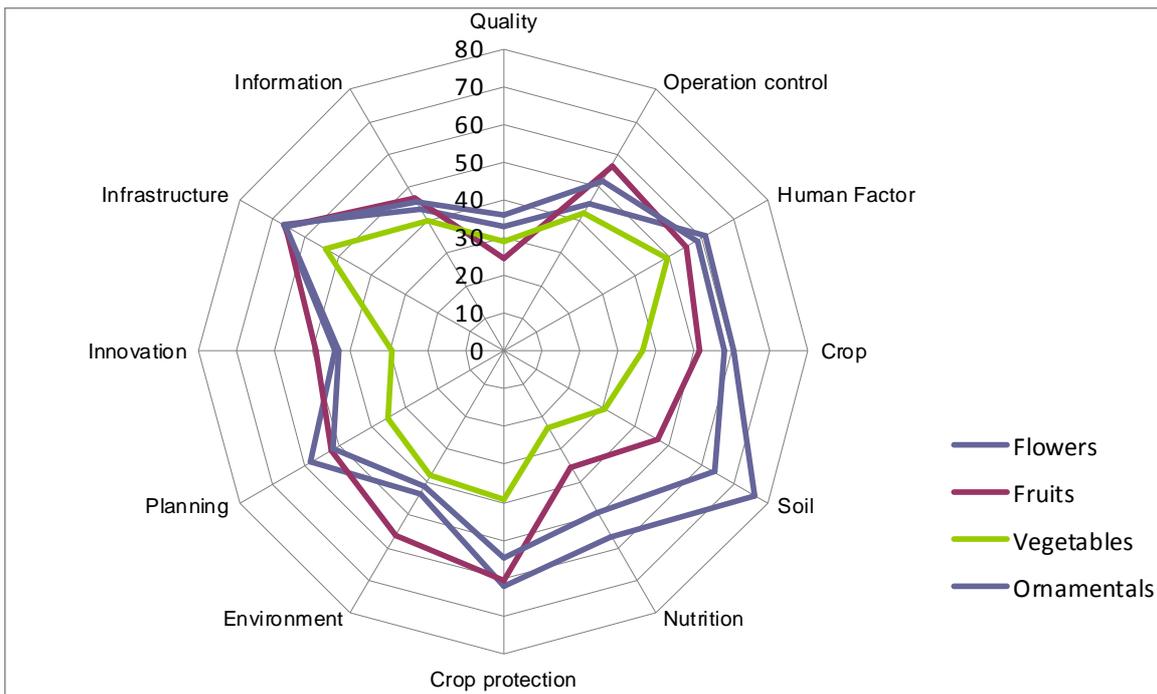


Figure 4.1 Results of technical competitiveness in four subsectors of agriculture exporter firms in Costa Rica from (A. Durán, González, & Mora, 2008)

The food industry in Costa Rica has become more competitive both in the local and international markets. The market for Costa Rica has proved to be excellent for the supply and demand of food and beverages sector. Globalization through multinationalization and FDI has increased the quantity and quality the food products in the local market promoting competitiveness in the sector and making local producers to look for new ways of innovation and consolidation. The increase power of supermarket chains (especially multinationals) explained in last section is presented in Costa Rica and has made changes in the production parameters defined for the agri-food industry. The three main priorities of the Costa Rican food

industry, for both large enterprises and SME's are specifications for raw materials, the improve of the shelf life and quality system assurance (HACCP) (Buitelaar, Pérez, & Urrutia-Álvarez, 2000).

Costa Rica has developed an important institutional support for the agriculture sector (maybe the strongest and more experienced of the different economic sectors of the country) that should be used as a base for new developments. In the next section the mapping of the "Generation and Assimilation of Knowledge" System presents in more detail the characteristics of this support.

5. Results and Analysis

This chapter presents the analysis of most important results obtained for answering the questions defined for this research: How is the impact of the NIS in the competitiveness of agri-food firms in developing countries? and how is this impact of the NIS specifically in three dimensions of agri-food firms (supply chain position, sizes and market penetration?)

In addition of the documental research realized which most important results were presented in section 3 and 4, the mapping of the NIS of Costa Rica is helping to define, for the specific case of Costa Rica, how the NIS is having impact in the developing of firms competitiveness. The multicase study in agri-food firms permits to evaluate the characteristics of innovation in firms, if it is used on the creation of competitive advantages and how the relations of firms with other actors of the NIS are. The last part of the analysis used all the information to define the impact of the NIS in the competitiveness of the interviewed firms.

5.1 Mapping of “Generation and Assimilation of Knowledge” System in Costa Rica

According to the theoretical foundation developed on the chapter 3, the mapping of the “Generation and Assimilation of Knowledge” could be used to understand the impact of organizations and their interactions in the developing of firms’ competitive advantages through innovation. The institutional setting is very complex and diverse. For this reason the results are presented in four subsystems: education, knowledge generations, intermediation and productive sector. Using the data collected through documents and interviews a SWOT analysis is presented for each subsystem. Bases for the posterior analysis, the mapping begins with some consideration of the political support (macro level).

5.1.1 The political support to innovation

In Costa Rica there is an institutional framework that explicitly supports the legislature to guide the development of science and technology policy. The law created in 1990 (Law No. 7169) contains tools and resources to encourage research, training human resources and technological development in all the production structures. This law creates the National System of Science and Technology (SNCT), consisting of all institutions, public and private sector entities and research and higher education institutions, whose main activities fit the field of science and technology system and promote investment in science and technology (Pomareda, 2001).

In 2006 the Ministry of Science and Technology established a “National Commission on Innovation”, in order to propose actions to strength and develop the National Innovation System, based in the results of the National Development Plan 2006-2010 and the “Strategy XXI Century”³.

The country is now in an important dynamic to encourage the efforts in the consolidation of the National Innovation System. The National Commission on Innovation made a mapping of the situation on innovation, called the “Innovation Atlas”(MICIT, 2008a). Using the conceptual map technique, the most important actors of the system and the barriers of innovation in the country were established and defined, respectively. The barriers were grouped in five important areas and for each case the Commission proposed specific actions. The main results are presented in Table 5.1; the interviews with two members of the commission confirmed that one of the most important barriers is the lack of a strategic and systemic vision. Without this vision

³ Strategy XXI century was established in 2004 through a participatory process that has involved more than 200 professionals and leaders of the country’s academic, entrepreneurial, institutional and political communities. The group’s proposal aims at transcending the governmental administrations differences so that the country may place science and technology as one of the national development axel. From a long term approach, strategy orients and articulates the necessary actions for Costa Rica to reach the proposed goals “The Half Century Plan in Science and Technology for Costa Rica”.

it is very difficult to coordinate efficiently the different effort that are taking place. For example many other studies are taking course through different organizations (as PROINNOVA, “The Innovation and Business Development Cathedra”, PARQUETEC, UNA, TEC), generating important information; however in the workshop of “Analysis of the situation of the National Innovation System”, where many actors of different sector were presented, was evident that in this moment one of the most important facts is that many organizations are working in this area with lack in coordination and interchange of information. In this workshop it was concluded that it is needed to establish a coordination mechanism to orient all efforts in a common goal. In addition through interviews with actors of the university and industry sectors, it was defined that one of the important issues in this moment is the lack of vision of innovation role as a tool of country development; the industry sector is not actively participating in the definition of strategies and policies in R&D and innovation. As an example, during last years the government has been promoting successfully foreign direct investment (FDI), which has had a positive effect in the economy in the short term. One of the long term benefits expected is a spillover effect in local companies but it is difficult for the country to take advantages on innovation from the multinational companies without a proper support (in training, infrastructure and funds) that permits a real spillover effect.

Table 5.1 Main barriers for the development of innovation in Costa Rica. Adapted from (MICIT, 2008a).

Area	Main Barrier	Propositions
a) Strategy	Lack of a strategic and systemic vision of innovation	Action-Thought Centre (CPA), to analyze and recommend strategies to the body governance and coordination of the innovation system, as a unit strategic planning
b) Catalyzing	Lack of specialized vehicles for the development of OTI (opportunities to innovate)	Training people: specialized postgraduate university covering aspects such as project management, technical evaluation technology, technology transfer and intellectual property, technological alliances, business incubation and management of technological information. Intermediary organization Specialized Center by sector
c) Financing	Lack of a financial/tax support system for R&D	Financing system clear, transparent, simple and fair, based on a desire for achievement and success, while giving second and third opportunities
d) Articulation	Poor systemic performance of the different actors and roles	Evaluation of results (indicators) Benchmarking Network
e) Culture	Lack in the development of a stronger culture and human capital in entrepreneurship and innovation	Strategy aimed at promoting awareness and entrepreneurship and innovation

In general terms the last innovation survey (MICIT, 2008b) reflects the situation already described for developing countries in section 3.3:

- **The investment in R&D is really low:** Costa Rica is still making very small investments in science and technology. According to the survey, the total expenditure in scientific and technological activities represents 1.26% and 1.24% of Gross Domestic Product (GDP) for the years 2006 and 2007 respectively, while spending on Research and Development (R&D) is 0.39% and 0.32% for the same years. It places Costa Rica bellow the Ibero American and Latin American average, according to data from the Network of Science and Technology Indicators - Ibero-American and Inter (RICYT).
- **Firms labor force has low level of education:** By studying the levels of education, (about 65% of all workers) are employed with a basic education or less, followed by technical education (approximately 25%) and professionals (about 9.9%). Workers in engineering or other hard sciences represent just over 2.9% in 2006 but increased slightly to 3.3% in 2007. It should be added that 86.5% of companies interviewed did not believed in increasing the number of workers for next years.

- **Most firms are local oriented:** Most companies (89.9%) have Costa Rica like a major market. For the international market the main location is United States, although there are some that sell mostly in Europe or in Central America.
- **Low novelty for international market:** in spite of most companies presented innovation activities most of them are made in a reactive way looking for improving in production. Only 13% of innovation was new to international market.
- **Low R&D in firms:** Of all the companies surveyed 62% said to realize research and development activities. Analyzing this group who performed R&D, only 29.2% performed these activities on a regular or continuous, centralized in one department of R&D. Another group (12.5%) has R&D activities but regular decentralized (which does not refer to a specific department of R&D).
- **The collaboration projects with universities are low:** The percentage of companies that has had a relationship with universities and public research centers to develop innovations is relatively low (32.9%). For most of these companies the collaboration has been successful in achieving the objectives. The duration of the collaboration has been less than five years for most companies
- **Low patenting:** Only a small number of companies have patents. The companies that have patented, the majority (65.1%) have only one patent. The enterprises surveyed reported even patents granted this year revealing a total of 53 patents (3 national and 50 foreign).

Through the presentation of the director of the National Innovation Council, in the workshop mentioned before, it is clear that the government has clarity that the efforts on the development of innovation have to be made in four pillars: industry, education, government and social-culture but it is not clear the translation of all the results of different analysis to specific and executable actions.

To continue with the analysis the following sections are going to present in more detail important characteristics of the different sub-systems (education, knowledge creation, intermediation and private sector). The results do not pretend to give exhaustive details of the different organizations related with each system but important characteristics that could be used in the development of endogenous scientific and technological capabilities in firms.

5.1.2 The education subsystem

The educational subsystem helps to build capabilities and competences on human resources to create and use the knowledge-base resources of firms. Table 5.2 emphasizes relevant characteristics of this subsystem for Costa Rica and the results of the SWOT analysis. For the case of Costa Rica it is important to emphasize that the country has developed important institutional support to train human resources in the agri-food sector at the technical level; this level is important for the understanding and application of new knowledge and, is one of the strength of the country, especially important for some foreign companies.

As the table presents, high education in the agri-food sector, in Costa Rica, is mainly depending on public universities which have good reputation in the region; however, as it is exposed in the weaknesses there is still some lacks in post graduate education. This is a very important issue because the development of new application through innovation generally requires critical mass founded in higher education. Other important fact that was mentioned by some of the interviewees (directors of Parquetec and PROINNOVA) is the lack of entrepreneurial orientation; it is seemed that the characteristics of the educational system and the country's social stability have inhibited entrepreneurial characteristics in the population. To this respect there are important realized efforts as the entrepreneurial program of the technological university (ITCR) and the new project of the Agronomy Department of University of Costa Rica; however there is needed an integral program of entrepreneur education including the complete system, from primary school until high education. This is cited on the Strategy XXI century, in the Atlas of Innovation and specifically in the interviews with the members of universities and the NGO-incubator.

Table 5.2 Main characteristics and SWOT analysis of educational subsystem

Level	Characteristics
Technical education	Formal: Professional and technical colleges: There are special areas of formation program for the agri-food sector. Specially design for the rural areas.
	Informal: National Training Institute (INA): Specialized infrastructures. Vocational training for apprentices and workers in both public and private sectors. Give key support for the sector (accreditation and certification processes, agriculture, etc).
	Center for Training of Trainers (CEFOF): Cooperation program with the Government of Japan. The principal objective is to contribute to increase productivity of small and medium enterprises in Central America by providing services in the areas of education, training and development, consultancy and laboratory services for quality assurance.
High education	<p>There are more than 50 private universities but less than 1% is related with the agri-food sector.</p> <p>National Council of Rectors (CONARE): It grouped the rectors of the four public universities. It is responsible for coordinating the Public Higher Education. It has some specific coordination activities in innovation.</p> <p>Four Public Universities: University of Costa Rica-UCR, National University of Costa Rica –UNA and Technological University of Costa Rica-ITCR, Distance Public University-UNED).</p> <p>Other specialized and International education institutions: i.e. Livestock Central American School (ECAG), Humid Tropics Region Agricultural School (EARTH) and the Tropical Agricultural Research and Higher Education Center (CATIE).</p> <p>Promotion of entrepreneurship in the Agronomy Department: Through a special program the Agronomy Department is promoting entrepreneurial student to create his/her own business. The project includes training, funds, infrastructure and a period of three years to develop the business.</p> <p>Entrepreneur Promotion (ITCR): contributes to the formation of professionals capable of creating and developing successful projects. It facilitates discovery and support students interested in creating their own technology-based firms as the main factor of competition. It promotes values towards a culture enterprising.</p>
Strengths:	Weakness:
<ul style="list-style-type: none"> • Basic education is strength of the country. • The technical formation gives important support to firms. • University of Costa Rica is considered one of the strongest in agriculture formation in Central America. • There is growing graduate programs at state universities, as well as joint programs, including coordinating with international institutions, both in Costa Rica (CATIE, OTS, INCAE, EARTH) and abroad (especially in Northern America and Europe). • There is good support training in quality management, accreditation and certification. 	<ul style="list-style-type: none"> • Lack in doctoral programs and support formation in management. • Scholarships for post-graduate studies are now somewhat less than before but there is still availability. • There is lack of institutional and economic stimulus for the experienced professional who specializes at the highest level. In most cases there are not mechanisms in institutions to insert them and use their scientific potential in education and R&D. Many of them do not return to the country, or do so briefly, either because of job problems (stability) or wages. • In spite of good initiatives as the model of the technological University (TEC), there is a lack in entrepreneurial formation.
Opportunities	Threats
<ul style="list-style-type: none"> • Increase high education formation through collaborative programs with international institutions and international scholarships. • Uses of the NIS platform to define a strategy of education in innovation. 	<ul style="list-style-type: none"> • Reduction in support to public education system. • Better conditions for post-graduated professional in other countries.

5.1.3 The Knowledge Generation Subsystem

As it is the case in many developing countries, in Costa Rica most agri-food R&D depends on public institutions. Strategy XXI century, already cited before, made a review of R&D organization; this information is complemented with some other documents (H. González, 2001; G. J. Stads & Beintema, 2009; G.J Stads et al., 2008) and interviews (with the directors of the Agronomy Department, Food Technology research centre, coordinators of two research programs, a researcher specialized in University-Industry relation and the director of one of the

universities knowledge transfer Office-PROINNOVA)⁴ to define the most important characteristics and the SWOT analysis for this subsystem, presented in Table 5.3.

Table 5.3 Main characteristics and SWOT analysis of Knowledge Generation Subsystem

Organization	Some important characteristics
Public Universities	<p>Public Universities: They have established research centers specializing in areas of interest to agriculture, livestock and forestry. They are capable of generating knowledge to improve vital aspects of agri-food sector. Some of them have diagnostic or official certification functions. They also build on research stations or experimental farms located in regions representing individual agro-ecosystem.</p> <p>CENAT: The National Center for High Technology (CENAT) is an inter organ of CONARE that specializes in the development of research and graduate programs in high technology disciplines and, the coordination of technological linkage projects between University-Industry.</p> <p>CENIBIOT: It is a unique plant in the region of Central America and Panama, and its primary purpose is the scaling of various biotechnological processes related to the agribusiness sector.</p>
Special NGO	<p>Subsector Promoters: It describes a group of arbitrarily institutions created through specific legislation to regulate the producer-processor-exporter of a certain item, improving their production and ensure their markets.</p> <p>INBIO: The National Biodiversity Institute (INBio) of Costa Rica is a private research and biodiversity management centre, established in 1989 to support efforts to gather knowledge on the country's biological diversity and promote its sustainable use.</p>
International institutions:	<p>CATIE: Has led an international investigation in plant protection, biotechnology, agro-forestry, watershed, forestry and environmental economics. Moreover, their Orton Library (inherited IICA) contains the largest collection of compilations, indexes and journals of agricultural and related disciplines that exist in Central America, available to scientists and technicians in Costa Rica.</p> <p>EARTH: Emphasizes teaching at the undergraduate level, and has ongoing programs of applied research on waste management and organic agriculture.</p> <p>IICA: Its studies in economic and political aspects of continental agriculture enrich the local knowledge about international trade, project finance and some aspects of training in agricultural sciences and forestry.</p>
<p>Strengths:</p> <ul style="list-style-type: none"> • Costa Rica has the Central America region's largest and most advanced agricultural research system. • There are some scientific groups with good development and international support. • The political stability of Costa Rica has deserved to host international institutions associated with cooperation, promotion, research and training in agricultural sciences or related. A strong institutional base for research and conservation activity exists; many institutions have been working in this field in an efficient, stable, and continuous manner. • University R&D organizations cover virtually all areas of knowledge necessary for agricultural development. From the more traditional schemes to the most advanced technologies in biotechnology. • Researchers have linkages with government entities, international organizations, producer associations and businesses. • There are some initiatives to use high tech in the agri-food sector (CENIBIOT, CITA-CIRAD). • Government and universities are making efforts in centralize databases of information. 	<p>Weakness:</p> <ul style="list-style-type: none"> • The scientific advancements are not at the level of the developed countries, even at the highest relative level of Latin America. • R&D is mainly focused in basic research or adapting copy technologies. There are few new products. • There is lack in research in some topics and in infrastructure especially in last generation research equipment. • There is always a tendency of more society demand for the increase in linkages and commitments. This trend is sometimes reduced by a number of factors such as insufficient resources, the prevalence of teaching about research and extension, the effect of the academia culture and the low strength and credibility of policies and national development plans. • There is a lack of post-graduated professionals. Many research groups are small and in some cases there is a high present of retired researchers without the possibility of substitutions. • There is a lack in R&D infrastructure for the food processing sector. • Most research is developed without participation of private sector. • There is few model of complete interaction of R&D with private sector. • Low protection of knowledge. • Lack in effective mechanisms of knowledge diffusion.
<p>Opportunities</p> <ul style="list-style-type: none"> • To develop new models of U-I interaction. • To take more advantages of infrastructure and international institutions for the development of more R&D. 	<p>Threats</p> <ul style="list-style-type: none"> • Reduction of support to public organizations. • Not replacement planning of retired researchers. • Use of not protected knowledge by external actors.

⁴ More details of the interviewees is presented in Table 2.2 and appendix 1

Costa Rica has developed a range of institutions (governmental, semi-autonomous and private) to support the productive agri-food sector; as is shown in the SWOT analysis, this is one of the strengths of this subsystem. According to the mapping realized in 2005 by the Strategy XXI (Macaya & Cruz, 2006a) from 34 R&D institutions in the sector⁵, 18 are from universities, 13 from general services, 2 international and 1 from the private sector; 60% of researchers have post-graduated formation and they are making mainly applied research.

An important fact, already mentioned in last section, and totally linked with this subsystem, is the lack in more post-graduated professional. It is needed more critical mass and dynamism in different R&D areas, including international networking and development of doctoral research. In addition to this, there is the lack in coordination and cooperation between the R&D organization and the private sector. Most of the R&D public organizations develop their research without the participation of possible users, trying to make the transfer of knowledge when the project is finished. As was mentioned by the Director of CITA, it is important to figure out new models of cooperation were the interaction could be more effective.

With some exceptions, important barriers on the development of research are limitations on infrastructure, acquisition of last generation equipment and consolidated research groups. These facts limited the possibility to develop new technologies. In the last years with the creation of CENAT and more recently CENIBIOT, universities are trying to strengthen the development and use of key technologies application (as nanotechnology and biotechnology); too little time has elapsed to see the effect of the two projects, however the specialist researcher in university-industry relationship interviewed, detected still no proper linkages between these projects and the productive sector.

