

Approximation to the study of the agricultural production chain of the Andean region: Case of Tungurahua Province

Teneda Willian, Santamaría-Díaz Edwin, Santamaría-Freire Edwin

Abstract— The present research is carried out in the province of Tungurahua, which analyzes the crops that are developed in the area. The crops include potatoes and fruits, fruits such as blackberry, strawberry, plum, tangerine, and avocado. By carrying out the appropriate analysis it is possible to confirm that the environmental dimension cannot be separated from the economic, social, cultural, political and territorial dimensions. The relationships among them determine the environmental sustainability of the territories. Fruit crops demand manual labor, which generates employment and makes producers and workers benefit one from the other. In addition, there are other activities such as intermediation, transportation, agrochemicals marketing, basket making, yarn, which indirectly also benefit from this productive work. Farmers in the Province of Tungurahua have been concerned about increasing agricultural productivity without sacrificing quality. Although their efforts are limited when prices in the market are low since they are determined by supply-demand.

Index Terms— agricultural, Andean region, chain, production, characterization, Tungurahua, agrifood, agricultural production

1 INTRODUCTION

SEVERAL countries have established mechanisms and public policies to guaranty enough food supply for the consumption in the country, especially to ensure the quality of the final product. Among them, the National Plan for Good Living in Ecuador, indicates that the agricultural strategy is focused on promoting the specialization of agricultural production and this consists of preparing and training the producers to increase a limited number of products in this case agricultural varieties [1]

It must be pointed out the difference between developing and using models to achieve a diversified agriculture, depending on the ecological and socio-economic conditions of the place [2]. Generally, indigenous producers have deep knowledge of their local ecosystems, as well as the practices required for their proper management. Currently, the large presence of peasants in fragile ecosystems raises the need to prioritize attention to these sites to conserve these ecosystems [3].

Within the Agricultural Strategy of the province, a baseline of products such as blackberry, strawberry, potato and agro ecological vegetables was established. In addition to the boost to agricultural production, part of the productive strategies is focused on clean production that can be explained as follows: Cleaner production is a company-specific, preventive and environmental protection initiative, which intends to minimize waste and emissions and maximize the manufacture of products [4]. The Food and Agriculture Organization of the United Nations (FAO) reports that 90% of tropical fruits are produced

in developing countries.

However, the evaluation of international trade of these fruits is difficult to quantify at present. What is clear to the international body is that tropical fruit production contributes to employment, increase farmers' incomes, food security and reduce poverty levels [5].

The products that are developed in diverse geographies have the capacity to generate greater economic income, benefiting the farmers and to the local and regional development. [6]. In addition, it helps to transform nearby sectors where the wealth in the soil is used to potentiate these products. [7]

1.1 Agroindustrial Chains

Agribusiness refers to the series of manufacturing activities through which raw materials and intermediate products derived from the agricultural sector are produced. Food industries are much more homogenous and easier to classify than non-food industries, since all their products have the same end use. [1]. The agroindustrial chains are continuous and discontinuous flows of products, processes and aggregation of values, which follow the primary products until reaching the final consumer [8].

The agribusiness is a set of pieces in balance, from the phase of agricultural production itself, through post-harvest processing, domestic and international processing and marketing, along the route that goes through the products of the field to the consumer.

1.2 Classification of agroindustries

Agro-industries can be classified according to the destination of their products: 1) Oriented to the domestic market: basic products and non-basic products. And, 2) Export oriented: traditional products and non-traditional products. [9]

Agribusiness is complex, since there are many variables that permanently influence the company's success, from the pro-

- Teneda, Willian master in business administration, Universidad Técnica de Ambato, University professor, Universidad Técnica de Ambato, Ecuador, cód. 180208, e-mail: wof.teneda@uta.edu.ec
- Santamaría Díaz, Edwin, Master in agroindustrial production management, University professor, Universidad Técnica de Ambato, Ecuador, cód. 180208, e-mail: ec.santamaria@uta.edu.ec
- Santamaría Freire, Edwin, Master in statistics, University professor, Universidad Técnica de Ambato, Ecuador, cód. 180208, e-mail: edwinjsantamaria@uta.edu.ec

duction process (pre-harvesting) to harvesting, post-harvest processing, packaging, refrigerated transport and storage, and quality controls in Different stages of the distribution [8].