CITA-CIRAD is participating in an interesting international project: "Producing added value from under-utilised fruit crops with high commercial potential (PAVUC)⁶, The project brings together a consortium of a core group of 8 partners from Latin America and the European Union involved in public research and technology transfer activities and a co-participants group of private institutions that are part of the selected agri-food chains. This project is mentioned because it is an interesting example that could be analyzed in more detail. It has interdisciplinary work, promote doctoral formation, international networking, and added value products; it has a vertical overview of the projects with chain analysis and marketing research.

Two important issues related with knowledge management have to be mentioned:

- There is not a proper diffusion of knowledge: The research activity produces many publications each year, which is not compiled in a comprehensive manner. Part of researchers published in journals of each discipline, usually abroad; also published in journals edited in the country, but a considerable portion of the research results remain in internal reports within each company or institution, thesis, reports of congresses (national and international) and non-serial specific newsletters. So it is very difficult to quantify the production of written under investigation in Costa Rica in agricultural sciences.
- There is a lack in knowledge protection: Some experts in Costa Rica intellectual property rights argue that most R&D organizations in the country (public and private) do not know the different mechanisms they can use to protect their innovations. According to them, this is due to the lack of a local appropriate and consistent, regulation law, with international treaties, that awareness on how to protect each type of innovation. An special consideration that have to be made by Monge (2004), is that for many organizations is very difficult to manage the cost of patenting, estimated in \$20000-\$60000 and the followed activities of managing the patent.

⁵ This value does not include centres from other areas that realized some works in the agri-food sector as some chemical and health organizations

⁶ More details about the project could be found in its website: <http://www.pavuc.soton.ac.uk/Default.aspx>

This section is ending with a remark of one important organization model identified in the subsystem: the sub-sector promoters. To understand better this model two interviews were conducted with the Director of R&D of two of these organizations. The following highlight presents the most important characteristics:

Highlight of Sub-Sector Promoters:

This is a group of arbitrarily institutions created through specific legislation, as non-governmental organizations, to regulate the producer-processor-exporter of a certain item, improving their production and ensure their markets. Examples are ICAFE (coffee), LAICA-DIECA (sugar) and CORBANA (banana). They have many differences, but have in common the possibility to use part of the funds generated by a tax to make research and apply the results through knowledge transfer. They have their own laboratories and experimental stations and in this model producers are involved in the prioritization of problems, experimentation and testing field, and supervision of research. These promoters have been crucial in the productivity improvement of their products.

Specific meetings with the research director of two of these organizations (CORBANA and LAICA) confirm the advantages obtained through the use of this model of R&D:

- *Because of the taxes, there is security of funds for research.*
- *Research is focused and coordinated on producers needs.*
- *The sector is represented in political forums.*
- *There is a clear and efficient system of knowledge transfer.*
- *The organizations have special national and international networking and facilities to develop research projects.*
- *Examples of successful results in the case of CORBANA are the country with the highest banana productivity of the world and the fast response to global market pressure about environmental issues. For LAICA important results have been biological control of pests, new varieties, liquid sugar for beverage industry and new strategies of sugar commercialization for the local market.*
- *As a negative factor both organizations have weaknesses in knowledge protection.*

5.1.4 The Private Sector Subsystem

Some of the private sector characteristics were already presented in section 4.3, showing the importance of this sector for the country's economy. In this section it is relevant to make some comments on the innovation capabilities of the sector; the characteristics presented and the SWOT analysis, showed in Table 5.4 are built through documental research and information collected from interviews (two staff members of industry organizations, and University researchers on industry situation⁷).

As was mentioned on the characterisation of the agri-food sector, in section 4.3, it is composed for diverse types of companies (local, foreign, multinational) and because of that their capabilities in innovation are diverse too. In general terms local companies are making few activities in R&D as was concluded from the 2008 innovation national survey (MICIT, 2008b) and specifically for the food processing sector it was confirmed by the interviews with staffs of the two Chambers and the research projects. The study realized by Duran (2008)⁸ on competitiveness in 453 no traditional export agriculture Costa Rican companies confirmed the situation for the primary agriculture sector. In this study the results are grouped in five subsectors: fruits, flowers, ornamentals, vegetables and roots and tubers (already presented in Figure 4.1 in section 4.3) and all of them presented low values on the innovation index developed by the authors, been fruits and flowers the subsector with the better values.

According to information from interviews many companies of the food processing sector still require special efforts to improve some productive areas to be competitive and many of them

⁷ Specifically the interviews with the Director of PROINNOVA, who makes a study on innovation in exporter firms, the coordinator of the "Innovation and Business development Cathedra", and the coordinator of project "Competitiveness Research in agricultural sector"

⁸ This study was discussed with the coordinator of the project during the interview

are focused in these processes: as quality system, standardization, environmental management, accreditation and strategic planning; this situation leaves few space to innovate.

The Food Industry Chamber (CACIA) is focusing in given support in these areas and the National Industry Chamber (CICR) is addressing effort in the improvement of the innovation possibilities through training, seminars and more specifically through the development of a consortium in a program called “Innovation and New Product Development for Internationalization” Program which is developed in cooperation with the Foreign Trade Corporation of Costa Rica (PROCOMER).

The efforts realized by CICR and other institution is justified by the study realized by PROINNOVA on innovation in 192 Costa Rican exporter firms (Jiménez & Villegas, 2008). This study concluded that innovative firms (with more than 3 innovations) have a formal strategy for monitoring its current potential competitors, allow the information that might be important for innovation available to everyone in the organization, have training and coaching in creativity, entrepreneurship and innovation, and use formal method for analyzing trends in their environment (market, technologies, consumption).

Table 5.4 Main characteristics and SWOT analysis of private sector subsystem

Organization	Some important characteristics
Chambers/ associations	<p>The Chamber of Food Industry of Costa Rica (CACIA): represents interests of the Food Industry. It gives special support in HACCP and GMP.</p> <p>The Chamber of Industry of Costa Rica (CI): represents the interests of the industry sector. It has a special Innovation promotion project in coordination with universities and PROCOMER.</p> <p>The Chamber of Exporters of Costa Rica (CADEXCO): It is a trade organization that provides information services to the exporter, as prices in international markets, export procedures, trade fairs, alternatives for transportation of goods, trade agreements and treaties promotion of exportable supply.</p>
<p>Strengths:</p> <ul style="list-style-type: none"> • Multinationals with formal research programs, sophisticated technologies. Many of them give technical training and support to suppliers. • There are some foreign companies, especially medium and large those have made a spillover effect in some sector. They have high technological capacity and professionals. They receive international publications, interchange information with importers and equipment sealers. • There are “sector organizations” supporting firms on innovation, especially in the manufacture sector. • It has been an important improvement in quality system last years. • There are incentives funds for R&D from governmental organizations. 	<p>Weaknesses</p> <ul style="list-style-type: none"> • In the agriculture sector many companies are still in the “high intensive-low cost” production model with negative consequences for the country. • Low investment in R&D. Few companies have the capacity to support ongoing researches itself, especially in new technologies; many demands technology information from public institutions, but few are willing to pay the research required to generate it. • SME’s include many informal firms with low technological capacity: They have diversified production system; generally in products with simple and not well developed technologies. • Lack in infrastructure: There are few options of local industrial equipment and specialized analysis. This reduces the option for some SME’s.
<p>Opportunities</p> <ul style="list-style-type: none"> • To take advantages of “sectoral organization” to promote strategic development of sectors. • To improve spillover effect from multinationals • Increasing markets 	<p>Threats</p> <ul style="list-style-type: none"> • Effects of globalization and free treat marks • Dependence of multinational in important export products

5.1.5 The Intermediation Subsystem

This section includes analysis of intermediary functions between the different subsystems; considering the organizations already identified and mentioned in interviews, special attention is given to intermediary functions in universities and governmental organizations. As is presented in Table 5.5, all universities have special offices for linkages with the private sector; however the low interrelation university-industry is one of the critical factors mentioned for many of interviewees and documents. This is an important deficiency of the country, specially knowing that most of the local industry does not have the capability to make R&D.

Table 5.5 Main characteristics and SWOT analysis of Intermediation Subsystem

Level	Characteristics
University-Industry relations	<p>University-Industry relations: All public universities have specialized offices in linkages with the private sector. The most important types of linkages are extension, training, contract research, collaborative research, donations, sales of goods and services, consultancy and technology transfer. All of them have a “foundation” to facilitate the management of collaborative projects.</p> <p>The Centre for Business Incubation (ITCR): Promotes the creation, development and consolidation of new innovative companies, and generate cultural changes of the potential entrepreneurs.</p>
Governmental organizations	<p>Ministry of Agriculture and Livestock (MAG): It is managed through regions and sectors to give services of management, extension, rural development, research, phyto sanitary and information support. Nowadays it is using the agro-chain approach, representing the axis of integration and coordination of services related to agricultural activities, which are led by the MAG. MICIT and MAG are directly related to the National Research and Transfer of Agricultural Technology (SNITTA) and the National Institute for Agricultural Innovation and Transfer (INTA) (In both organizations the Science and Technology Minister is part of the Board).</p> <p>Ministry of Science and Technology (MICIT): The highest governing body the Government to define science and technology policy of the country through the National Science and Technology Plan.</p> <p>National Council for Science and Technology Research (CONICIT): is responsible for the implementation of international loans to finance scientific and technological activities. It is also under its jurisdiction the updating of Science and Technology files, which contains information on research, publications and technology-based businesses.</p> <p>The Foreign Trade Corporation of Costa Rica (PROCOMER): it provides professional services for export and market information, is financed with government budget and provides services both nationally and internationally through trade aggregates.</p> <p>The Costa Rican Coalition for Development Initiatives (CINDE): It is a national institution that provides professional services for production, export and market information. It provides market intelligence services, support for exports and attracting foreign investment.</p>
Special Organizations	<p>There are many different NOG’s defined by cooperative international or national projects. Some specific examples:</p> <p>Cantonal Agricultural Center (CAC): The CAC functions as a small NGO to regional level, which identify needs, provide resources (which may go to research) and support technology transfer, as well as hold accountable public institutions.</p> <p>Management Industrial Technological Center (CEGESTI): Private, independent, non-profit, organization ,established since 1990 to promote and support the competitiveness of the productive sector in Costa Rica and other countries in Latin America, offering integrated services in consulting, training, research and information to private companies and public universities, technology-based companies and government organizations.</p> <p>Costa Rican Certification Institute- ECA - the National Quality System: This structure provides support tools to encourage firms to ensure the acceptance of its products in international markets, without incurring additional costs by the demands of accreditation and certification. It includes three institutions: the Costa Rican Metrology Laboratory (LACOMET), the Institute of Technical Standards of Costa Rica (INTECO), and the Technical Regulations Committee.</p> <p>PARQUETEC: Parque-Tec is a non-profit association found in 2004. It became the first software incubator in Costa Rica and its main purpose is to promote the entrepreneurial spirit of novel ideas in the technological sector. Some agribusinesses are being incubated in this organization.</p>
<p>Strengths:</p> <ul style="list-style-type: none"> • All universities have an intermediary office to facilitate the interaction with the private sector. • After reduction of extension support to farmers the government through MAG has developed other mechanisms of intermediation. Nowadays the institution is using the agro-chain approach. • The ministries of S&T and Agriculture have created a way to coordinate actions. Including a new model called “the National Institute for Agricultural Innovation and Transfer” (INTA), which is including the private sector. 	<p>Weaknesses</p> <ul style="list-style-type: none"> • The studies of intermediation of University of Costa Rica reveal that University-Industry relations are few and not focused in disruptive innovation. • There is little development on incubation. There are important lacks in support of start-ups. Few of these initiatives are focused on the agri-food sector. • There is a shortage in intermediary organization that helps to fulfill the lacks of interaction between actors. This model has been especially important in some countries to fulfill needs of proper demand articulation, networking and innovation management process.
<p>Opportunities</p> <ul style="list-style-type: none"> • Establishment of “best practices” program between intermediary organizations of universities. • Promotion of intermediary organizations. 	<p>Threats</p> <p>a)Reduction of support on intermediation projects.</p>

Studies realized by the specialist researcher on university-industry relations interviewed, in last decade, reveal that universities are given important support in training, laboratory analysis services, and solving of specific technical problems but there is a real disconnection between this sectors for R&D oriented to innovation; many of potential new products and technologies are developed in isolation, and because of that, they are difficult to transfer to private sector; in addition the private sector is not willing to pay for research and in many cases prefer to use external sources. The lacks, already mentioned, of infrastructure, last generation equipment and critical mass are important barriers.

Nowadays the Ministry of Agriculture is given services of management, extension, rural development, research, phyto sanitary and information support to the agri-food sector through regions and sectors and different organizations. It is important to highlight the “agro-chain approach” that is looking for coordination and vertical integration and the National Institute for Agricultural Innovation and Transfer (INTA) which board is counted with participation of the private sector and the Research and Technology Ministry. These are initiatives with less than 5 years and there is not enough information about their results.

5.1.6 General consideration of Costa Rican NIS impact in firms' competitiveness

In section 3.2 was explained that the main impact of the NIS on the competitiveness of firms is to create the space for the development of knowledge and its application through the knowledge creation and assimilation system. This system is composed by important subsystems: education, knowledge creation and productive (private sector). In developing countries the three subsystems are not totally developed and the production of innovation has to be build in an environment with important gaps. In the specific case of Costa Rica, the SWOT analysis of each subsystem indentified similar gaps as the report in literature for developing countries (Arocena & Sutz, 2005; Spielman, 2005; G. J. Stads & Beintema, 2009) and already mentioned for each subsystem. Considering these gaps, through the mapping it was possible to identify how the countries' NIS is impacting the competitiveness of firms on the different subsystems:

- **Education Subsystem.** Positive impacts are good educational system (including basic, technical and educational levels), training and support in complementary aspects (as quality system, accreditation and innovation management), and promotion of training to apply high technologies. However, negative impacts are lacks of higher education, especially at doctoral level, proper structure of incentives to retain high educated professionals into the educational system and in entrepreneurial spirit (key for increasing the dynamic and catalyzing the entrance of new businesses).
- **Knowledge Creation Subsystem:** positive impacts are the creation of important institutional support capable of covering all aspects of the agri-food sector, special sub-sectoral models of R&D and creation of new models of R&D, promoting the use of high technologies and improving connection with the private sector. The most important negative impacts are the lack of good interaction between R&D entities and universities causing problems of absorptive capacity and bad communication, unclear connection between consumer needs and R&D priorities, limitation in resources (infrastructure, equipment, human resources, funds) and important deficiencies in knowledge management (protection and diffusion).
- **Private Sector Subsystem:** The positive aspects are R&D funds availability for the private sector, sector organization given support in different aspects and the dynamics produced by the FDI strategy and the presence of foreign and multinational companies (with possibilities of a spill-over effect). Negative aspects are low industry R&D production, in some cases, low educational level of human resources, and lack of understanding of the importance of strategic innovation to develop competitiveness, infrastructure and information systems.
- **Intermediation Level:** the positive impact is the important institutional setting to promote the interaction and support from governmental organizations and the private sector; in the case of the agri-food sector, the Ministry of Agriculture is playing an important role. The

negative impact is the interaction problems between R&D organizations and the private sector.

Considering the aspects mentioned before and based in the literature review it is important to make a reflexion on the situation of NIS impacting competitiveness in developing countries. In spite of the gaps, developing country's firms have to compete in equal condition in the international market; it means that they have to learn how to develop competitive advantages in the face of limitations. Many developing countries have found successfully ways to improve their institutional support in some sectors, as Korea in the electronic sector. According to Ernst (2002) by providing critical externalities such as information, training, other support services and finance the Korean government has fostered the growth of firms large enough to overcome high entries barriers. In this case it is clear that it was designed a strategy covering all different aspects to be sure that the efforts will be transformed in tangible results. What is relevant to learn from this case is the importance to elaborate an integrate strategy and not isolated projects. In the case of Costa Rica for example there is not clear connection between some of the important efforts as FDI promotion or new research centers. The actual dynamics is an important scenario to try to do something in coordination, using experiences already documented as the importance of the following factors:

- **International networking:** Limited domestic knowledge base implies that developing countries have to use external knowledge. To compensate weak national production is needed to blend international and domestic source of knowledge. To realize that it is very important to have global knowledge linkages and to take advantages of the international knowledge diffusion (Ernst, 2002).
- **Strategy:** This is the key factor to be sure to make a synergic effect of different effort. For example in the electronic case of Korea, rather than proceeding from innovation to investment to production, they focused on the ability to operate production facilities according to competitive cost and quality standards. Through reverse engineering and other forms of copying and imitating foreign technology and by integrating into increasingly complex production networks, they were able to avoid the huge cost burdens and risks involved in R&D and in developing of international distribution channels (Ernst, 2002).

Numerous opportunities exist for developing knowledge and technologies that can improve agricultural products, add value, and generate income for local primary producers, processors, and other actors. To identify what innovation is really required; knowledge providers need to take into account the complementary and sometimes competing demands of primary production, processing, agribusiness, and consumers. Suppliers of innovation include not only research organizations, universities, and extension agencies, but also consultants, agro-industry, and farmers and processors themselves (Pomareda & Hartwich, 2006). Perhaps one of the most urgent challenges that must be addressed in the present time is to take with intelligence the new role gained from agriculture to the food situation in 2008 (food security crisis). It is urgent to develop the skills to successfully exploit this situation and really encouraging technological innovation (Palmieri, Alarcón, & Rodríguez, 2009).

According to Hu (2005) three key factors have to be considered in a country level strategy, namely on cumulative building of their R&D manpower; in targeting certain industrial sectors and specializing their innovative activities in these sectors; and in promoting and effecting public R&D as a means of enhancing national innovative capacity. Costa Rica has shown to have advantages in the agri-food sector because of its institutional setting, biodiversity and experience and because of that it will be important to continue building strategies in this sector.

- **Clustering:** There is a lot of debate about the influence of FDI and multinational in the dispersion of knowledge and innovation. Clustering effects are particularly important for knowledge externalities and spillover effect. Concentrations of companies succeed when

they cooperate as well as compete. The focus of cooperation is on sharing of knowledge, skills and technologies among the companies and with public agencies.

- **Absorptive capacity:** To keep pace with the fast-changing technological scenario, firms have to build their internal capability to be able to choose the right signal from the external environment and assimilate the same internally to introduce changes for their commercial benefits. This is a cumulative learning process and is the strategy of a firm. For firms, R&D investment as a process of learning is seen in the light of their operation in the market where technological strength of firms depends upon their absorptive capacity. To be technologically competitive and to be a market maker, it is very essential for a firm to invest in capability building. What is important here is that whatever the firm's strength, whether it is in manufacturing, basic research, reverse engineering, or at the operational level, the firm with this knowledge base can move ahead in that direction (Mrinalini & Nath, 2008). In the case of developing countries, because R&D is done by public institutions, absorptive capacity acquired through research is missed. It means that special consideration has to be made to be sure to fulfill this gap.

5.2 How firms are Developing Competitive Advantages through Innovation

After making the evaluation of the impact of the NIS through the mapping which gives a holistic view of the situation, this section is looking for the point of view of the NIS impact directly in firms. For this reason there were selected 16 competitive companies to identify how they are innovating, if they are using innovation to create competitive advantages and how the relationship with the other elements of the NIS is. This information and the result of the mapping is used later to analyze the impact of the NIS in firms' competitiveness.

5.2.1 Characteristics of the firms interviewed

As it was explained in the methodology, considering the characteristics of the analysis, to be sure that firms are exposed to a competitive market it was decided to interview exporter firms. They were grouped in Primary Agriculture (PA) and Food Processing (FP), 8 in each group; the main reason to make this separation is that FP group is already related with processing to increase the added value which has an influence in the kind of innovation they realized. In the specific case of Primary Agriculture, they were chosen from representative groups of no traditional export products. In the case of Food Processing group there were selected companies known by its dynamic in innovation. The detail of the selection is presented in Table 2.3 (in the methodology section) and the specific characteristics of firms are presented in Appendix 3.

In general terms the PA firms selected are considered typical success cases of its respective subsector. The chayote firm interviewed is the second in size of the sector with 100 employees, with Euro-Gap certification and systemic production, and it does not have full time technical professional. Both flower firms are subsidiaries of external companies, medium size, with 20 years of existence in the country; the parent house is in The Netherlands (the country with the best technology developed). In these cases technology was adapted to the country conditions. One of them is focus in breeding and propagation of cut flowers and the other one is exporting tropical flowers and ornamental cuttings (it has three patents in tropical flowers). The company reasons to choose Costa Rica were availability of qualified technical personnel (required for the business), proximity to U.S. market and conditions of the country (export incentives, political stability, and climate). For them it is important the network with other producers in the region, especially for solving common problems as exportation and marketing barriers.

The ornamental company is focused in dracaenas, tropical plants. Nowadays this company is 100% Costa Rican capital, but one of the two founders was American. This is a medium size company with 10 years of foundation. The technology used is a combination between adaptation and internal development. They are leaders in the market of one specific variety (Dracaenas nemeses). The foliage company is focused in exportation of ferns and other foliage. This is a

large company, with 25 years of experience. Its technology is an adaptation from US. The development of parameters has been done with public universities.

There were interviewed three pineapple producers: a start-up (2 years) 100% Costa Rican capital company with 334 employees; a company with previous experience in banana production, 100% Costa Rican capital, 12 years in pineapple production with 800 employees, and a multinational, parent house in Colombia, 25 years in Costa Rica, 3000 employees, production and commercialization of banana, pineapple and other products. The 2 Costa Rican companies showed similar characteristics, the technology was adapted from the “environment”; according to them the knowledge of pineapple production is known in the country, each company has its special adaptations and consultancy between producers is very common when there are some production problems.

In the case of FP firms there were selected exceptional cases as the coffee firm that is very innovative in the coffee sector and now is reaching into other sectors. It began in 1985 as a roaster coffee company, nowadays is a large company with 800 employees (595 at professional level); it is a specialty travel retailer with over 50 stores in 5 countries that owns and manufactures its key brands in premium coffees, chocolates and specialty items, it designs most of its products, and integrates its physical and web-channels. The dairy product company is the most important dairy firm in Costa Rica; more diversified company of the world with more than 500 products and one of the most outstanding dairy production businesses in Latin America. The “corn product company” is a multinational, worldwide leader in corn flour and tortilla production with operations in United States, Mexico, Central America, Venezuela and more recently, Europe. The four SME’s companies are very active innovative firms.

Figure 5.1 shows the main characteristics of the general analysis of the complete sample; most firms have more than 10 years of foundations, which reflex experience; most are independent companies, 3 international and 2 “cooperative or association”. The groups present important differences: the PG firms are all medium or large, while in FP group there are two small companies. With some exception exportation of Primary Agriculture products is based on high intensive production, which needs much labour force, for this reason generally the enterprises of this group have bigger sizes. Other important difference is the proportion of professional (including technological, marketing and management areas) present in each group; major labour required in agriculture is related with low education level, which explains why in PA group all companies has less than 25% professional while in the FP group there were two companies with more than 50% professional, evidencing that FP needs more qualified labor force. Finally, most FP firms export 20% of their production, meaning a high dependence of local market, while PA firms export 80 or 100 %, depending mainly on international market.

5.2.2 Firms’ innovation characteristics

The main objective of this section is to evaluate if firms are using innovation to create competitive advantages. It is important to make the remark that this step of the analysis is very significant, because it is needed to define if the chosen firms are using innovation in the creation of competitive advantages to continue with the evaluation of NIS impact. Considering that the impact of the NIS is based in the interrelation of the education and R&D systems with firms, through the interviews it was evaluated the characteristics of knowledge based resources, knowledge acquisition and relation with other organizations.

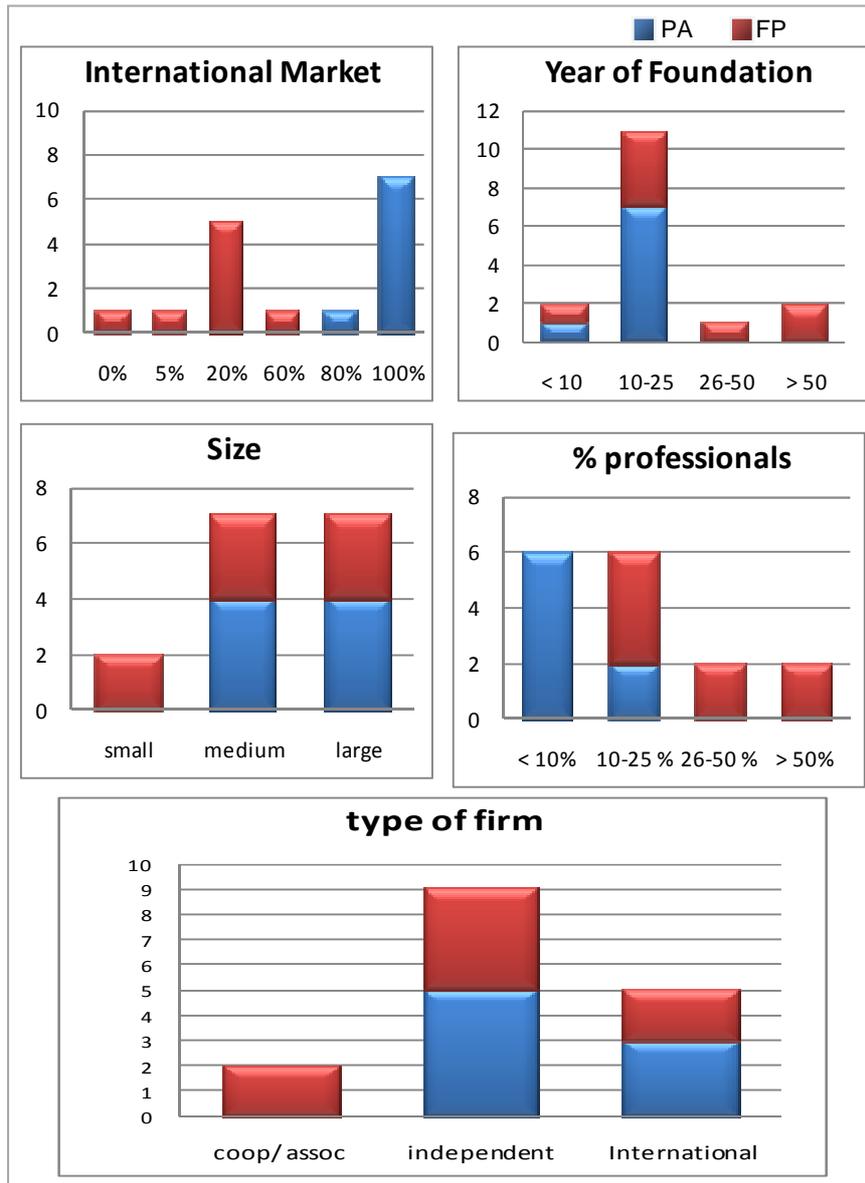


Figure 5.1 Main characteristics of interviewed firms

To analyze knowledge based resources, firms were asked about their perception in different knowledge areas; it was made using an evaluation scale between 7 (perception of strong competences in the respective area) and 1 (perception of weak competences in respective area).

It is important to make a special remark in the differences on “perceived” and “real” knowledge of firms. The perception of knowledge depends on the background of the person consulted, is subjective and does not necessarily reflex the comparison with other firms. For example one of the firms has limited technological knowledge based in 20 years of family experience, without professional personnel, in addition it was perceived through the interview that the firm does not have the capacity to understand, evaluate and apply knowledge developed by research institutions; however the firm perceives itself as strong (7) in technological knowledge.

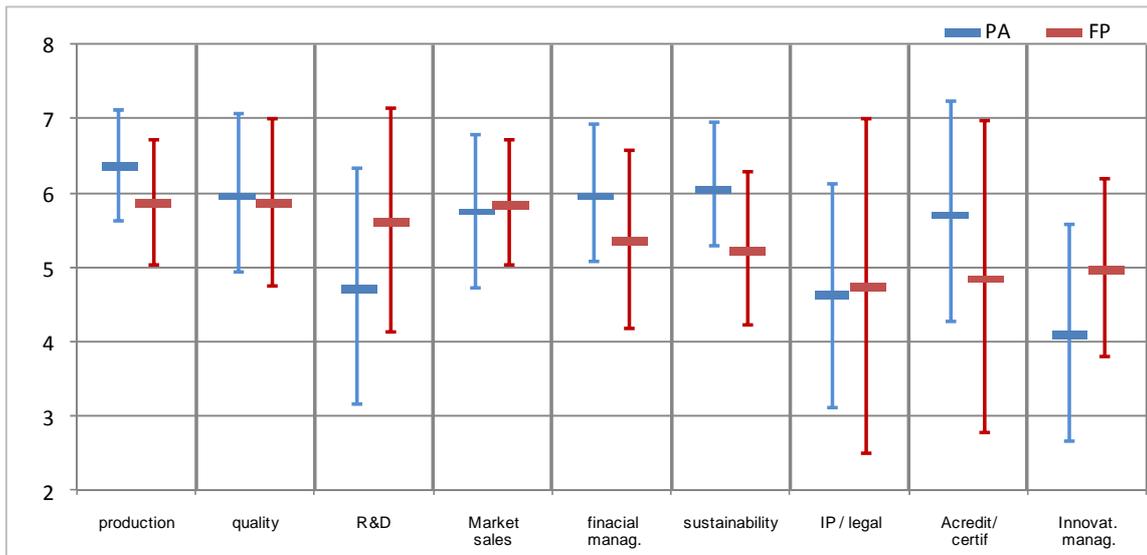


Figure 5.2 Firms' competences perception in different areas

Figure 5.2 presents the average value of the 8 responses for each group of firms (PA and FP) with the standard deviation (to show the variation between answers) to have an idea of the general response. As could be extracted from the information, firms perceive themselves strong in production, quality, marketing and sales, and weak in intellectual property/legal aspects and innovation management. In this two areas as well as R&D and accreditation/certification, there is more variability into firms showing that there are some firms with different levels of perception into the groups. All firms of the PA do not have a R&D department, which explain their perception of lower competence in this area in comparison to FP, the same tendency happens with innovation management where all FP firms are innovating in a more structure way, in spite that in some cases it is through an informal structure.

As was shown in section 4.1.2 the country has a weakness in intellectual property, the results show similar perception for both groups, but the variation in the FP sector is higher. In general terms FP firms are using trademark as the main way of protection and do not have experience on patenting. The opportunities of patenting new varieties have given some competences in this area to 3 firms of the PA, which explain the variation in this case.

This subjective perception of knowledge has important influence in the effort that companies make to acquire knowledge and in the communication with other actors. It is necessary to establish more objective mechanisms that permit companies to evaluate its real position. For example the technical competitiveness index presented by Duran (2008) could be used to evaluate the knowledge-based resources of companies in key areas; it is based in a diagnostic where the competitiveness of firms is defined by different objectives factors of production process. In addition, this kind of diagnostic tools give the possibility to benchmark in sector or country level. Similar diagnostic tools have been used by CITA to evaluate food processing firms.

The competences of firms are the foundation to use knowledge acquired. One of the firms shows the importance of an internal structure to support the process of knowledge management: this is a transnational FM firm; in these days is developing what they call an "innovation system". In the interview it has shown important elements mention in theory of the "knowledge management structure"(Gold, Malhotra, & Segars, 2001): technological infrastructure as mapping of knowledge through specific information tools, structure infrastructure as channel of communication in internet, to share new ideas and receive training in innovation, and shaping culture through training and motivation. The goal of the company is that this system would be implemented in other subsidiaries of the international organization.

Other aspect to be underlined on the experience of the interviews related with knowledge management is the importance of absorptive capacity. It has been defined by many authors as a key factor in the innovation process (Fortuin, 2006; Gold et al., 2001; Gray, 2006; Grimpe & Sofka, 2009; Vang & Asheim, 2006). All companies said to have an ability to adapt foreign technologies; in fact, two foreign firms were established in Costa Rica because of the professional formation of human resources. On the other hand, one of the cases shows the importance of absorptive capacity on the knowledge transfer from public institutions to SME's or farmer. Normally in developing countries many research efforts from public institutions are oriented specifically for producers' application, specially farmer or SME's, but in many cases they do not use or apply the new technology. Specifically in one of the interviews, one public university developed a new technique, using high-tech technology, to produce seeds for the firm; in spite of the investment on the research, the results are not used; during the discussion it was possible to realize that the firm does not understand the benefits of using the technology, how to use it and how to ask for implementation. In this case the firm does not have the capacity to assimilate and use the knowledge; as a result the firm evaluates the results of the research as negatives and does not want to continue working with this university.

According to the review realized for this case (presented in appendix 4), since 1980's the evolution of production of this product (chayote) has been supported by multidisciplinary research from government authorities, research and teaching institutions, and public universities. Over the past 10 years the ministry of Agriculture (MAG) has provided training to producers in many technical aspects: safe handling of pesticides, sampling and laboratory analysis, lectures on chayote diseases, use of bio-pesticides and organic pest control, good agricultural and manufacturing practices, postharvest handling of chayote; however very few of the producers are adopting the recommendations learned. In general terms, farms do not have technical professionals, they receive the technical support from the government offices, one or two professionals for the complete region and sporadically from universities or other institutions (MAG, 2007a). Government and other elements of the innovation system are generating knowledge to solve problems and innovate; but the sector does not have the capacity to use it. As an important conclusion of Gray (2006) in his research of "Absorptive capacity, knowledge management and innovation in entrepreneurial small firms", he suggests that policy-makers need to re-appraise the role of technical and vocational education not only at all levels in the educational system (in fact, calls are already becoming increasingly strident in this direction), but also with the respect to the development of absorptive capacity in SMEs to encourage more entrepreneurial identification and exploitation of business opportunities in our changing economies.

Referring directly to innovation there are important differences in the type of innovation developed by firms. Figure 5.3 shows, in general terms that firms are not making organizational innovations; many of them are making process innovation, especially new to the firm showing incremental innovation to improve in efficiency; the results obtained are according to the 2008 Innovation survey of the country, that few innovation products in the country are new for international market.



Figure 5.3 Types and novelty of innovation in firms⁹

Analyzing more specifically each firm in the FP group it is important to presents significant information:

- The dairy company case is very interesting; they have more than 500 products in the market, they are leader in the national market, without any clear competitor; however they have a dynamic of diversification to improve profits, as an example this company has milk for many market segments as kids, old people and pregnancy women. The company evaluate products and in some cases decided to put them out of the market in a very short time. That is one of the reasons because it is one of the most diversified firms.
- The coffee/chocolate firm began the local market of gourmet coffee in Costa Rica in the 80's, established a new market for tourists designing a tour to a coffee plantation and special stores in the airport. Nowadays the model is exported to other Latin American countries. They are making more than 100 products by year. For this two companies there are planning tools to define the priorities.
- The “corn products” company is developing an “Innovation system” to improve its possibilities of using innovation. In general, most developments are incremental innovations but its goal is to promote disruptive innovation

⁹ The Oslo Manual (OECD, 2005) defines four types of innovations that encompass a wide range of changes in firms' activities: product and services, process, organizational and marketing. In the case of novelty by definition, all innovations must contain a degree of novelty. Three concepts for the novelty of innovations are defined in the Oslo Manual: new to the firm, new to the market, and new to the world.

- The Nutri-snack firm has a new concept of nutritional snacks. The firm has an innovation strategy focused on consolidation of its image and dynamism of new products. For some products acts as a prospector, for others is an analyzer.
- The mini-vegetable firm represents an example of farmer association looking to increase the added value of agriculture. As strategy they selected a “gourmet vegetable”. At the beginning they had some lack in technological knowledge and they used different organization of the system (universities and public organization) to consolidate its position. This has helped them to achieve a proper technological level and introduce some improvements but they do not have a clear understanding of how to use innovation to create competitive advantage.
- The “bakery improvers” firm is basing its innovation in internal competences and marketing strategies. This firm is taking advantages of international information and networking to develop its products.

In the case of PM group priorities are related with improving production. In this group there was not mention strategic plans or other managerial tools. They are making reactive innovation typical of firms in the agriculture sector of developing countries (Spielman, 2005). It is important to mention the following:

- In the two flower firms there is not a formal R&D division in the country; innovation is mainly made and coordinated through the parent house including technology transfer and protection of the knowledge developed. They are using the institutional set of the country for some developments, training and developing of quality systems (as public universities and technical educational institutions). The tropical flower one is taking advantage of biodiversity to offer special varieties to the International market. This company patented some of these varieties and it is receiving benefits from it.
- The foliar firm is using innovation to consolidate its position; it is implementing an environment friendly technology to consolidate its image in environmental friendly consumer and it is making modification in the packaging area and alliances with smaller producers, with different and complementary products, to offer more diversity to final consumer. Connection with universities and suppliers (e.g. Bayer) are very important in these processes.
- Ornamental firm is a very proactive company in innovation, but without strategy. Innovation activities are defined according to needs of improving production and customers. One of the particular characteristics of this company is the experience of patenting a variety in the US system (A. Alvarado, 2003). According to the experience of this company the most difficult part of patenting is the management after the adjudication to obtain benefits. One of the important aspects mentioned is the dependence of brokers and intermediaries in the commercialization part. For them it is clear that the added value is mainly acquired in the last part of the chain where the price is increased ten times more than the sale price of producer. It is important then, to define new ways of commercialization and new markets.
- The three pineapple firms do not have formal R&D department and realize reactive innovation focus in the improvement of productive, reduction of illnesses, increase of shelf life and specifically elimination of natural blooming. These activities are realized in combination with supplier and public institutions as universities or MAG offices

After analyzing the characteristics of knowledge based resources and types of innovation the next step is to define if firms are using this innovation to create competitive advantages. Through the analysis of firms’ responses about the ways to define priorities of innovation, the effects of innovation, and competitive strengths, it was defined as well if firms are using innovation to create competitive advantages. Through codification of the information, the main criterion is that the combination of the mentioned factors has to show a strategy to consolidate an advantage position in the market. This strategy could be formal, specifically defined in a plan or informal, based in experience without a written plan.

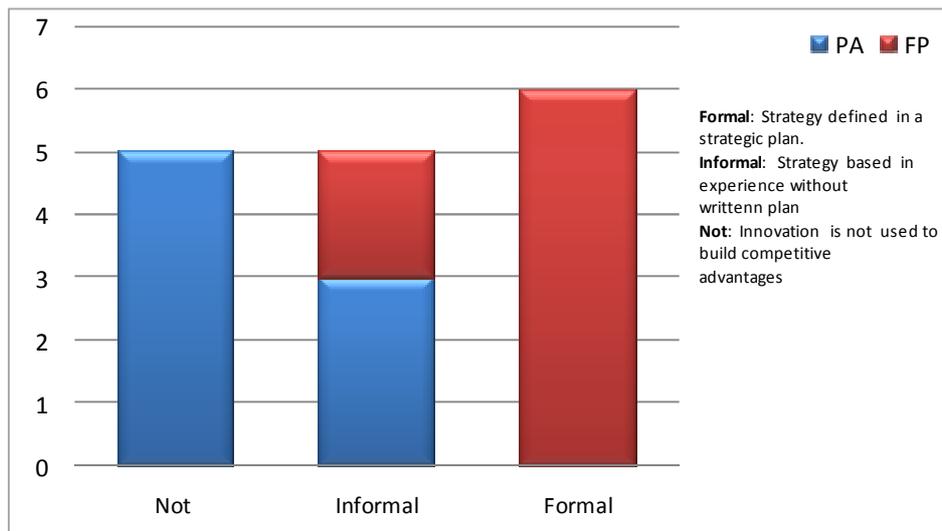


Figure 5.4 Quantification of firms using innovation to built competitive advantages

As it is presented in Figure 5.4, all firms of the FP and three PA are using innovation to built competitive advantages, almost all FP firms with clearly definition through a strategic plan (formal) and 2 FP and 3 PA firms in an informal way. It is important to emphasize that this result is influenced by the selection criteria chosen, considering that all FP selected firms are innovative.

The PA firms that are not making competitive advantages through innovation are from the pineapple sector (the three of them), chayote and one of the international flowers companies.

Chayote firm is the second in the national market but all production is sold without problem. The market is stable and the near competitor for the country, according to the firm, does not represent a real threat. Considering this scenario the firm is not worry in building competitive advantages.

Two pineapple firms are focused in improving production to reduce costs considering the important competitive position at country level. The pineapple multinational defines its competitiveness through its strategy of vertical integration and, the flower company is focused in the country's position for a better location in the US market and the strength of trained labor force in the country, its competitiveness is defined and managed in the parent company.

The firm with most interesting characteristics is the coffee/chocolate firm. According to innovation strategies (Fortuin, 2006) this is a prospector; in general terms this company is introducing new products in the market and other companies are following. The company is creating competitive advantages based on the dynamic of innovation. They are not afraid of imitation of products and clearly define an innovation culture as one of its ways to compete.

5.2.3 Relation of firms with the National Innovation System

Through the analysis of the ways of access to knowledge it is confirmed the importance of networking; all firm except one mention explicitly or implicitly networking as the main way to access knowledge. Special attention in this respect is given for some companies to the associations or groups of the same sectors where it is possible to share information and ask for new knowledge. Training is an important way to improve knowledge and in this respect, public organizations (governmental, technical training and universities) are taking and important role, especially for PA, as presented Figure 5.5.

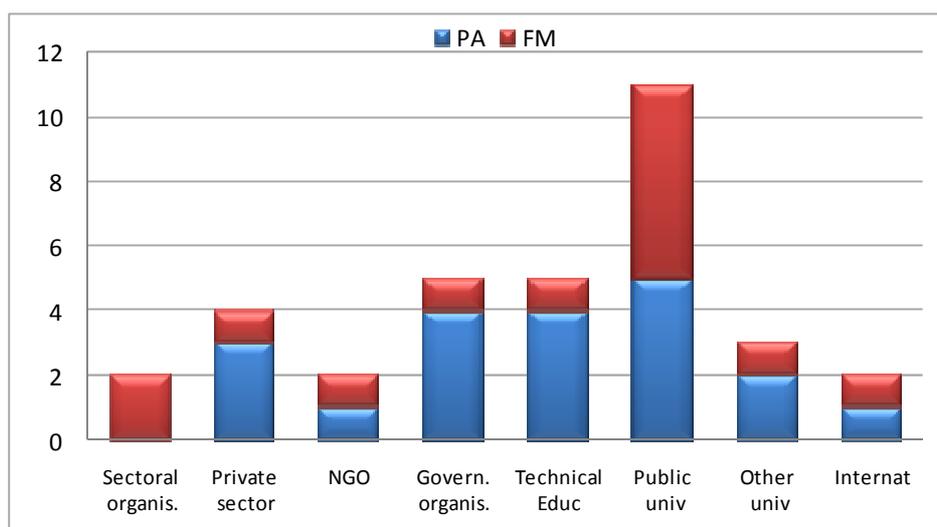


Figure 5.5 Important NIS organizations for training and Knowledge acquisition

The mapping of the education and knowledge creation system shows that the country has strength in organization for the agriculture sector. Many of the intermediary organizations of the government through extension work have an important role in knowledge acquisition for this sector. The technical training Institute (INA) was mentioned by 4 of the PA firms showing the importance of complementing the low education level of human resources with specific training. University of Costa Rica, as the most important university of the country in agriculture, was mentioned by six of the PA firms. Because of the tradition of public universities in extension work, there is many informal ways of training as workshops to explain a new methodology or individual training in a specific technique. The Agriculture Department of the University of Costa Rica has a special program to define the technical competitiveness of firms, especially for exporter firms. Through this program firms receive a report on 12 parameters and some training on the most important deficiencies. This program has been found for some firms as very useful to evaluate its technical characteristics and make comparison with other companies of the sector.

Most mentioned organizations in the case of FP firms were public universities, especially used for training in quality system and as a source for information. Food Technology Research Centre has developed a tool of technological diagnostic for the food industry, specially focused in quality, Good Manufacturing Practices and production. For FP firms the sector organizations are making important contributions in the acquisition of knowledge in marketing and management, especially for SME's.

Considering the importance of R&D and the dependence of the sector in public organizations, the relationship between firms and university is an important factor that is not working well. There is a factor clearly identified in the interviews because firms are asking for a better interrelation university-industry. The other important factor is the improvement of the entrepreneurial orientation in education. This was mentioned in general as one of the most important factor that inhibits innovation in the country.

The analysis of collaborative innovation in firms (Figure 5.6) shows the importance of public universities especially for PA firms, which in general do not have R&D departments, and need them for technological developments. As was identified in the mapping, the country has an important group of institutions that could give support to the Primary Agriculture sector in many topics. Many of the collaboration in research for some of these firms are made in informal ways. Firms have key contacts in some of the organization and through verbal communications ask for help for the evaluation of e.g. a new agrochemical, or identification of a new illness. In few cases the R&D of the universities is through a contract, were firms has to pay for the services. Mainly this is done when the firm wants some exclusivity of the results. These results

reflex the behaviour identified by Adamson (2006; 2009), who have made several studies on mechanisms linkages of the University of Costa Rica with the private sector.

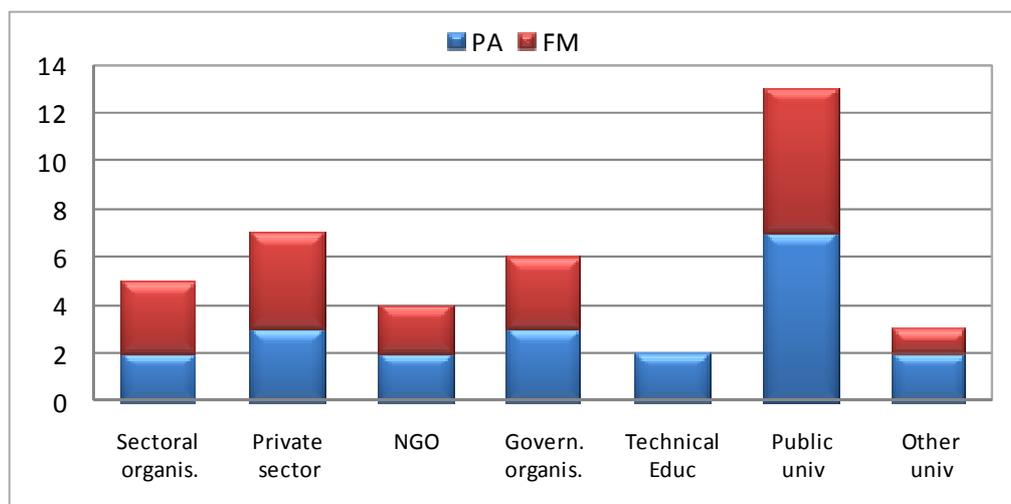


Figure 5.6 NIS organizations collaborating in innovation

According to firms' experience, there are not many private intermediary organizations helping on the innovation process. Different studies (Batterink, Wubben, & Omta, 2006; Howells, 2006; Klerkx & Leeuwis, 2009) show that these organizations are having an important role in developed countries, covering three important functions: demand articulation, network formation and innovation process management.

The firms that expressed more connections and relations with other organizations of the NIS were the foliage firm and three food processing SME's; the foliage firms expressed the importance of its networking with NIS organizations to create its competitive advantages through education and training and collaborative research with universities and suppliers. In the case of mini-vegetable firm, it is always looking for collaboration, into public organization, to fulfill its technological and marketing gaps. FP large companies defined small or not connection for collaboration in innovation with public organizations. The main characteristic perceived in many of the most related companies is that they are not waiting for help; they are proactively looking for using and taking advantages of relation with other actors of the NIS. This characteristic allows to realize on the importance of firms' entrepreneurial orientation as the base of taking advantages of any situation.

Because of R&D limitations in the country most firms interviewed are not defining innovation in new inventions but in new uses of knowledge; into the samples of firms there are many cases but the most illustrative is the coffee/chocolate firm. Founded in 1980's this company is now a multinational basing its success in new markets, application of knowledge in the development of new options and a very dynamic and aggressive plan of growing.

5.3 Dimension analysis of National Innovation System impact in the creation of firms' competitive advantages

Through the analysis realized until now it is clear that there are important differences between the PA and FP sector; in addition, the interviews allowed to identify important differences between firms. The following sections are going to describe the important findings of the embedded analysis of the multi-case study of the 16 firms in the definition of the impact of the NIS in different dimensions. The analysis is divided first in the main dimension, the supply chain position of firms: Primary Agriculture and food processing. Into the Primary Agriculture is analyzed the dimension of penetration market (global commodities and no traditional products to specific market) and, for the Food Processing it is analyzed the dimension of size (SME's and large companies).

5.3.1 Impact of NIS in the development of competitive advantages in Primary Agriculture firms (PA)

Through the building up of the case it has been understood that the firms of this group have important differences; for this reason it was decided to complement the information collected until now with a documental study of the characteristics of these products in the market and its relation with other organizations. Part of the information is used to support the case. Appendix 4 presents the details of the study.

As was demonstrated in last section PA firms have a close relation with public organizations. Most of governmental organizations were created with the idea to support the development of farmers focused in increasing productivity. This means strengthening competitiveness based in high production and low cost. It is important to evaluate now if this relation are helping to create competitive advantages.

First, it is detected an influence at the macro level. The policies of promotion of diversification, implemented in the 80's by the Government, gave results and had an important influence in the characteristics of the Primary Agriculture sector in recent years. In spite of banana and coffee, the most important export agriculture products, there are others as pineapple and, ornamentals and flowers, that have taken an important position in the economy of the country. Into this group of no traditional products it is possible to distinguish two important sub-groups: products that continue with the strategy of competitiveness with high productivity and low added value and products oriented on looking added value. Into the sample chayote and pineapple are high productivity oriented and "ornamentals, flowers, minimally process and mini-vegetables are added value oriented (because its processing characteristics for the last two firms were included into the FP group).

The government tries to attract "high-technology" agriculture and with this idea it has increased the promotion to motivate the insertion of international companies (FDI) of the flowers and ornamental sectors. As a result, this sector has now an important participation in exportation, taking especial advantages of biodiversity and climate of the country. Part of the development of the sector is explained by a spillover effect that permits the creation of local firms. However, the weakness of the country in knowledge protection has reduced the possibilities of some firms to use in better way intellectual property to create competitive advantages from the biodiversity of the country. In spite of the use of high-technology, some of the firms interviewed from this group do not have a totally proactive innovation strategy showing that they do not have the influence of better understanding and use of innovation for the creation of competitive advantages. In general terms, it is possible to identify here a positive impact at the macro level, through incentives to promote the development of a sector and use the advantages of the country in biodiversity to have competitive advantages. However, a negative influence is presented with the lack of proper knowledge protection.

In recent years, through the creation of INTA and agri-chain analysis the government is trying to promote the application of added value and vertical integration as strategies of development. The effect of these models is still not evaluated. These two approaches could be an important base to have a better perspective on the definition of competitive advantages. However the reduction of interest in the agriculture sector is making it difficult to implement these initiatives.

Especial consideration of impact of the NIS in the market penetration dimension

Into the Primary Agriculture group they were found important differences between no traditional products from small groups of farmers direct to a small market (as chayote), and global commodities (as pineapple). The most important differences of these cases are presented in Table 5.6.

One of the reason because three pineapple firms were selected (one start-up, one large with previous experience on banana production and one multinational) was with the idea to see the differences on innovation, in this three companies, of a product that have had an impressive developing in the country in last decade. Surprisingly, the interviews showed that the three firms

are not using innovation to create competitive advantages; they are making reactive innovation and mention competitiveness at the country level.

Table 5.6 Differences found between small market and global commodity products

Character-istic	Small market	Global commodities
Farmers	<ul style="list-style-type: none"> • Local producer • Organizations with coordination problems • Low knowledge 	<ul style="list-style-type: none"> • Large local producers, multinational
Production technology	<ul style="list-style-type: none"> • Problems of definition of quality parameters and proper uses of agrochemical 	<ul style="list-style-type: none"> • Multinational defined technology of production and quality parameters • Generally high use of agrochemicals
Supply chain	<ul style="list-style-type: none"> • Lack of a leader in the supply chain who defines and establishes the direction 	<ul style="list-style-type: none"> • Multinational are clear leader. They are focused on commercialization • Some producers are trying to use other ways of commercialization
Innovation	<ul style="list-style-type: none"> • Low competitiveness in international market is translated in low motivation to innovate • Reactive innovation looking for improving productivity. • Lack in market innovation 	<ul style="list-style-type: none"> • High international competitiveness main motivation of innovation¹⁰ • Realized by multinational. Focused on keeping its power. Local farmers are not really involved in innovation
Impact of NIS	<ul style="list-style-type: none"> • Try to help on solving problems and increasing productivity. • In spite of important effort realized in R&D by different actors of the country, innovation does not take an important role in this sector. In this aspect the lack in absorptive capacity of the sector is playing an important role. 	<ul style="list-style-type: none"> • Support to keep the country with the highest productivity. Important results in pineapple, banana and coffee, especially through the coordination of especial model of NGO's

The documental study of this case permitted to understand that the competitive advantages created in pineapple for the country has been developed by a multinational which defined a strategy for the introduction of the new variety into the global market. In this case the incentives of the government already mentioned and the competences of farmers developed through the production of banana are used for the multinational; and the support of the governmental institutions and public universities to farmers is helping them to achieve the quality requirements needed to sale the product to multinationals. As a spillover effect some farmers have decided to make its own connection exporting directly to USA and Europe. In this case the country has competitive advantages because of climate (natural condition of the country) and the capacity of production of farmers, influenced by the support of the governmental institutions. Into global commodities the influence of the special institutions of the country is more clearly defined in banana and coffee through the support of CORBANA and ICAFE respectably (sub-sector promoters, already described in the NIS mapping). In these cases the innovation realized by these institutions, focused in high productivity, has permitted to have the highest productivity worldwide in both products and a rapid response to specific changes in the market as the use of clean technology, the reduction of agrochemical and responses to the coffee crisis of last years.

In contrast, chayote is a regional product; in this case the combination of a special variety selection (in the 70's) with government support (in the 80's) have permitted Costa Rica to create a new market for a no traditional product, as chayote. It is a small market with few competitors, which represents the main economic activity for a region of the country. Through more than 20 years Costa Rica has been the world market leader. In spite of the experiences developed in these years, the chayote sector does not have a structure that let an appropriate

¹⁰ Two illustrative examples were identified in pineapple and coffee. In the first case how a new variety with an important logistic is used to create competitive advantage in the global market. In the case of coffee the characteristics of the sector, stable market with low growth, and crisis, are making all different actors to innovate to survive. Innovations are presented in the different steps of the chain, agriculture, processing, new products, new ways of commercialization and new markets. The details are presented in appendix 4.

evolution in the market. The production system is not consolidated; there are not clear standards, quality management and marketing strategies. The lack of a leader in the supply chain who defines and establishes the direction of the chain is an important factor. In spite of important effort in R&D realized by different actors of the country, especially public universities, innovation does not take an important role in this sector. In this aspect the lack in absorptive capacity of the sector is playing an important role.

These finding shows that in the case of global commodities NIS is having a positive impact in the creation of competitive advantages at the country level through the institutional setting of public organization (governmental, universities) and NGO. However it is important to emphasize that the strategy of “high productivity-low added value” is not the best way to improve the development of the country as has been discussed in the background of this study. In the specific case of pineapple there is a lot of controversy about the negative effects of this huge development in the environment and sustainability of the country. In the case of chayote many of the same institutions are trying to help in the development and consolidation of this product, with modest results.

5.3.2 Impact of NIS in the development of competitive advantages in Food Processing firms (FP)

As was mentioned before, the development of the case has shown important differences between PA and MF firms. The impact of NIS in FP is depending in the needs of this sector clearly added value oriented. All FP firms with less or higher degree of development have R&D departments, but with lacks in infrastructure and last-technology equipment; in addition the NIS mapping shows that the country has less R&D organizations related with the FP sector. One of the important impacts of the NIS in the FP sector is the support in the improvement of quality systems and accreditation. This has been one of the most important goals of the Food Technology Research Centre and other organizations as CEFOF and INA. These efforts have permitted firms to compete in better position, especially as supplier of multinational companies, and have defined the base to be more competitive.

Having lacks in the developments of new technologies FP sector has focused its innovation in adaptation of foreign technologies and the fulfillment of niche markets. They are looking for technological information abroad through suppliers, fair or technical articles. They have competences and skills in managements and marketing and innovation is part of its strategic plan.

Especial consideration of the impact of NIS in the size dimension

Some differences have been found in SME's, they have some needs on R&D that could be fulfilled by public organizations and, they are actively implementing innovation management as strategy to build competitive advantages. For this reason, they have more relation with NIS organization; in three of the five SME's interviewed there is a professional in food technology on charge of the development of new products. In two cases there are connections with CITA for some developments, training or other complementary activities. For these two firms a special remark is made on the influence of the “Industry Chamber”. This is a sector organization of the manufacture industry of the country and it is promoting added value strategies on companies in combination with other governmental organizations. Part of the influence of this organization explains the dynamic of the firms interviewed in innovation that is not generalized for most SME's in the Country. Through the effort of this Chamber and the Exporter Promoter Office (PROCOMER) it was made a consortium of SME's and through a consolidate group strategy they are trying to increase their market to other countries. These organizations give support in presentation the products in international fairs, training and networking.

The company of the gourmet vegetables is connected with many organizations, public universities, governmental institutions, funds organizations. Founded by farmers they had to adapt packaging processes and implement GMP and HACCP programs to be allowed to export

to US market. In this case many organizations have helped in its development. Similarly the case of “minimally process” firm has built its quality system with the CITA support.

The bakery improvers firm is an interesting case; this firm is working alone, without contact with organizations of the NIS. Its developments are made internally and most of the information is found externally through its suppliers or technical information from specialized technical databases. It is a strategy for the development of the company including internal marketing innovation and 6 new products in last two years, 2 for Central America countries. The main reason of the isolation is to avoid the knowledge diffusion of the key findings.

It is important to underscore some market barriers mentioned by SME's firms: (1) access to special raw materials: for example the nutri-snack company have to abort some developments by lack on special nutritional raw materials; there are not suppliers for these products in the region and the minimum amount to direct import are so high that it does not make sense to do it; (2) the retailers' power on the definition of their new products in the market: for the SME's it is very difficult to afford the requirement on quantities or special policies defined by retailers; in some cases they simply do not accept the new product.

As can be seen in the description of the SME cases, SME's firms are connected with other organizations and most cases public organizations are given support to help in building competitive advantages. In many cases CITA is having an important role in the support of quality systems but not so clear in the development of new products.

For large companies the relation with organization of the system is more reduce. They already have implemented quality systems; have international connection for some developments, and the local R&D from the university is not needed for them. Most of their new developments are adapted from external technologies. The three of them have an innovation strategy and this is used to build competitive advantages. The main relation with the NIS is through education and training of technical and professionals. An important weakness of these large companies is that they are totally dependent of technologies developed externally with low power of novelty as a way to compete with international competitors at the same level.

An interesting effect identified in the cases is that some large firms and multinational companies have had influence in the development of the sector, increasing competitiveness and opening new segment markets for other local firms. The coffee-chocolate firm is an example; generally low quality or rejected product is designated to the domestic market. It was the case for coffee in Costa Rica. This company decided to introduce “gourmet coffee” to the local market thinking in special segment markets (high acquisitive power local customer and tourists). The response was very positive and produced a big dynamic in the local market for other coffee companies. More details of the case are presented in Appendix 4.

6. Conclusions and Recommendations

The main objective of this study was *to identify the impact of the National Innovation System on the competitiveness of agri-food firms in developing countries, with special focus on Costa Rica.*

To address the research two main questions were defined: what is the impact of the NIS in the competitiveness of agri-food firms in developing countries?, and how does the NIS specifically impact three dimensions of agri-food firms (supply chain position, sizes and market penetration)?

During the development of the research three secondary questions were answered. The first one was aimed at analyzing how the NIS potentially impacts the development of competitive advantages. The present study was conducted with a conceptual framework based on theory: external factors from the NIS and firms' internal factors have influenced the development of knowledge-based resources. The firms' capacity to understand and apply knowledge (absorptive capacity) allows them to use these knowledge-based resources in the creation of competitive advantages through innovation. In addition, to create sustainable competitive advantages firms have to define strategies that would them to develop dynamic characteristics which would be difficult to imitate by competitors.

In this context, the NIS impact is founded on the support to be used by firms to acquire competence and knowledge. This support is provided by elements of the system, which are institutions and organizations (universities, research institutes, companies, ministries) of the educational, scientific and productive sectors. This impact could be analyzed through the mapping of the "Knowledge Acquisition and Education" System. Mapping includes the analysis of three subsystems (education, knowledge creation and production) at three different levels: micro (refers to the individual actor's level), meso (includes the link structure between actors) and macro (comprises the area of planning, policies, strategies and regulatory frameworks). The use of this approach in this exploratory study permitted the SWOT analysis to identify the main characteristics that have had an impact on the creation of competitive advantages through innovation of agri-food firms in Costa Rica. The most important conclusions are presented below.

After understanding how the NIS could impact the firms' competitiveness, secondary question number two focused on how the NIS impacts developing countries. Important differences were found on innovation creation between developed and developing countries. In general terms, in developed countries the elements of the NIS (education, R&D and production) are strong and consolidated and efforts are addressed at the meso level to improve the connection between actors. On the other hand, because of their internal conditions, developing countries present gaps in one or more of the three sub-systems which define the possibility to use innovation to be competitive.

The comparison with similar studies in other developing countries such as Taiwan and Korea shows that the proper improvement of innovation as a local development tool should be based on the strengthening of the three subsystems in a coordinated manner. These coordinated actions should include international networking (to complement external and domestic knowledge), strategies (this is the key factor to ensure a synergic effect of different effort and has been the main reason for success in other developing countries), clustering (clustering effects are particularly important for knowledge externalities and spill-over effect) and improvement of absorptive capacity (to keep pace with the fast-changing technological scenario, firms must have internal capability to be able to choose the right signal from the external environment and assimilate the same internally. In the case of developing countries, because R&D is performed by public organizations, absorptive capacity acquired through research is missed. This means that special consideration should be given to the foregoing to ensure that this gap is filled).

According to this study, the most important impacts of the NIS in the creation of competitive advantages are as follows:

- At the macro level there are two important potential developments:
 - The promotion of competitiveness orientation using knowledge to create added value products. In Costa Rica many government policies have tried to encourage added value in different sectors. However, the country has kept the model of high productivity-low added value in the Primary Agricultural sector. With this scheme the country is losing possibilities to generate important developments based on biodiversity and climate.
 - Strengthening of the “innovation platform”, which is built by the different actors of education, knowledge acquisition and private sector and their interactions. The gaps in the system reduce possibilities for the firms to compete. The NIS has created important circumstances for the development of competitiveness in the agri-food sectors, but there are still many deficiencies that act as barriers for competition under equal conditions with developed country firms. The positive and negative aspects of the Costa Rican NIS were identified through the SWOT analysis.
- **Education Subsystem.** Positive impacts are a good educational system (including basic, technical and educational levels), training and support in complementary aspects (as quality system, accreditation and innovation management), and promotion of training to apply high technologies. However, negative impacts are lack of higher education, especially at the doctoral level, a proper structure of incentives to retain highly educated professionals in the educational system and in entrepreneurial spirit (key for increasing the dynamics and catalyzing the entrance of new businesses).
- **Knowledge Creation:** positive impacts are the creation of important institutional support capable of covering all aspects of the agri-food sector, special sub-sectoral models of R&D and creation of new models of R&D, promoting the use of high technologies and improving connection with the private sector. The most important negative impacts are the lack of good interaction between R&D entities and universities causing problems of absorptive capacity and bad communication, unclear connection between consumer needs and R&D priorities, limitation in resources (infrastructure, equipment, human resources, funds) and important deficiencies in knowledge management (protection and diffusion).
- **Private Sector:** The positive aspects are R&D funds availability for the private sector, sector organization given support in different aspects and the dynamics produced by the FDI strategy and the presence of foreign and multinational companies (with possibilities of a spill-over effect). Negative aspects are low industry R&D production, in some cases, low educational level of human resources, and lack of understanding of the importance of strategic innovation to develop competitiveness, infrastructure and information systems.
- **Intermediation Level:** the positive impact is the important institutional setting to promote the interaction and support from governmental organizations and the private sector, in the case of the agri-food sector, the Ministry of Agriculture is playing an important role. The negative impact is the interaction problems between R&D organizations and the private sector.

Mapping of the Costa Rican “Knowledge Acquisition and Education” System permitted to define the following conclusions:

- In spite of some specific advantages in the country, such as biodiversity, good R&D organizations in the agri-food sector and stability, Costa Rica’s NIS is similar to the one in other Latin American countries with important gaps in the educational, knowledge creation and production subsystems and at the macro and meso levels.
- The country has special organization models that present benefits in the production and transferring of knowledge, specifically 1) the sub-sector promoters (type of NGO) that permit the use of innovation to build competitive advantages at the sector and country levels; 2) the initiative of “governmental agri-chain orientation” could help in the use of innovation to create competitive advantages through vertical integration and marketing innovation; 3) INTA is a new model of governmental intermediary organization that encourages coordination between S&T, the Ministries of Agriculture and the private sector.

- Important limitations include deficiencies in: (1) knowledge management as knowledge protection and access to information; (2) entrepreneurial orientation in the educational system, and (3) links between the R&D organizations and the industry sector.

After explaining in general terms the impact of the NIS, secondary question number three addresses how agri-food firms are creating competitive advantages through innovation. This question was answered by analyzing competitiveness in the situation of the agri-food sector and by interviews with personnel from 16 Costa Rican agri-food firms. Globalization and free trade agreements have created a special competitive environment for firms in the agri-food sector. Globalization has made this market very competitive especially for Costa Rica due to its proximity to American firms and other multinationals. Firms are actively trying to learn new ways to be competitive taking into consideration their technological resource limitations. For instance, they are looking for new market segments, adapting new technologies in regional products and providing special client services. Many Primary Agricultural firms are still focusing competitiveness on high productivity and low added value products. However, some firms in this sector and all Food Processing firms define their competitiveness in adding value.

As to whether firms are implementing organizational innovations or not, many of them are indeed applying the process innovation, especially when it is new to the firm and shows incremental innovation to improve efficiency. In the case of the PA group, priorities are related to improving production. Firms are implementing the reactive innovation, which is typical of companies in the agricultural sector of developing countries. The food processing group exhibits very interesting cases such as the dairy company that makes more than 70 new products per year or the coffee/chocolate firm that has developed new markets and is exporting the model to other countries, producing more than 100 products per year.

The analysis of the firms' responses on ways to define innovation priorities, innovation effects and competitive strengths indicated that all FP firms and three PA firms are using innovation to build competitive advantages. In addition, almost all FP firms have a clearly defined formal strategic plan, while 2 FP and 3 PA firms have an informal strategy (based on experience but without a written plan).

The analysis of the ways to access knowledge confirmed the importance of networking. All firms, except for one, mention networking explicitly or implicitly as the main source to access knowledge. Training is an important way to improve knowledge and, in this respect, public entities (governmental, technical training and universities) are playing an important role, especially for the PA firms. The organizations that were mentioned the most in the case of FP firms were public universities, especially for quality system training and as a source of information.

The analysis of collaborative innovation in firms shows the importance of public universities, especially for PA firms, which in general do not have R&D departments and need them for technological developments. According to firms' experiences, the missing actors in the system are private intermediary organizations, which play an important role in the innovation process in developed countries.

The firms that claimed more connections and relations with other NIS organizations were the foliage firm and three food processing SMEs. The main characteristic perceived in most of the related companies is that they are not waiting for help; instead, they are proactively looking for and taking advantage of relations with other actors in the NIS. This characteristic emphasizes the importance of having entrepreneurial orientation in the firms to take advantage of any situation.

Based on the interviews, the most interesting firm from the innovation point of view is the coffee/chocolate company. This firm is a prospector that has a strong internal innovation culture and an entrepreneurial orientation. What makes this case interesting is that innovation is based on the new application of existing knowledge and is clearly focused on new markets.

In the development of competitive advantages using innovation in firms, the NIS has different levels of impact according to the particularities of each firm, such as its position in the supply chain, characteristics of the market and firm size. Some specific findings in different dimensions are as follows:

- In the supply chain dimension, the influence of the NIS on the Primary Agricultural sector is based on public entities that provide support in the technological developments, especially those aimed at improving productivity by better applying agrochemicals, pest control, and clean technologies. This is possible because of the strength of the R&D organizations in the country. In the Food Processing sector the influence is lower and more oriented towards supporting the development of the quality system and training in managerial aspects.
- In the Primary Agricultural segment, FDI has significantly influenced the ornamental plant and flower sector producing a spill-over effect on local producers. This subsector currently has a meaningful participation in the country's exports.
- For the Primary Agricultural sector, in the case of non-traditional products with low market penetration, the influence has been focused on the support from public entities (governmental organizations and public universities) in the creation of technological knowledge in order to improve productivity (definition of quality parameters, reduction of sicknesses and better marketing). However, an important barrier has been the absorptive capacity of the firms, which are not taking advantage of the knowledge produced. In the case of global commodities, through the support from "sub-sector promoters", public universities and governmental organizations, it has been possible to consolidate competitive advantage at the country level, based on high productivity and the rapid response to changes in the market. In this case, the country has worked very effectively in some sectors such as banana, coffee and more recently pineapple.
- Important differences were found in Food Processing firms regarding the NIS impact between SMEs and large companies. Governmental and sector entities have developed training programs on innovation management and marketing that have been used by SMEs in the creation of dynamic competence to respond to changes in the market. In some cases, R&D public organizations support the creation of new products. The main NIS impact for large companies is proper training of human resources according to market needs; there is little connection with public R&D organizations in relation to the development of innovations.

This study was concluded with the following recommendations:

- During the NIS mapping interesting organizational models were identified. An important contribution would be to analyze in more detail the characteristics of these interesting organizational models identified in Costa Rica: Sub-sector promoter, agri-chain approach, and INTA.
- During the study not many intermediary organizations were found in the system. These organizations are playing an important role in developed countries. For this reason, it is important to map the models of intermediary organization present in the agri-food sector of developing countries and analyze the characteristics of intermediation needed in the agri-food sector in the demand articulation, networking, and innovation management process.
- Absorptive capacity is a key element for the proper use of knowledge. During the study, it was identified that the lack of absorptive capacity could be an important barrier in the relationship between the R&D organizations and SMEs and small farmers. It is important to study in more detail the effect absorptive capacity on the relationship between R&D and small farmers.
- Successful development tools that have been used by developed countries such as the spill-over effect, incubation and start-up of companies will have different results in developing countries since deficiencies in the systems will act as important barriers to obtain positive results. For this reason it is important to evaluate the following:

- The critical success factor of the spill-over effect of FDI in agri-food firms in developing countries.
- The characteristics needed in developing countries for incubators and support of “high added value” start-ups in the agri-food sector.
- In general terms, entrepreneurial orientation is the main characteristic that makes firms take the risk to use new knowledge. This study shows that Costa Rica lacks in entrepreneurial orientation in the educational system. Therefore, it is important to evaluate options to increase the entrepreneurial orientation in the educational system.

7. Appendix 1: Characteristics of NIS key interviewee actors

The following table presents the main characteristics of the NIS actors interviewed and their institutions.

Table 7.1 Interviews to key actors of Costa Rica National Innovation System

Organization (sector)	Position of interviewed	Topics discussed	Characteristics of the institution
Proinnova (University)	Director	<ul style="list-style-type: none"> • Characteristics of U-I relation • Main activities of Proinnova • Main results of Atlas of Innovation • Special research on innovation in exporter firms 	Knowledge transfer unit of the main University in Agriculture research of the Country. Its mission is to promote, facilitate, manage and support the efficient transfer of knowledge are intellectual property of the University of Costa Rica in order to promote innovation in the productive sectors
Food Technology Research Centre-CITA (University-Government)	Director	<ul style="list-style-type: none"> • Relation U-I • Research Needs of Food Processing sector • Gaps in the sector 	Food Technology National Research Center. R&D and knowledge transfer in science and food technology to enable the national and regional agri-food sector to raise their competitiveness and produce quality food
Innovation and Business development Cathedra (University)	Coordinator	<ul style="list-style-type: none"> • Main details of its research in innovation in firms • Characteristics of NIS • Role of private sector in NIS policies 	It is an open chair dedicated to organize various activities whose primary purpose is to promote the development of entrepreneurial innovation, through discussion, study and implementation of joint work. Will offer various activities throughout the year, such as courses, symposia, seminars, symposiums, meetings and roundtables, and other studies.
Agronomy Department (University)	Director	<ul style="list-style-type: none"> • Details of research in agriculture sector • Importance of especial NGO (e.g. CORBANA, LAICA) 	Agronomy department of the University of Costa Rica. Special project of entrepreneurship in the agriculture sector
Research Project "Competitiveness Research in agricultural sector" (University)	Coordinator	<ul style="list-style-type: none"> • Characteristics of innovation in the export agriculture sector • Details of study in technological competitiveness in agriculture firms 	Professor/consultant. Project Link to export. Development of Technological competitiveness Index. Used as a based to select firms to interview
Food Industry Chamber (CACIA) (Food Industry organization)	Food Technology area	<ul style="list-style-type: none"> • Innovation in the Food Processing sector • Activities of the Chamber • GAPS in the sector 	Business organization with over thirty years of experience that represents the interests of Food Processing' firms in various public forums and private, with a strong development orientation of conditions and policies that improve competitiveness and participation of products on the market
Industry National Chamber (Industry organization)	Project Director	<ul style="list-style-type: none"> • Innovation in the industry sector • Details of the project: promotion of innovation 	The Chamber of Industries of Costa Rica is the institution that represents the industrial sector since 1943 in the country. His leadership in the business sector has enabled levels of excellence in pursuit of better conditions not only for industry but for thousands of Costa Ricans who depend directly or indirectly from this activity. Project Innovex
Parquetec-incubator-NGO	President	<ul style="list-style-type: none"> • Results of Atlas of innovation • Experience of incubators • Needs in the sector • Characteristics of entrepreneurship in developing countries 	The "Asociación Incubadora" Parque Tec is a non-profit association found in 2004. It became the first software incubator in Costa Rica and its main purpose is to promote the entrepreneurial spirit of novel ideas in the technological sector.

Economy Department, University of Costa Rica	Researcher	<ul style="list-style-type: none"> • Results of studies in U-I interaction (data of last 10 years in the UCR) • Most important conclusion of the study 	Two works about innovation and the productive sector
CORBANA (Banana NGO)	Research Director	<ul style="list-style-type: none"> • Characteristics of R&D in the organization • Innovation in the sectors • Mechanisms of knowledge transfer • Examples of developments 	The National Banana Corporation (CORBANA) is a public non-governmental body, created by national law in 1971. It has been designated as the regulatory body of the Costa Rican banana industry, and its mission is to “serve national producers”. Its share capital is made up, in equal parts, by the central Government, the state banks (three) and the country’s banana producers, who have voting rights.
LAICA (Sugar NGO)	Research Director	<ul style="list-style-type: none"> • Characteristics of R&D in the organization • Innovation in the sectors • Mechanisms of knowledge transfer • Examples of developments 	The League of Agro-Industrial Sugar Cane (LAICA) is a non-state corporation with its own legal personality, under public law, responsible for marketing the sugar, as well as to ensure the full and optimal use of other co-products, inspecting industrial processing, quality, boosting its sales and marketing. The Costa Rican sugar producers are organized since the beginning of the decade of the 40s, when the distortion of the market forced them to unite to form the Board for the Protection of Agriculture of the cane.

Table 7.2 Description of the two activities related with Costa Rican NIS

Name of the activity	Organization	Main characteristics	Date of activity
Innovation Management Master Innauguration	National University of Costa Rica (UNA)	This was the inauguration of the first master program on innovation management in the Country. As part of the activity they were presented some results on innovation	May 26 th , 2009
Workshop “analysis of the situation of the National Innovation system”	Science and Technology Ministry (MICIT) Direction of innovation	It was an open workshop were actors of different sectors expressed their though about the situation of the National innovation system. There were actors of the government, universities and other education organizations, NGO, Venture capital, and one innovation expert from Spain. The “brain storm technique” was used to obtain information of all participants.	May 27 th , 2009

8. Appendix 2: General questions in the firms study

1. Firm Characteristics: Sector, sub-sector, main products, year of foundation, size, # employees, % of professional, size, market, type of company
2. Performance
 - 2.1. Compare sales, profit margin, number of employees of the current year with two years ago and with expectations for the next two years to assess growth/decline
 - 2.2. How is your financial performance as compared to competitors?
3. Competitive advantages
 - 3.1. The main competitor are: National , International do not have
 - 3.2. How do you define your position in relation to competitors?
 - 3.3. What are the most important competitive strengths of your company?
 - 3.4. How easily can your competitors imitate the competence that differentiates your main products from competitors?
 - 3.5. What are your needs to be more competitive?
4. Innovations
 - 4.1. Type and amount of innovation in last 5 years (product, process, organizational, marketing). Define the level of innovation: new to the company, new to the firm, national market, international market
 - 4.2. What have been the most important results of innovation? What is the innovation performance (bringing new products to the market before competitors, revenue contribution of new products)?
 - 4.3. What assessment tools does the company use to identify promising areas for innovation?
 - 4.4. What are the main priorities to innovate in your company?
 - 4.5. What are the innovation strengths of your company?
 - 4.6. What have been the most important barriers to innovate?
 - 4.7. Which other organization collaborate in the innovation process?
 - 4.8. How are the results of innovation protected?
5. Knowledge-based resources
 - 5.1. What is the level of competence of your firm in the following areas? (production, quality, R&D, Marketing and sales, Financial management, sustainability and environment aspects, Intellectual property and legal aspects, accreditation, Innovation management)
 - 5.2. How is acquired the technological knowledge in your firm?
 - 5.3. How is acquired the knowledge for marketing decisions?
 - 5.4. What are the core management competencies of the firm?
 - 5.5. How is the capacity of your personnel to use and adapt external knowledge (absorptive capacity)?
 - 5.6. What are the needs in training and knowledge acquisition of your firm?
6. Relation with the National Innovation System
 - 6.1. What are the most important factors that promote or inhibit innovation in CR?
 - 6.2. What are the most important organizations that support the innovation process of your company?
 - 6.3. What is needed to facilitate the innovation process of your firm in CR?
 - 6.4. What organization have an important role to improve the knowledge (technological, market and organizational) of your company?

Spanish version of the questionnaire used for firms' interviews

Influencia del SNI en el desempeño de las empresas del Sector Agroalimentario

El propósito de la entrevista es evaluar la relación entre el desempeño de la empresa, la existencia de ventajas competitivas, innovación, las características de los recursos de base de conocimiento y el sistema nacional de innovación.

Persona entrevistada:		Cargo:
E-mail:		Teléfono:
Fecha:	Encuestador:	

1. Información de la empresa

Nombre:		
Dirección		
Apartado Postal:		Website:
Principal Actividad:		Subsector:
Principales productos:		
Año de fundación:		Forma legal:
La empresa es: 1. <input type="checkbox"/> Independiente 2. <input type="checkbox"/> Parte de un grupo de empresas		
Porcentaje del capital extranjero en el capital total de la empresa: _____%, País de origen _____		
Donde se encuentran los mercado <u>más importante</u> de la empresa y el porcentaje a que corresponde País <input type="checkbox"/> _____% Centroamérica <input type="checkbox"/> _____% E.E.U.U. <input type="checkbox"/> _____% Europa <input type="checkbox"/> _____% Otro <input type="checkbox"/> _____%		
Otras características u observaciones:		
La tecnología utilizada por la empresa fue:		Detalle del tipo de institución
Desarrollada internamente		
Desarrollada en colaboración con otra institución		
Suministrada por otra institución		
Adaptada de una tecnología externa		

Empleados

Detalle del número de empleados de acuerdo al nivel de educación y nacionalidad:

Nivel de educación	Nacionales	Internacionales
Básica o menos		
Técnica		
Profesional en área científica y tecnológica		
Profesionales en mercadeo y ventas		
Profesionales en área administrativa		
Total		

2. Desempeño

2.1. Comparación del desempeño de la empresa con los dos años anteriores y expectativas para el futuro

	Años anteriores	Expectativas para el futuro
Ventas		
Margen de ganancia		
# de empleados		
Metas		

2.2. ¿Cómo considera el desempeño financiero de la empresa en comparación con los competidores?

3. Ventajas competitivas

3.1. Los principales competidores de la empresa son: No tiene Nacionales Internacionales

3.2. ¿Cómo calificaría la posición competitiva de su empresa?

3.3. ¿Cuáles son las principales fortalezas de la empresa para competir en el mercado?

3.4. ¿Qué tan fácil es para los competidores imitar las competencias que diferencian sus principales productos?

3.5. ¿Qué necesita para ser más competitivo?

4. Innovación

4.1. Tipos y cantidad de innovación introducido por la empresa en los últimos 5 años

Tipo de innovación	Desarrolladas por	Fueron novedosos para el mercado
Producto / servicio	empresa en colaboración por otra institución	empresa nacional internacional
Proceso	empresa en colaboración por otra institución	empresa nacional internacional
Organizacional	empresa en colaboración por otra institución	empresa nacional internacional
en Comercialización	empresa en colaboración por otra institución	empresa nacional internacional

4.2. Efecto de las innovaciones en el desarrollo de la empresa (Ventas, proceso, mercado, ventajas competitivas, nuevos productos primero)

4.3. ¿Qué mecanismos usa la empresa para identificar áreas promisorias de innovación?

4.4. ¿Cuáles son las prioridades de innovación de la empresa?(gestión de la innovación)

4.5. ¿Cuáles son las fortalezas de la empresa en innovación?

4.6. ¿Cuáles son las barreras más importantes para poder innovar?

4.7. ¿Qué otras organizaciones colaboran en los procesos de innovación de la empresa?

4.8. ¿cómo se protegen los resultados de innovación?

5. Recursos de base de conocimiento

5.1. A qué nivel posee el equipo de trabajo competencias en los siguientes campos (basado en educación o experiencia). 1 = No del todo 5 = alto grado

Producción	1	2	3	4	5	6	7
Calidad	1	2	3	4	5	6	7
Investigación y desarrollo de productos:	1	2	3	4	5	6	7
Mercadeo y ventas	1	2	3	4	5	6	7
Administración financiera	1	2	3	4	5	6	7
Sostenibilidad y aspectos ambientales	1	2	3	4	5	6	7
Propiedad intelectual y aspectos legales	1	2	3	4	5	6	7
Procesos de acreditación	1	2	3	4	5	6	7
Gestión de la innovación	1	2	3	4	5	6	7

5.2. ¿Cómo adquiere la firma conocimiento tecnológico?

5.3. ¿Cómo adquiere la firma el conocimiento para la toma de decisiones de venta en el mercado?

5.4. ¿Cuales competencias especiales posee la empresa en el área administrativa?

5.5. Es fácil para el personal usar y adaptar conocimiento externo? (absorptive capacity)

5.6. ¿Cuáles son las necesidades en formación y adquisición de conocimiento de la empresa?

6. Relación con el Sistema Nacional de Innovación

6.1. ¿Cuáles son los principales factores que promueven o inhiben la innovación en Costa Rica?

6.2. ¿Cuáles son las organizaciones le dan soporte en el proceso de innovación de la empresa en Costa Rica? ¿Con que frecuencia?

6.3. ¿Qué es necesario para facilitar o catalizar el proceso de innovación de su firma en Costa Rica?

6.4. ¿Qué organizaciones cumplen un importante papel en la adquisición de conocimiento (tecnológicos, de Mercado y organizacional) de la empresa?

9. Appendix 3: Characteristics of interviewee firms

Primary Agriculture group				
Firm	Type of organization	Size	Position in the market	Important observation
Chayote	Independent	medium	2	Chayote is a no traditional export. The company is second exporter of the chayote sector. In this sector there is not big competition.
Foliar (ferns)	Independent	large	First places	Commercialization and generator of technology. 300 Ha of ferns, 200 Ha other foliages. They are applying new strategy according to new products 22% other foliages and improving the image using clean technologies
Ornamental	Independent	Medium	Leader in one product	The company markets special ornamental from tropical countries. It worldwide leader in one of them. Company with two patents.
Flowers 1	Multinational (Dutch)	Medium	Parent #5 worldwide First places in USA	Multinational. Parent company in the Netherlands. Location is special to access USA market.
Flowers 2	Independent 100% Dutch	Medium	First places in tropical flowers	Dutch company. It is focus in tropical flowers and cuts. Patents in Europe and USA
Pineapple 1	Independent	Large	ND	Start-up but shareholders from other Pineapple companies.
Pineapple 2	Independent	Large	Third (national producers)	Large company in pineapple sector. Local producer. Before banana producer
Pineapple 3	Multinational (Colombia)	Large	Worldwide: Pineapple 4 Banana 7	This a multinational company with the main office in Colombia. It is the combination of production and commercialization. In addition of pineapple they produce banana and roots
Food Processing Groups				
Bakery improvers	Independent	small	Artisanal 3 Industrial ND	Small company focus in improvers and other products for the bakery industry. At the beginning the company was focus in the technology skills of the owner. Now is combining knowledge with commercialization strategies. Isolated company
Mini-vegetables	Association of producer	small	Local 1 International: first places	It is a company founded by small farmers in 1989, which was born as a need to diversify production, specializing in the production area of mini-vegetables and other no traditional products. Main international markets USA and Canada
Nutri-snacks	Independent	medium	Leader in the segment market	This company focuses on the preparation of biscuits and snacks and baked specially developed for health care consumers. It has a wide range of food products made with natural ingredients, whole flour, whole grain cereals and fat free of trans fatty acids. 4 year ago began the incursion into international markets. Currently exported to Puerto Rico, Caribbean, United States, Guatemala, El Salvador, Panama, Honduras and Nicaragua.
Condiments	Independent	medium	Leader in a segment	A small old company active in the incursion of new markets and innovation. It has a specific innovation team
Minimally processes	Independent	medium	National Sub-leader	Very new company. Minimally process products for Food Services and multinational. Products mainly to multinational fast food, hospital, hotels and some “maquila” for exportation. Introduce the concept of minimally process in hospitals
CoffeA/ chocolates	Multinational (Costa Rica)	large	Leader	Interesting innovative company, pioneers in some products in CR and other countries. The company is a specialty travel retailer with over 50 stores in 5 countries that owns and manufactures its key brands in premium coffees, chocolates and specialty items, it designs most of its products, and integrates its physical and web-channels.
Corn Product	Multinational (Mexico)	large	Leader	Multinational. Worldwide leader in corn flour and tortilla production, with operations in United States, Mexico, Central America, Venezuela and more recently, Europe. Parent house has 37 patents. Local company is developing an innovation management system.
Dairy	Cooperative	large	National Leader Leader in CA (milk-yogurt)	Cooperative. Most important dairy firm in Costa Rica. More diversified company of the world. More than 500 products. One of the most outstanding dairy production businesses in Latin America

10. Appendix 4: Primary Agriculture Sector analysis

This section presents the documental study results realized to have a better understanding of the situation of products related with PA interviewed firms. It is included information about characteristics of chayote, flowers, ornamentals, banana, pineapple and coffee sectors.

To begin Table 10.1 presents an overview of important characteristics of each sector studied.

Table 10.1 Overview of important characteristics of the sector studied

Product	Costa Rican Export Goods rank	Area 2008 (ha)	Exportation 2008 (ton)	Exportation 2008 millions US\$	% Total Costa Rica agricultural exportation	% export. to US	% exportat. to EU-27	Costa Rica Internat. Market Position	# export firms
Chayote	ND	550	29 355	13.3	0.6	81.2	12.0	1	ND
Foliages, leaves and other	20	ND	30 594	76.8	3.7	13.2	82.9	ND	78
ornamentals	18	ND	63 156	83.4	4.0	44.5	42.7	ND	143
flowers	41	ND	9 263	36.9	1.8	89.4	4.9	ND	57
Pineapple	4	33 480	1.462 116	572.9	27.3	42.1	56.5	1	137
Banana	3	44 313	2.037 179	680.2	32.4	46.8	48.1	3	100
Coffee	6	98 681	99 556	327.8	15.6	50.8	34.6	13	71

The table was elaborated with information of PROCOMER (Arce, Chacón, Chaves, & Tristán, 2009)

N.D: Not defined

Chayote

The “chayote” (*Sechium edule Sw*) is a cucurbitaceous originally from Mexico and Central America that has been cultivated since colonial times for its fruit, roots and shoots for human consumption. Nowadays the chayote is grown in the Americas from Mexico to South America and also is planted in the tropics and subtropics of Malaysia, Australia, New Zealand, India, Europe and South Africa and United States in Texas, California, Florida and Louisiana (Lira, 1996; MAG, 2007a).

The chayote earns its highest value in large supermarket chains that cater to wealthy, health-conscious European and North American consumers. It is a healthy product, with high water and low calories contents (MAG, 2007a; Mannon, 2005).

World trade in chayote is controlled by specialized importers in ethnic and exotic products. This market is unstable, meaning that prices for chayote rise and fall often based on supply and demand. The fluctuation could be between US\$ 0.30 and US\$0.70 per pound (USAID, 2006).

Costa Rica is clearly the leading trader and exporter of chayote; close to 80% of the production is exported; as shows Table XX the main export markets are located in Northern America (81%) and Europe (12%) (Arce *et al.*, 2009; Sáenz, 2006). For the US market Mexico is in second place. Exports from other countries such as Peru, Dominican Republic and Brazil, have been sporadic and in far smaller quantities (Lira, 1996). The Mexican export is placed primarily in Miami, and seasonally, because their production is affected by climatic aspects; Costa Rica is able to produce and export the product during the twelve months of the year (Navarro, 1999).

The Costa Rican export variety of chayote is known as "Quelite" and according to documentation of the Ministry of Agriculture and Livestock (MAG) it was selected in the mid-1970. This selection achieved a major change in the quality and productivity fruit, giving uniformity in size, color, texture and shape; because of that Costa Rica was the first exporter of chayote, satisfying a demand that was not covered by any supplier in 1972 (MAG, 2007a). According to Quiros (2009) this is one of the competitive advantages of Costa Rican chayote; it is preferred by color, uniformity and the absence of spines on the surface.

The politics of no traditional export in the 1980's stimulated the chayote production of Costa Rica. The exportation went from 2400 ton in 1980 to 6150 in 1988 (Mannon, 2005). The

opening of the export activity turned production methods, from a stage of self-sufficiency and small-scale marketing to an intensive economic exploitation (MAG, 2007a).

Through years it has become the principal agricultural activity in the valley of *Ujarrás*, southeast of San José, the capital city. Chayote cultivation is highly labor-intensive, with labor representing approximately 70% of total production costs; it consisted of near 450 farmers and producers with an average farm size of around 3 ha (MAG, 2007a; Sáenz, 2006). Most farmers prefer to use family labor, whereas hired labor is used for incidental maintenance of plots or the trellis; it is estimated that about 2,750 persons work directly in chayote production, and 2,000 work hired as field laborers, or in transportation and processing facilities (Sáenz, 2006). Exportation represents 0.6% of the agriculture sector (SEPSA, 2008).

There are differences between producers for the size (area), organization (organizational level of the sector) and levels of integration. Hartley and Díaz (2008) identified a small group of producers joined under cooperative figure focus in the agricultural phase of the chain; another group is a vertically integrated and smaller producers with capacity to pre-pack the product and finally a group of producers who are not organized and limited to produce.

According to Saenz (2006) the chayote supply chain does not have a clear strong leading agent, since there are no large retailers or branded manufactures involved in the design and promotion of chayote in international markets and operates in a rather fragmented way. The commodity moves from Costa Rica to the international markets without any value added abroad. Once the product is sold in target markets, wholesalers-importers (brokers) store and distribute the commodity to the retailers and set the purchase price for Costa Rican exporters. Retailers basically perform a distribution function and consumers purchase chayote in the same condition as it is packed by the exporter. Chayote suppliers cannot afford the investments required to introduce sophisticated food safety and quality control systems, and there is no official regulatory framework specifically for chayote in the importing countries. The most common standard is a list of prohibited or regulated chemical biocid (Sáenz, 2006). The only food safety control is performed by the phyto-sanitary authorities in the country where the commodity is imported. In the case of the United States the Environmental Protection Agency of U.S. (EPA) placed the crop under the category of cucumber and other cucurbits and no data are available for some chemicals (MAG, 2007a).

Importers only specify certain product parameters (color, shape, size, no damage). Their main strategic activity is linking overseas suppliers with ethnic niches in the target country. To remain participating in the supply chain, Costa Rican suppliers have to match brokers' product parameters. Trading is based on quality assessment and market knowledge of the broker. Hence, quality default is penalized via price rather than by exclusion from the market. These informal governing rules are enforced from exporters to packers and finally to producers in a backward sequence (Sáenz, 2006).

Poor organization is reflected in the large number of clusters formed, the disloyalty shown by years between producers, export firms and retailers and loss of confidence in community leaders. In the sector, there are many producers groups as associations, cooperatives, corporations and the Chamber of Producers, packers and exporters. However most of these organizations were formed by different targets than production and marketing, as land acquisition and obtaining irrigation water system for crops in general. Only the Chamber of producers has been involved in chayote problems and research needs and among its goals is to consolidate and to lead all activities related to chayote, for the region and the country in general (MAG, 2007a).

The analysis realized by Mannon (2005) about the risks of small farmers in the chayote sector reveals that the combination of volatile export markets and limited resources makes it almost impossible for small farmers to participate in global production without some sort of assistance or strategies. Generally they have to affront the marketing risk (when product is rejected by wholesalers, export firms passed the financial loss to farmers), normally they have problems of uniformity or excessive use of chemical and when demand or prices plummeted, chayote

exporters simply did not buy from small farmers. The most popular strategy among small farmers is to sell their production to the national market in combination with the export market and diversification of production. Indeed, the strategic engagement of small farmers with local markets branded them as less capable players in global production.

For traders and processors, farmers' default on quality is one the most important problems in contract performance. From the producer's viewpoint, the difficulties in forecasting production and deliveries, together with limited access to information and technical assistance, tend to affect compliance with contracts and could easily induce distrust or disloyal behavior. Market imperfections due to coordination, information and negotiation problems are major reasons for deviating from previous agreements or defaulting on quality requirements (Sáenz, 2006).

The percentage of rejection of the product reaches an average of 20% production. But for the largest producer in the country (fully integrated) this percentage is reduced to 2% (Hartley & Díaz, 2008), showing that with proper production system the rejection could be minimized. The percentages of rejection of the product is not related solely to managing the farm and crop post harvest handling, but also with the lack of investment analysis of soil and plants, resulting in a deterioration of the crop and the quality of products. In this particular small producers require further advice, training and accompaniment by the Government (Hartley & Díaz, 2008).

In addition of the quality problems other three important facts were identified: 1) "Bleaching" disease: The disease began in 1998, it now affects over 30% of the plantations and threatens the whole. The illness is caused by a phytoplasma whose structure and other characteristics are not known very well, it affects the external appearance of the product, given a white color to the surface that is not accepted by exporters. For 2007 this disease represented a loss of US\$ 1 million (Barquero & Gutierrez, 2007; Quiros, 2009). 2) Genetic erosion of variety: since 1973 the process of seed production has made a strict selection of few phenotypes with commercial value for export. This process is reducing the possibility of using varieties to improve the quality of the product and increase the resistance to some illnesses (Abdelnour, Ramírez, & Engelmann, 2002; Alvarenga-Venutolo, 1990). 3) Better varieties from competitors: Mexico, the main competitor of Costa Rica, is improving the quality of its varieties, offering products with more homogeneity (Quiros, 2009).

Considering these facts, it is clear why technicians and producers agree that the development of new higher yielding varieties that are resistant to common pests is a priority for the sector (Sáenz, 2006).

After the characteristics of the sector have been analyzed, to understand the role of innovation, it was necessary to make a review of the contributions of research institutions and an analysis of the interviews carried out (or conducted). Since 1980's the evolution of production has been supported by multidisciplinary research from government authorities, research and teaching institutions, and public universities (MAG, 2007a). Table 10.2 shows examples of articles found in literature. As could be seen from the table many of the problems defined before, were already investigated by researchers of different institutions. Part of this information is used by the Ministry of agriculture; according to the "Chayote agro-chain" report (MAG, 2007a), over the past 10 years MAG has provided training to producers in many technical aspects: safe handling of pesticides, sampling and laboratory analysis, lectures on chayote diseases, use of bio-pesticides and organic pest control, good agricultural and manufacturing practices, postharvest handling of chayote; however very few of the producers are adopting the recommendations learned. In general terms, farms do not have technical professionals, they receive the technical support from the government offices, one or two professionals for the complete region and sporadically from universities or other institutions (MAG, 2007a).

Table 10.2 Chayote publications

Title	Autors	Organization	Year
Grow analysis on chayote (<i>Sechium edule</i> Sw.)	(Valverde-Gómez & Sáenz-Murillo, 1985)	UCR	1985
Identification and seasonal variability of sub-standard factors for exportation of Costa Rican chayote fruits.	(M. Saenz & Valverde, 1986)	UCR	1986
Nutrition removal from soil by the chayote plant (<i>Sechium edule</i> Sw.)	(E. Valverde, González, & Cordero Vásquez, 1987)	CIA, UCR	1987
Evaluation of postharvest treatments for keeping quality of chayote (<i>Sechium edule</i>) fruits.	(S. Alvarado, Saenz, & Valverde, 1989)	UCR	1989
Chemical control of red spider mites (Acari: Tetranychidae) in chayote (<i>Sechium edule</i> Sw.)	(Ochoa, Aguilar, & Merino, 1989)	CATIE, UCR	1989
Preliminary studies on the post-harvest preservation of the chayote (<i>Sechium edule</i>) fruit.	(E. Valverde, Sáenz, & Vargas, 1989)	CIA, UCR	1989
Micropropagation and study options for the conservation of germplasm of chayote	(Alvarenga-Venutolo, 1990)	CATIE	1990
Micropropagation of chayote (<i>Sechium edule</i> Jacq. S.W.) from vegetative shoots.	(Abdelnour et al., 2002)	ITCR, UCR, IPGRI	2002
Export contracts for no traditional products: Chayote from Costa Rica	(F. Saenz & Ruben, 2004)	CINPE, WUR	2004
Risk takers, risk makers: small farmers and no traditional agro-exports in Kenya and Costa Rica	(Mannon, 2005)	Utah State Univ.	2005
Meristem culture, thermo- and chemotherapy to eradicate ChMV in chayote (<i>Sechium edule</i> Jacq. Sw.).	(Abdelnour, Bermudez, Alvarenga, & Rivera, 2006)	ITCR, UCR	2006
In vitro conservation of chayote (<i>Sechium edule</i>).	(Alvarenga, Abdelnour, & Villalobos, 2007)	ITCR, CINVESTAV	2007
Genetic characterization of a collection of chayote, <i>Sechium edule</i> (Jacq.) Swartz, in Costa Rica by using isozyme markers.	(Abdelnour & Rocha, 2008)	ITCR, UCR, Kent University	2008

It was perceived through the interview that producers do not have the capacity to understand, evaluate and apply the knowledge developed by research institutions. The firm interviewed is part of the board of the Chamber of producers, with Euro-Gap certification and systemic production, is the second in size of the sector with 100 employees and does not have full time technical professional. It was very important to realize that, in spite that the Chamber has invested money for a research on “cloned seed production”, carried out by two public universities, it was not possible for the interviewer to understand the importance and possible benefits of the results and according to the interviewer it was not possible to reproduce the results. In addition, innovation is not perceived as an important way to grow, it is perceived some resistance to open new options of industrialization.

This case shows important elements in the use of knowledge: In spite of government and other elements of the innovation system are generating knowledge to solve problems and innovate, the sector does not have the capacity to use that knowledge. Absorptive capacity define by Cohen and Levinthal, cited by Tidd and Besant (2009), as “the ability of firm to recognize the value of new, external information, assimilates it and applies it to commercial end” is a key element in this case.

Three important characteristics could be defined from this case:

1. The combination of a special variety selection (in the 70's) with government support (in the 80's) permitted Costa Rica to create a new market for a no traditional product, as chayote. It is a small market with few competitors, which represents the main economic activity for a region of the country. Through more than 20 years Costa Rica has been the market leader.
2. In spite of the experiences developed in these years, the chayote sector does not have a structure that let an appropriate evolution in the market. The production system is not consolidated; there are not clear standards, quality management and marketing strategies. The lack of a leader in the supply chain who defines and establishes the direction of the chain is an important factor.
3. In spite of important effort in R&D realized by different actors of the country, innovation does not take an important role in this sector. In this aspect the lack in absorptive capacity of the sector is playing an important role.

Flowers, ornamentals

It was this high-tech agriculture sector that came symbolize to nontraditional exports in the mid-1980s, as many Costa Ricans hoped to profit from investment in new, sophisticated exports (Clark, 1995). The first companies developed in the country were the product of foreign investment and gradually, domestic investment has grown substantially (Monge, 1996). The technology for several crops has been enrichment by the experience and networking of producers which has worked before with these crops in other countries. To have an idea, according to Kalmowitz (1991), in 1991, from the 14 flower larger producer only two were Costa Rican and 29 foliage exporters were foreigner and 3 local. Many new firms have been founded by ex-workers of the foreigner firms.

Generic called ornamental, from the point of view of tariff items there are three groups: "Foliage, leaves and other", "ornamental" and "Flowers and buds". To assess the outlook each industry needs to be treated separately.

In Costa Rica the cut flower industry is the smallest of the three industries. Considering the market competitiveness in this sector, been able to export flowers requires intensive cultivation, quality plants, infrastructure and appropriate technology. Additionally, post-harvest logistic is a key factor to be sure quality is kept until final consumer. The Netherlands is the leader in flower exportation (42% for 2004), this dominance is highly advantageous for the large volume enables efficient logistics at low costs. The following countries are Colombia (12%) and Ecuador (5%). The main importers are the developed countries.

Most of propagate material imports of U.S comes from production areas with favorable climate and low production cost such as Costa Rica, Guatemala and increasingly in Mexico. After shipment these plants are further grown into maturity (USAID, 2007).

In Costa Rica cut flower exports have grown slowly, but steadily, since the point of near disaster in 1987 when the US International Trade Commission (ITC) imposed penalties on Costa Rican flowers in an anti-dumping case. Industry experts say that the ITC finding and a Colombian near-monopoly on exports to the United States of the "big three" flowers (roses, chrysanthemums, and carnations) drove many smaller Costa Rican growers to bankruptcy but, at the same time, also encouraged a healthy move toward growing less popular and tropical varieties. It does not seem to be any market barriers to these varieties in the United States, which should augur a positive growth in exports (Clark, 1995). Exportations for 2008 were US\$ 37 million; 57 enterprises are engaged in export markets of floriculture products and currently generate 5000 direct jobs in rural areas (Barquero, 2006), 89% is exported to US and 5% to EU-27 (Arce *et al.*, 2009).

In the early 80s, mainly chrysanthemum flowers were exported. Little by little diversification has increased to include a range of traditional and tropical flowers (with very special characteristics of originality and quality). Producers are constantly looking for new varieties, making access to very specific market niches. Furthermore the production is complemented by foliage (M. Durán, 1996).

The term "tropical flowers" is most often used to make reference to floral products native to tropical regions of the world and which in the past decade or so have become increasingly popular among consumers in many countries around the world. Within a worldwide context, the market for tropical flowers is small, representing approximately 4% of all cut flowers traded (Pizano, 2003).

Many marketing experts consider that tropical flowers have a potential for growth: consumers from temperate countries often regard these products as "different" and "exotic" and with proper promotion and consumer education there may well be opportunities for increasing their consumption. Presently, the main producer of tropical flowers as a whole is the Netherlands, where in addition much of the production research and breeding has traditionally been carried out. However, locations with more suitable climates where production can be more cost effective and for which shipping flowers by air is feasible are rapidly emerging as important

suppliers. Large producers, most of which are also exporters include the Netherlands, Costa Rica, Ecuador, Mauritius, and USA (Pizano, 2003). The conditions for planting of flowers in Costa Rica are very interesting; microclimate allows the existence of diversity. Generally each producer has different varieties that in some cases become more than 60, as the case of heliconias. Perhaps the biggest challenge in the coming years is to provide management knowledge and decorative possibilities to importers (M. Durán, 1996).

The second group, Ornamental plants, began its development in parallel with coffee production, ensuring many small and medium producers, additional income that allows them to cope with crisis situations in the prices of grain in the international market. Furthermore, the ornamental low costs and international demand have meant that this activity was extremely attractive for small and medium producers in the region (MAG, 2007b).

Nowadays there are a lot of firms dedicated exclusively to ornamental production. Export production began with "indian cane" (*Dracaena fragans*) but after a promissory beginning the exportation was reduced because of excess product in the market and low quality of Costa Rican product. In 1989 it was a new boost with the introduction of new products and varieties.

In the country there are few statistics on the areas and volumes of ornamental plants (MAG, 2007c). According to Procomer, 143 enterprises are engaged in export markets and the export value was US\$ 83.4 million in 2008. The main markets are US (44.5%) and EU-27 (42.7%-mainly The Netherlands) (Arce *et al.*, 2009).

As an important barrier, United States prohibits the importation of plants over 18 inches, as well as access is not allowed to the plant in its pot, as they argue that it is a risk of pests entering, this is considered a barrier to protect Americans farmers or packing, who are given the added value to the product (Ocampo, 2007). To eliminate this regulation, under the NAFTA-CA, it was established as a priority national within the agriculture sector, the export of ornamental plants of *Dracaena* over 18 inches of stem. After negotiations, it was allowed to increase the maximum permitted height to 54 inches, with the condition of a study from Costa Rica for pest risk analysis (already completed) and a series of management, inspection and certification programs for ornamental plants that are exported, known as "Clean Stock Program" or Program Nursery Fair (CSP). The elimination of this size restriction would represent an annual increase of \$ 15 million in additional exports and greater competitiveness (Benjamin, 2006).

Finally, the highest growth industry of the three is foliage (mostly fern leaves). Worldwide, ferns are the predominant cut foliages used by florists. In the United States, for example, leather leaf fern was the second most valuable cut florists' crop (after lilies) produced in 2005. The popularity of ferns as cut foliages is due to their ready availability, high consumer acceptance, low cost and generally good durability (Stamps, 2007). Exportation for 2008 were US\$ 63.7 million and includes 78 export firms, mainly to EU-27 (82.9%) (Arce *et al.*, 2009).

The success of these products is due to quality and price of ferns, green plants, cuttings and other Costa Ricans ornamentals. The availability of port services, maritime and banking had helped the growth of exports of these products. Technological advance developed in the country has allowed the development of new varieties and increased productive efficiency (Monge, 1996).

The production of flowers and ornamental foliage in Costa Rica meant the importation of materials, technology and experts. In 1986 the CINDE Agricultural Division through the Floriculture program developed a research with the aim of improving the quality of the flowers and looks for promising varieties, increasing productivity, lowering production costs and adapts foreign technology to conditions of our country. The information developed was given through technology transfer activities, publications, and agricultural extension. State institutions such as universities, in some cases in agreement with the agricultural division of CINDE also contributed in research and teaching. This division of CINDE was closed in the 1990's. The MAG provides technical assistance to small producers whose product is directed mainly to domestic market (E. González, 1994).

In this sector most exporters are not working under contract and sells through intermediaries, in addition the product features require producers to keep abreast with new technologies and market trends. Because of that the producers of the three groups have formed different organizations to unify efforts to make its business more competitive. At present there are three chambers: "CANEPLANTA" National Chamber of Producers and Exporters of Ornamental Plants, "ACOFLOR" Flower Costa Rican Association and ACOPEHEL-Costa Rican Association of Producers and Exporters of Ferns. In 2007 the three organizations have formed the Federation of Ornamental Exporters of Costa Rica, in order to ensure the interests of its members (Ocampo, 2007).

In survey made by CANEPLANTA about challenges for the sector, producers defined the biggest obstacles to improve their business as the lack of market information (45%), payment problems (40%), lack of buyers and development of new varieties (29%), lack in innovative products, lack in counseling a 16%, quality problems (14%) and transportation problems (13%).

To develop this case four companies were interviewed; two of them are from the flower sector, and the other two from ornamentals and foliage firms.

Both flower firms are subsidiaries of external companies, medium size, with 20 years of existence in the country; the parent house is in The Netherlands (the country with the best technology developed). In these cases technology was adapted to the country conditions. One of them is focus in breeding and propagation of cut flowers and the other one is exporting tropical flowers and ornamental cuttings (it has three patents in tropical flowers). The reasons to choose Costa Rica were availability of qualified technical personnel (required for the business), proximity to U.S. market and conditions of the country (export incentives, political stability, and climate). For them it is important the network with other producers in the region, especially for solving common problems as exportation and marketing barriers.

The competitive advantages of these companies are related to their parent house (technology used, quality, added value to final consumer, experience). In both cases there is not a formal R&D division in the country; innovation is mainly made and coordinated through the parent house including technology transfer and protection of the knowledge developed. They are using the institutional set of the country for some developments, training and developing of quality systems (as public universities and technical educational institutions). According to them important barriers for innovation in the country are legal aspects, lack in proactive attitude in human resources (comfort feeling) and access to funds.

The other company is related with ornamentals, it is focused in dracaenas, tropical plants. Nowadays this company is 100% Costa Rican capital, but one of the two founders was American. This is a medium size company with 10 years of foundation. The technology used is a combination between adaptation and internal development. They are leaders in the market of one specific variety (*Dracaenas nemeses*). This is a very proactive company in innovation, but without strategy. Innovation activities are defined according to needs of improving production and customers. One of the particular characteristics of this company is the experience of patenting a variety in the US system (A. Alvarado, 2003). According to the experience of this company the most difficult part of patenting is the management after the adjudication to obtain benefits. One of the important aspects mentioned is the dependence of brokers and intermediaries in the commercialization part. For them it is clear that the added value is mainly acquired in the last part of the chain where the price is increased ten times more than the sale price of producer. It is important then, to define new ways of commercialization and new markets.

The last company is focused in exportation of ferns and other foliages. This is a large company, with 25 years of experience. Its technology is an adaptation from US. The development of parameters has been done with public universities. The competitive advantages are related with the existence of strategic plan focused in client needs and sustainability image; brand, proper planning, price, technology developed, low environment impact, special human resources are some mentioned aspect. They are looking for different segments in the market, improving

quality and packaging system. Into this context, innovation processes are reactive, responding to client and production. Connection with universities and suppliers (e.g. Bayer) are very important in these processes.

In general terms the ornamental case shows the following aspects:

1. The 80's incentives created by the Costa Rica Government were important for the foundation of all the companies.
2. For all of them qualified human resource is a key factor. There are technical professionals as part of the fulltime employees and training is used to improve the knowledge. In this aspect the technical training institutes of the Country (INA) plays an important role.
3. In all cases innovation is reactive focus in short-term needs, especially clients and production. There is not management innovation system or strategies defined.
4. In spite of their contribution to the Country economy, this sector is not a priority. For this reason networking and grouping are important tools for the sector development.
5. Influence of foreign people was important for creation and development of business
6. All cases expressed lack in proactivity as one of the main barrier for innovation in the country.
7. Considering that consumer preferences are continuously changing and the biodiversity of the country, innovation in plant varieties is essential in this sector, but also in respect with cost effectiveness, quality and quantity improvements in new varieties are necessary in the highly competitive sector. Breeding new varieties of plants requires substantial investments. Because of that the Country has to improve the assistance in intellectual property, knowledge protection and management of patents. Cases as the dracaena patent could be analyzed and used as a way to develop "best practices in knowledge management".

Pineapple

The pineapple is a special case in the international fruit sector: world pineapple production quadrupled between 1960 and 2005, growing from 4 to 16 million tons; a much faster growth than that of fruits in general. Fresh pineapple imports more than doubled between 1999 and 2007 in both the USA and the European Union (EU). Simultaneously, the unit value of fresh pineapples increased in the USA, the leading import market, from less than US\$ 400 per ton in 1994 to US\$ 580 in 2002, and US\$ 530 in 2005 (Vagneron, Faure, & Loeillet, 2009).

Costa Rica is today world's top exporter of fresh pineapples, with exports reaching 1.4 million tons in 2008 (Arce *et al.*, 2009). On the other hand the pineapple champion of the 1970s – Côte d'Ivoire – has been experiencing a constant decrease in its market share on the European market since the mid 1980s. Vagneron et al (2009) defend the idea that not only does the evolution of the world market for fresh pineapples signal "the competitive dynamics of nations, firms and industries" but it also reflects the fierce battle that takes place between the downstream actors of the chain (global agro-food giants and large retailers). According to their analysis, in this battle, innovation in its wide acceptance -varietal, logistical, and the safety of food products- has played a crucial role.

From the mid 1980s to the mid 1990s, consumer enthusiasm for fresh fruit and vegetables grew and sea transport techniques with container cooling systems were developed. Costa Rica increased their exports of fresh pineapples to the US, with increasingly dominating in the latter half of the 1980s. Exports from Costa Rica stagnated in the early 1990s but grew dramatically from the mid 1990s reaching approximately 700,000 ton in 2004, coming to dominate the global supply of fresh pineapple. Recent data indicates that pineapples from Costa Rica had a market share in the EU of about 69% in 2007 (up from 44% in 2003) reflecting the substantial increase in imported volume from 184,175 ton to 573,832 ton during the same period (Fold & Gough, 2008).

According to Vagneron (2009), the changing trade patterns outlined above are closely related to transnational companies (all these partners founded on trade in bananas) that have come to dominate the international flows of mass-consumed tropical fruits. Fresh Del Monte Produce was one of the first US transnational companies to relocate production from Hawaii to Costa Rica in the early 80s (Vagneron *et al.*, 2009).

Costa Rica has produced pineapple since long time ago in a very natural production process. From the appearance of Pindeco (a Fresh Del Monte Produce subsidiary) at the end of the 80's, attracted by the incentives for non-traditional products and the US Caribbean Basin Initiative (CBI), the crop was reoriented towards export. Technological packages and a new variety of pineapple for export were introduced, generating an horizontal expansion of production (Roldán, 2008). For the climatic conditions of the country, Costa Rica has environmental conditions for the cultivation of pineapples; the production is ahead of 9 months cycle to the rest of the world's pineapple producers. In Costa Rica pineapple production occurs throughout the year, and production peak can be induced depending on the behavior of the market (Monge, 1996).

In 1994, Fresh Del Monte Produce obtained a US patent on a pineapple variety named CO-2 (Oda & Williams, 1994). A year later, the company obtained a patent for the same variety in France, presumably in order to block production in Côte d'Ivoire and marketing in the EU by other companies (Vagneron *et al.*, 2009). In 1996, PINDECO starts in Costa Rica large-scale production of the GoldTM Extra Sweet pineapple with the new variety, renamed MD2, claiming restricted property rights on the variety: 4000 hectares of land are grouped in a single holding, an ultra-modern packing station is set up (as MD2 requires advanced cooling, packaging and transportation technology, the company's facilities were upgraded and expanded), large-scale farmers were subcontracted to do likewise and high-level agricultural support is offered; reliable and rapid export logistics are developed together with an efficient organization of sales and a powerful marketing plan. The product was marketed in the US under the brand name 'gold extra sweet' resulting in a immediate success and pineapple exports from Costa Rica regaining momentum (Vagneron *et al.*, 2009).

The Fresh Del Monte Produce patent on MD2 expired after a decade enabling other major plantation companies, notably Dole Food Company, to deal in MD2 since 2003. The resulting massive increase in fresh pineapples from Costa Rica first hit the US market but as that soon became saturated the EU was targeted. Marketing campaigns were carried out by the transnational companies with special weeklong in-store stands offering slice tasting backed up by massive advertising in the media. The campaigns promoted the taste, colour, shape and size of MD2. The taste is sweeter and without the somewhat bitter bite which can characterize Smooth Cayenne (the other variety used). MD2 is more golden in colour and more rounded in shape, yielding slices of approximately identical size. The smaller size was promoted as being suitable for a family meal removing the problem of how to store the leftovers in a fridge. Retailers were also convinced of MD2's superiority due to its longer shelf-life and easier storability. European consumers consequently turned their back on pineapples from West Africa and from being a niche product on the EU market, Smooth Cayenne slipped to the bottom of the price spectrum of fresh pineapple (Fold & Gough, 2008; Vagneron *et al.*, 2009).

The new variety produced a great expansion especially in the Caribbean and North parts of Costa Rica, from 12.500 hectares planted in 2000 to about 33480 hectares in 2008 (Arce *et al.*, 2009). Some of 1,000 small and middle producers are part of this activity, contributing 4% of total production of pineapple, which remains largely in the hands of large companies. At least 20,000 people are employed directly in this activity and others 45.000 are indirectly labor, in activities such as transport, sales of inputs and other related industries, and it is estimated that between 1.050 and 1.100 in the crop producers and 135 exports firms. There are some 32 fruit packing (Roldán, 2008).

Outside Costa Rica, new producers enter to the market. Many multinational invested in Latin America and Africa. Over this period, differentiation through varietal innovation (MD-2) is

progressively replaced by other modes of differentiation such as brands and labels. The retail sector progressively gains strength through its own innovations (packaging, new sourcing mechanisms and product lines) (Vagneron *et al.*, 2009).

Parallel to the large increase in income and employment generation, the expansion of cultivation resulted in complaints; increasingly common on the alleged water pollution, destruction of soils and indiscriminate grow without taking care of sustainability and biodiversity. A complaint contamination even led to the suspension of water in the aqueducts of nearby villages. That decision was based on a study that revealed the presence of pesticides Bromacil, Diuron and Tridamefón widely used on pineapple farms. In 2007 the European Union reported intentions to increase their demands regarding the use of chemical ethephon applied at different plant products and virtually in all Costa Rican pineapple exports. European studies reveals that, to prevent damage to children digestive and nervous system, the ethephon maximum residual amount that can be found in food should be 0.05 parts per million; however, the maximum allowed is 2 parts per million (Roldán, 2008).

The Ministry of Agriculture and Livestock (MAG) in coordination with the National Institute for Agricultural Research and Technology Transfer (INTA), has made research for several years, looking for new alternatives to combat pests and diseases in pineapple production. It is reported to have reduced pesticide applications, in addition, the introduction of new noble molecules of insecticides could be a very promising tool (Roldán, 2008).

Vagneron et al (2009) made important conclusions through its “Global value chain analysis”¹¹ of the pineapple chain:

- “After the introduction of the new variety appeared a new leader (Costa Rica) and a new pilot (Del Monte) on the world market for fresh pineapples. Del Monte exerts a high level of control at almost all levels of the value chain: 1) the definition of product quality through varietal innovation has been achieved thanks to the large investments in research and development made since the 1970s (MD-2 variety was developed in view of optimizing logistics); 2) in order to secure consistency in volumes and quality, Del Monte controls the production of fresh pineapples since the late 1970s through its producing subsidiary PINDECO. This firm enjoys huge economies of scale by using very intensive agricultural practices and industrial management methods throughout the production process; 3) taking advantage of the investments made in its banana plantations (economies of scope), innovation in the field of transportation and logistics (land and sea transportation) allows a constant control of the quality and timeliness of the products (as well as access to the seaport); 4) the homogenous and high quality product obtained thanks to this tightly controlled chain is marketed under a well known brand-name supported by important advertising investments”.
- Del Monte becomes a “price maker”: the price paid for MD-2 pineapples has become a reference on world markets for other origins and varieties.
- The investments – in logistics, branding, marketing, research and development, etc. – required by such a strategy can only be supported by a very large company, able to achieve economies of scale across its products.
- This proactive strategy of innovation is accompanied by product differentiation and a focus on food quality and safety, two fields that are also ploughed by the increasingly powerful retail sector.
- Only a few small farmers are able to export through cooperatives and contracts with large plantations or exporters, who impose strict standards in terms of volumes and quality consistency. Many are confined to production of traditional varieties for the domestic market and fruit juice industry.

¹¹ Global commodity chain framework analyses the organization of global production systems and their evolution by focusing on firm strategies and actions.

- This story highlights the everlasting importance and the diversity of forms taken by innovation: varietal innovation (from Smooth Cayenne to MD-2); logistical innovation (investment in reefers, warehousing facilities, port infrastructure, etc.); the development of new quality standards and codes of conduct; and product differentiation (through pre-packing, branding, development of new products, etc.).

For this case three large pineapple producers were interviewed: a start-up (2 years) 100% Costa Rican capital company with 334 employees; a company with previous experience in banana production, 100% Costa Rican capital, 12 years in pineapple production with 800 employees, and a multinational, parent house in Colombia, 25 years in Costa Rica, 3000 employees, production and commercialization of banana, pineapple and other products.

The 2 Costa Rican companies showed similar characteristics, the technology was adapted from the “environment”; according to them the knowledge of pineapple production is known in the Country, each company has its special adaptations and consultancy between producers is very common when there are some production problems. There is not understanding on “knowledge protection” or intellectual property. Both defined competitive advantages for the Country in general, as climate conditions, human resources, quality and in both cases it was mention the existence of external partner that is in charge of commercialization to USA and Europe.

In the technology used, the multinational made special developments in post-harvest and packaging processes. The more important competitive advantages for this company are vertical integration and integration of production and commercialization. The company has internal policies for knowledge protection.

The three companies do not have formal R&D department and realize reactive innovation focus in the improvement of productive, reduction of illnesses, increase of shelf life and specifically elimination of natural blooming. These activities are realized in combination with supplier and public institutions as universities or MAG offices. As barrier to innovate were mentioned: lack in a specialized research centre, access to information, lack in proper policies, and misunderstanding of innovation importance.

The analysis of this case allows the following facts:

1. Innovation could be a powerful tool, especially when is based in logistic and strategy and is used for a powerful actor in a Global chain.
2. Knowledge management played an important role in the introduction of innovations. First, patenting gave the multinational time to position the new invention in the market. Second, the indiscriminate knowledge transfer of the new high intensive production technology allows realizing a very fast expansion of the new product. The post-harvest and packaging technologies were not transfer, this fact made dependence for the commercialization process and in spite other multinational has banana infrastructure, they have to adapt and develop their own technology. According to database in US-patents two new varieties are patented by Del Monte
3. The dynamism produced for these powerful multinationals in supply chains allows individual companies to realize small movements to be successful; they have to learn how to survive according to the directions defined for the main actors of the chain. In these case companies are focus in improving productivity, quality and having a space to commercialize its production. There is little space for proactive innovation.
4. Clearly, the institutional environment of Costa Rica in the 80’s promotes the development of the pineapple sector in the Country. Generally interests and goals of companies are different from those of Countries. The control of the pineapple chain is in multinationals hands; however Governments of producer countries have to take control of the effects in the Country. In the same way than multinationals, logistic and strategy should be used for Governments to be sure that the development of businesses is traduced in benefices for the Country; especially taking care of the negative consequences as in this case pollution, non-sustainable development and low added value development.

Banana

In terms of volume, the banana is the first export fruit worldwide (12% of the total volume of fruit produced). Considering nutrition aspect, it is the world's leading fruit crop, and in terms of economical value it is the number five agricultural crop in world trade. There are nearly 100 banana producing countries (Aurore, Parfait, & Fährasmane, 2009). Developed countries account for 83% of global imports of bananas, and the main markets are represented by North America, European Economic Community (collectively cover 60%), Japan, countries in Eastern Europe and the former USSR (Martínez, Delgado, Pargas, Manzanilla, & Ramírez, 2007)

At the international level, two groups can be distinguished by the nature of the forms of production and negotiation of banana: 1) Group "Dollar Zone" known by this name because traditionally are under the influence of the US Dollar, and also because the growth of their banana industry was usually associated with multinational companies (Ecuador, Costa Rica, Colombia, Guatemala, Honduras, Panama, Brazil, Mexico, Nicaragua, Peru and Venezuela. 2) ACP Group: Made up of African, Caribbean and Pacific countries which signed the Lomé Convention with the European Union in 1975, which was a trade agreement and support, with 48 of its former colonies, which allowed duty-free access to a variety of products (Ivory Coast, Cameroon, Saint Lucia, Jamaica, Belize, St. Vincent Grenadines, Dominica, Suriname, Grenada, Dominican Republic and Ghana).

The considerable socio-economic challenges existing in some producing countries and the removal of preferential trading arrangements with European Union, have lead to tension and recourse to WTO arbitration (World Trade Organization). Since 1993, marketing and pricing of bananas imported into Europe have been ruled by a Common Market Organization for Bananas (CMOB), which covers the flows from various zones: Europe, ACP countries, Latin America (dollar bananas) and the Philippines (Aurore *et al.*, 2009).

Competition between exporters of dessert bananas from different producer countries makes commercial quality of the products a critical marketing factor. High quality products are obtained under highly controlled technical conditions. Product identification and labeling signs have been set up to ensure product quality and origin, create added value, and enable consumers to distinguish products with particular and specific qualities. During the past few years new regulations have appeared in Europe: "Rational agriculture" certification, the AB label (organic farming) and the "Fairtrade" label (Aurore *et al.*, 2009).

A small number of vertically integrated transnational corporations as United Brands (United Fruit Company.), known as Chiquita; Casti & Cook (Standard Fruit Company) with the brands Dole, Del Monte, Fyffes and Noboa, dominate international banana marketing and trade, and these companies are able to exercise their market power at several or all the stages of the banana marketing chain. Although these multinationals are vertically integrated in sourcing, shipping, ripening, packing and distribution, they are moving away from direct ownership of production. As with other commodities, preferred-supplier arrangements are now the norm, with contracts specifying standards for quality, packaging etc. (Martinez, Delgado, Pargas, Manzanilla, & Ramírez, 2007; Vorley, 2005).

According to Vorley (2005) only around 12% of revenues from banana retail sales remain in producing countries, despite of the very limited amount of product transformation outside of the farm or plantation. The dominance of retailers has had an increasing influence over the structure and distribution of value along the banana chain. The shift of profits up the chain has been dramatic over the last decade, and the transnationals' margins on bananas are now very slim. Forty percent of retail value may stay with the supermarket even though this is the least demanding part of the chain. Lower prices for supermarket suppliers are felt keenly in exporting countries, making it impossible for growers and labourers to be paid legal minimum wages. International buyers are in effect obliging all banana-exporting countries to reproduce Ecuador's poor labor and environmental conditions.

For Costa Rica banana is one of the traditional export crops. Its exportation began in 1880 and nowadays it is ranked as the third largest banana exporter in the world, after Ecuador and the

Philippines in 2008 (CORBANA, 2009). For this year, exportations were US\$ 680 million. The number of direct related jobs was 35,451; additional, the banana industry generated around 90.000 indirect jobs in commerce, raw material and transportation (CORBANA, 2009)

Bananas are grown in plantations by relatively large independent producers and multinational that control about 50% of the area planted. For 2008 the area was 43,313 ha; in this year the national banana productivity reached a value of 2,325 boxes per hectare (42 metric tons) and as years before, it is the highest of the world (CORBANA, 2009).

The main exporting companies are Cobal (Chiquita), BANDECO (Del Monte) and Standard Fruit Co. (Dole), which constitute over 80 percent of banana exports from Costa Rica (MAG; Martínez et al., 2007). In 2008, the main markets were USA (45.6%) and the European Union (49.9%) (Arce *et al.*, 2009).

Two important policies have been created by Costa Rica government in relation to banana industry: (1) Exportation Tax: Banana exports have to pay a tax of US\$ 1.0 per banana box, of which US \$ 0.09 is allocated to the Ministry of Finance and US\$ 0.91 is included in the minimum price to be paid to producers. This tax is paid by trading companies and could not be translate (MAG). (2) In 1971 was created by national law the National Banana Corporation (CORBANA); this is a public non-governmental Organization and designated as the regulatory body of the Costa Rican banana industry, and its mission is to “serve national producers”. It aims to strengthen research in the cultivation, increasing productivity with reduced environmental impacts, reduce production costs, give laboratory services and technical assistance to producers, foster and maintain an equitable system of relations between national producers and traders, establish in conjunction with the Government banana policies and provide information on this activity (CORBANA, 2009; H. González, 2001).

Banana production has a number of environmental costs associated with significant loss of soil fertility, deforestation and biodiversity degradation. The pursuit of higher levels of productivity tends to increase the environmental costs. The technological standard predominant in the banana plantations involves an intensive use of pesticides and nutrients, as well as the use of large quantities of plastic materials (H. González, 2001). Social pressure, both nationally and internationally, for a cleaner environment and healthier products, has led to the creation of rules relating environment and businesses to develop programs aimed at their preservation. In 1992, in the context of the “Earth Summit” in Rio de Janeiro, Brazil, the Costa Rican banana industry decided to take a step forward and create its own standards of self-regulation based on the principles of sustainability and corporate social responsibility. This led to the establishment of the banana industry’s Environmental Commission (CAB), a body composed of representatives of the banana industry, governmental bodies, public universities and organizations associated with the environment. The CAB’s mission is to monitor the industry’s compliance with its own standards of environmental self-regulation (CORBANA, 2009; H. González, 2001; MAG).

The environmental improvement developed around this crop has allowed 90% of companies to be certified with ISO 14001, SA-8000, Rain Forest Alliance or EUREP-GAP; all farms incorporated to CORBANA are certified according to standards EUREP-GAP (H. González, 2001; MAG).

Furthermore, through a waste management program for all banana farms, the banana rejected is sold to agro-industrial plants such as Gerber (Novartis), Mundimar and Fructa which produce “banana puree” for exportation; the waste plastic used is sold to recyclers and it has been developed a technology for using the “bunch waste” and rejected bananas for composting, which go through a process of decomposition and are converted into fertilizer, used in the same farms (MAG).

In the case of Productivity, CORBANA has gradually accumulated a valuable store of scientific knowledge, which it has placed at the disposal of the country’s banana producers. For the purposes of research CORBANA has experimental fields and laboratories to advance work on fertility and nutrition, plant pathology, nematology, tissue culture, soil and drainage, soil microbiology and agronomy (H. González, 2001).

To implement recommendations, CORBANA has a technical support service that includes monitoring by visiting farms, validation and transfer, training and a close and constant liaison with researchers in problems identification and solution needs, input of knowledge and experience and visits of researchers to farm producers. Three elements of a technological innovation system are present in this body: 1) the research and extension as an interrelated and continuous process, with specialized functions, 2) policy development activity is made between producers and government and 3) a strong social control of producers, those with direct responsibility in the institution funding (H. González, 2001).

In the commercial part, producers in coordination with CORBANA have developed efforts to sell fruit directly to the European market; on one hand they have participated in international fairs to capture potential buyers. On the other hand, it has been developed an advertising campaign in Europe to create consumer awareness of the benefits in which Costa Rica bananas are produced and exported, which is an important effort to promote differentiation and identification of CR bananas (MAG).

Considering the characteristics of this sector to analyze the innovation part one interview was made with the direction of R&D of CORBANA.

In this case the creation of CORBANA is seen as one of the most important competitive advantage of the Country. None other Banana producer Country has this model. Through the law created in 1971 it is possible to have funds clearly directed to R&D, there is infrastructure and high trained personnel. The closeness to producers allows to coordinate research, define strategies, make long-term plans and response to short-term needs. The existence of CORBANA explains main competitive advantages of Costa Rican banana: the highest worldwide productivity of the Country, quality and scientific, social and environmental impact.

Innovation is clearly oriented in primary production: increase quality, clean technologies, semi organic production. There is a research plan; innovation is planned through internal sections and feedback from producers and is defined according to market and worldwide trends. The main barriers to innovate are confidential agreements, access to information and funds.

Networking is an important strength of CORBANA; there is collaboration and coordination with the Institutional setting of the agriculture sector. Internationally it is working with EMBRAPA, CIRAD, WUR and is active member of the Banana Latin American Network.

Knowledge transfer is other important strength but at the same time in the knowledge management area there are two important weaknesses: low publication in international media (needed to look for international funds) and low protection of knowledge.

One important point of discussion in the interview was why innovation is not focus in added value products. According to the interviewer banana sector in Costa Rica has looked for industrial products to give solution to the rejected banana that some years ago was a big pollution problem. Nowadays all rejected banana is processed. Industrial products have not been seen as a way to increase the value of banana industry.

In this respect Aurore et al (2009) presents a review were opportunities of industrial processing of banana are analyzed. Considering the nutritional value of this fruit, interesting options according to consumer needs should be developed.

Important findings of this case are:

1. CORBANA, as a sector organization, is an important complement for the development of a sector that is clearly control by multinationals. Through a centralized R&D organization of the sector it is possible to create competitive advantages for the Country and to take care of the producer interests.
2. Proper knowledge management and networking are key factor for this kind of institutions. Considering the importance that knowledge could have in the development of new strategies for a sector, CORBANA have to improve its skill in knowledge management, especially in protection of knowledge.

3. In the context of a Country, a sector as banana should dedicate efforts in innovation to give added value to the business.

Coffee

Coffee is the second most traded commodity in the world. It is an important income earner for rural areas, providing jobs and income for more than 125 million people worldwide. Since the 1990s, coffee has seen a crisis of oversupply that led to price drops unprecedented in recent history. According to the International Coffee Organization (ICO), between 1997 and 2004, global coffee production has been rising at an average annual rate of 3.6%, but demand has only increased at 1.5%. As a result, wholesale coffee prices have fallen. In the 1980s, a pound of standard-grade green coffee sold for around US\$1.20; by 2002 its price had dropped to about \$0.50 – not enough to cover production costs in most parts of the world (Gerz & Avelino, 2006; Mosheim, 2002).

This global feature is accompanied by a change in the structure of supply of roasters who are now distributing in an easy and flexible way in any region of the world due to the global organization of intermediary companies. In turn these large companies tend to organize their supply systems schemes in the context of "just in time" which moves the cost of storage to producers and processors. It is also necessary to underline the emergence in the markets for specialty coffee which consists of consumers' segment with greater purchasing power and refined taste and the existence of solidarity markets and organic coffee. These structural and organizational changes occur in a new relapse in the international prices (I. Alvarado, Molina, & Bol, 2008; H. González, 2001).

The coffee is processed from cherry to grain in the producer country. The coffee was the first commodity that for many years had a trade agreement (International coffee agreement-ICA). In 1989 the ICA agreement was dissolved; nowadays negotiations are made between producers and consumer countries independently. Trade between producing and consuming countries consists mostly of green coffee¹² and bulk instant coffee. Most international coffee trade is "green" coffee packed in 60-kg bags. Bulk instant coffee imported from producing countries is usually blended and re-packaged in consuming countries. The roasted coffee trade takes place almost exclusively between consuming countries. This pattern of trade comes from the fact that green and instant coffees can be stored for a long period of time, while roasted coffee loses its freshness much more quickly (Gerz & Avelino, 2006; Mosheim, 2002; Ponte, 2002).

The balance of power in the coffee chain has shifted dramatically in favour of commercial interests in the industrialized world, with only around 10% of retail value retained in producing countries. Trading is quite concentrated, with four companies controlling around 40% of global trade, but without countervailing power against the roasters in an oversupplied buyers' market. Coffee is a roaster-driven chain – the big coffee roasting companies, Nestlé, Kraft, Procter & Gamble and Sara Lee/Douwe Egberts, through their control of 45% of the global market, are big enough to provide price leadership. Speciality coffee (10% of worldwide production) represents a transition of part of the market from bulk commodity to a buyer-driven chain. (Vorley, 2005).

Among consuming countries, Scandinavian countries (which have the highest level of consumption per capita in the world) and Germany prefer Mild Arabica coffees in their blends. Robusta coffee is a key component in espresso blends and darker roasts, therefore important in Southern Europe. The US and UK markets prefer lighter roasts in general, but require a wide spectrum of qualities. Historic trading links are still important in shaping the international coffee trade. A sizeable proportion of East African coffee finds its way to Germany and the UK.

¹² To obtain the green coffee first, farmers grow coffee cherries and then processes; the process included depulping, fermenting, drying, curing, and bagging. Coffee is also traded in its instant and roasted forms. Trade between producing and consuming countries consists mostly of green coffee and bulk instant coffee. Bulk instant coffee imported from producing countries is usually blended and re-packaged in consuming countries. The roasted coffee trade takes place almost exclusively between consuming countries. This pattern of trade comes from the fact that green and instant coffees can be stored for a long period of time, while roasted coffee loses its freshness much more quickly.

France maintains close links with Côte d'Ivoire and other Francophone countries. Dutch trading links with Indonesia remain important as well (Ponte, 2002).

The coffee market is considered "mature" due to the relatively stable and low level of growth of consumption; about 1% per year in 1987–97. Low levels of growth of consumption have led roasters and retailers to invest in product innovation and segmentation in order to increase added value and also in efforts to "cultivate" markets where the potential for growth of consumption is most promising— especially Eastern Europe and the traditionally tea-drinking countries of Asia (Ponte, 2002). The emergence of new consumption patterns, with the growing importance of "conscious" consumption, single origin coffees, the proliferation of café chains and specialty shops, and increasing out of home consumption poses new challenges to "traditional" roasters.

Special Gourmet coffees have resisted the crisis better. These coffees are known for characteristics such as taste, production processes, marketing conditions or origin. These special characteristics correspond to the demands of specific coffee roasters and consumers, so can be sold for higher prices. That in turn means the producers receive a higher price for their crop (Gerz & Avelino, 2006).

The evolution of specialty coffee cannot be appreciated without making a reference to the "Starbucks factor." Starbucks was founded in 1971 in Seattle, following the steps of Peet's, another quality roaster based in Berkeley. As other specialty operators, Starbucks spent most of the 1980s building a loyal customer base and "educating" consumers on the qualities of fine coffees. The breakthrough that made Starbucks a stunning success was creating a "café" atmosphere where customers could hang out and consume an "experience" at a place that was neither home nor work. The "Starbucks phenomenon" may have revitalized interest for coffee in consuming countries and new (higher added value) ways of consuming it. Still, it is unclear whether specialty coffee will be successful in permanently de-commoditizing coffee and in breaking the oligopoly held by a few roasting companies (Ponte, 2002).

Other innovation in process have had influence in international trade: The new technique of steam-cleaning Robusta allows roasters to improve its quality and to substitute poorer Arabicas with premium grade Robustas, this have allow some countries as México, to increase its sales (Ponte, 2002).

Costa Rica, has over time built a strong reputation in the world coffee market. Coffee runs through Costa Rica's history, culture and economy. Production began at the end of the 18th century in the Central Valley (Meseta Central), an area with almost perfect soil and climate conditions for coffee growing. The coffee varieties introduced to Costa Rica was 'Arabica'. The coffee trade has received strong support from successive governments, and coffee was long Costa Rica's economic mainstay and main export, a position it maintained until recently. By this reason, it was established in 1937, through law, the Coffee Institute (ICAFFE). This is a public non-state activity that promotes national coffee and establishes the relationship between producers, processors, and coffee exporters (ICAFFE, 2009). ICAFFE contributes to the development of the coffee-growing and agricultural diversification in the country, supports the complete process, and promotes coffee in Costa Rica and abroad. R&D are made through the Coffee Research Centre (CICAFFE) , founded by ICAFFE; results are transfer to producers and processor to a good system of technology transfer in coordination with MAG, including extension activities and publications (H. González, 2001).

Costa Rica is the sixth coffee exporter. The main export markets are the Japan, United States, UK, Germany and other European countries (Gerz & Avelino, 2006; MAG, 2007a). Over the past 6 years, the country has experienced a reduction in the coffee area. In 2008 more than 98000 ha of coffee are cultivated, yielding more than 100000 tonnes for 2008; 80%t of this is destined for export. Coffee accounts for 15% of the country's export earnings. The sector employs 5% of the country's workers, or 20% of the rural workforce (Arce et al., 2009; Gerz & Avelino, 2006; MAG, 2007d).

The Costa Rican coffee sector covers over 78,000 growers, 94 processing firms, 73 roasting companies, and 30 export firms. The growers are large, medium and small-scale farms, but small-scale farmers are dominant: 92% of growers have less than 5 ha of coffee. They market their produce either through cooperatives or individually (Gerz & Avelino, 2006; ICAFE, 2009).

Coffee processing firms buy the beans at competitive prices from special collection centers in the coffee-growing regions. They support growers through technical advisory services and credits. The processors must register with the Costa Rican Coffee Institute (ICAFE). Their profits are fixed by law at 9% of the profit from sales after deducting processing costs. The roasting sector, industrialized since 1920, is a consolidated industry. It plays a key role in the production chain, as it is strongly linked to other actors in chain, both upstream (processors) and downstream (traders, exporters). The 71 export firms, of which 70% are small, must also register with the Costa Rican Coffee Institute. Their profit is fixed by law at 2.5% of the transaction value (if the exporter buys the coffee and assumes the risk of market fluctuations), or 1.5% (if the exporter simply acts as middleman). Under these conditions, firms' profits are dependent on volume processed (Gerz & Avelino, 2006; ICAFE, 2009; Mosheim, 2002).

The minimum that must be paid to the coffee farmer is determined and published for each processing plant. As international coffee prices dropped after the dismantling ICA, the average price for coffee sold in the domestic market increased because of the liberalization of the internal coffee market and the increased consumption by Costa Ricans of higher quality coffee. However, this trend in the domestic market was not sufficient to prevent the decrease in farmers' average revenues (H. González, 2001).

As a result of the operation of a cooperative Program ICAFE-MAG the country managed to end of the 80s the world's highest productivity, measured in terms of coffee yields per hectare. This high productivity also contributed another number of factors such as agro-ecological conditions suitable for production, high degree of organization of the activity, the regulatory environment and the institutional support. The important thing is that it rises to the institutional system of the technological innovation imperative to produce a technological leap in primary production, in turn also achieved innovations in marketing and other chain associated with the processing and classification (Gerz & Avelino, 2006).

Costa Rican coffee sector has implemented a special program of "Differentiate coffee" since October 2002 to improve the quality, image and market position of Costa Rican coffee. The strategy is to reduce the coffee supply by withholding 5% of producers' lower quality coffee from the export market, thereby boosting consumption of higher quality coffee in traditional and emerging markets. Minimum grades and maximum moisture content are fixed for exports, eliminating the lower grades from the market. This program is conceived as a medium-term investment to raise prices for high-quality coffee in new market niches (Gerz & Avelino, 2006; MAG, 2007d).

One of the mechanisms currently being considered is the promotion of distinctive quality signs, such as a geographical indication. Several possibilities are under discussion. One is a nationwide geographical indication for quality Costa Rican coffee. This may be difficult, given the variety of agro-ecological conditions, processing techniques, knowhow, and product characteristics embodied in Costa Rica's coffee. This approach is being considered by a part of the private sector. It would have to be based on fairly broad qualitative rules, rather than tying it to a specific locality or production system (Gerz & Avelino, 2006).

Fair trade coffee is emerging slowly in Costa Rica. COOCAFE, the only certified fair-trade coffee cooperative in the country, represents 3,500 small coffee producers, grouped into nine independent cooperatives throughout the country. During the last 10 years, COOCAFE's sales through fair trade channels brought in premiums of over €5.9 million out of a total income of €33.6 million. Estate coffees are also being successfully developed in Costa Rica. These coffees are processed on the farm, promoting quality control and producers' participation in the reputation and added value of the end product. A similar approach at a micro regional level

might bring collective benefits to coffee growers (Gerz & Avelino, 2006; ICAFE, 2009). But globalization and free trade are challenging the competitive advantages which were built through state-regulated markets. The Central American Free Trade Agreement with the United States contradicts the government's ban on the imports and sale of foreign coffee into Costa Rica. Foreign coffees and multinational firms are entering the national market, forcing Costa Rica's coffee sector to seek new strategies to sustain the country's good practices, its reputation and premium prices (Gerz & Avelino, 2006) (ICAFE, 2009).

For this case one interview was made to a company that is very innovative in the coffee sector and now is reaching into other sectors. It began as a Roaster Coffee company. I was created in 1985, is a large company with 800 employees (595 at professional level). According to its general manager the competitive advantages of the company are proactive team (there is a policy of promotion for proactive people), culture of learning from good practices, open organization, risk tacking attitude, quality, innovation and dynamism. To be more competitive they need more fluidity and define mechanisms to reduce dependence of financial market. The company built an innovation culture with daily meetings and a strategic system; into this culture important factors are: human environment, tolerance to make mistakes, successful enterprise culture, "company concept" (the way to make things). One important weakness of the company is the lag in knowledge protection.

Important examples of innovation of this company have to be mention:

- Their brand coffee had created the specialty market segment in the Costa Rican domestic coffee market when it was introduced in 1983 as the first high-quality coffee available to the Costa Rican consumer. Traditionally, most Costa Rican coffee had been exported, leaving only a small quantity for domestic consumption. There were five grades given to coffee by millers based on appearance and density of the beans. The top three grades were generally exported, and the Costa Rican consumer ended up with coffee from the bottom two grades and remnants of the third grade. As a result, ground coffee that was sold in Costa Rican supermarkets had 12% sugar mixed into the grind to improve the taste. The domestic marketing system required that the beans to be used for the domestic market be delivered to ICAFE so they could be dyed and made unexportable. This was the way, therefore, that domestic consumers came to expect and enjoy their coffee. Costa Ricans believed that good coffee "stained like ink" and was sweet (Brenes, Bolanos, Burciaga, Jimeno, & Salas, 1997). The new coffee was immediately accepted by consumer and the habits of the Costa Rican consumer began to change. The new coffee was distributed domestically through supermarkets and food stores, tourist shops, hotels, and restaurants.
- In 1991, while continuing the search for a differentiation strategy that would open export markets, the company introduce the "Coffee Tour" for foreign tourists to Costa Rica as a means of penetrating the international market. Tourist activities were initiated by the Gourmet Travel Agency. A bilingual (English-Spanish) tour was offered on the grounds of company's main production facilities, led by actors dressed in traditional Costa Rican coffee farming garments, and it included one of Care company's coffee farms and the company's production facilities. The tour also included a slide presentation on coffee history in Costa Rica and an opportunity for participants to taste and buy coffee and other products. Tour facilities included modern rest rooms, lookout points with impressive panoramic views of the Central Valley volcanoes, ample parking space, transportation, and credit cards accepted as payment for the tour and the company's products (Brenes *et al.*, 1997). In addition they open stands at Costa Rican International Airport that promoted Cafe Britt to arriving and departing tourists.
- Nowadays the company is a specialty travel retailer with over 50 stores in 5 countries that owns and manufactures its key brands in premium coffees, chocolates and specialty items, designs most of its products, and integrates its physical and web-channels. They have coffee and chocolates production facilities in Costa Rica, Peru, Curacao, Chile and Florida. For

each Country they developed special stores for tourist and design special products as chocolates with original fruits.

- Last year the company develop more than 100 new products

Important findings of this case:

1. Considering the characteristics of the sector, stable market with low growth, and crisis, all different actors have to innovate to survive. Innovations are presented in the different steps of the chain, agriculture, processing, new products, new ways of commercialization and new markets.
2. The institutional support, specially through ICAFE, have permit the sector to be organized to develop competitive advantages as a Country: quality, special coffees are examples.
3. The case of the Company shows and example of a “innovative-firm” in a sector with low dynamic and classified as “low-tech”.
4. Domestic consumers could be an interesting market segment for “exportation high quality products”. Generally the low quality or rejected product is designated to the domestic market.

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