The agro-industrial chain is based on a set of interactive components that add value and are strengthened by associativity, which is a cooperation mechanism between companies, mainly small and medium enterprises that develop joint efforts with other participants, in order to achieve long-term international competitiveness in the agro-industrial field. [10]. A gro-industrial chains involve continuous and discontinuous flows of products, processes and aggregation of values and are units of analysis for decision-making at the political level and for technological development.

From the chains can be formed sectoral or geographical concentrations of companies, which have their performance in the same activities or in closely related activities, which are integrated and cooperate associatively, both backwards suppliers of equipment and inputs, and forward and Sides, processing industries and users, as well as closely related services and activities. [11]

1.3 Productive chain

The productive chain involves a number of interconnected stages, through the union between production, transformation and consumption. This dimension implies that we consider the different production processes and economic relations that occur between the initial supply and the final demand. [12]. The clusters represent a unit for the analysis of the intermediate competition between the company and the industry, which have an intangible importance in the business environment of a locality, beyond the collection of taxes, costs of services or wages. [13] The analysis of the chain allows prioritizing the material and human resources necessary for planting, care and harvesting of plantations and other processes, which aims to make agricultural activity efficient [14].

The productive chain is a subsystem of the agricultural business, whose set of interactive components includes production systems, input and service providers, processing industries, distribution, storage and marketing agents and final consumers, [15] It can be interpreted as part of the agri-food system, understood as an economic and social reality, constituted by a set of actors and activities that interact and interrelate to meet the needs of specific markets. [16]. that can be summarized as a system constituted by interrelated actors and by a succession of operations of production, transformation and commercialization of a product [17]. Being formed by the interaction in harmony between diverse participants, directly or indirectly, in the production of product and service from production to the consumer. [11]. That is, there is a relationship between different elements that add value during the various stages.

The productive chains have made a positive contribution to territorial economic development in rural areas, [18] understood this development as the improvement of the living conditions of the population, [19] Based on more equitable access to opportunities, resources, means of production and power.

The critical factors of the productive chain are: a. Critical factor is any variable (or set of variables or structures) that affects the performance of a system, in a positive and negative way and in a relevant way. b. The driving and restrictive forces are

defined as variables (or set of variables or structures) that influence each critical factor to performance, either positively (driving forces) or negatively (restrictive forces) [20]. Indirect actors, provide a support service to direct actors: suppliers of inputs or services. [17].

The agricultural sector has an economic structure based on agricultural products typical of the region where they harvest healthy food for health such as vegetables, vegetables, milk, eggs, meat, boosting agriculture and increasing the economic income for the families engaged in this activity of the sector. [21]

By carrying out the appropriate analysis it is possible to confirm that the environmental dimension cannot be separated from the economic, social, cultural, political and territorial dimensions. The relationships among them determine the environmental sustainability of the territories. Productive chains of fruit and vegetables, demand manual labor, generating employment, turning producers and workers as direct beneficiaries of crops [22]. The systemic understanding of the relationships of actors involved in the process that a product follows. In the context of a world economy, with an increasing complexity in the circuits of agri-food production, this understanding is relevant because so the different actors interested in successfully placing the product in the market, can detect problems, bottlenecks or factors Critics who block certain links in the chain. [23]

The analysis of a productive chain is an exercise that seeks to know and understand the state and functioning of the productive chain. It identifies the critical points that detract from the competitiveness of the chain and the competitive advantages that help the development of the chain. This analysis exercise should also allow the recognition and visualization of the main barriers to participation and access gaps to opportunities and resources that exist in the chains. [17]

2 METHODOLOGY

The research methodology to be applied in this project is the inductive method together with the deductive method, because we start from a series of data that can give a more general conception of the subject investigated and vice versa, obviously from the data or the information that concerns the subject research.

Following a descriptive approach and exploratory analysis, according to the objectives of the research, a sample design is carried out where the geographical area is divided by: representative fruit products of each canton (six groups) as well a) Potato and sweet tomato in the cantons Mocha and Pelileo b) Strawberry in the canton Cevallos; c) blackberry and potato in the canton Tisaleo; d) Tangerine and avocado in Patate, e) Plum in the canton Ambato, f) strawberry in the canton Tisaleo.

The population is calculated based on the information existing in the INEC by each canton, of which is taken the Economically Active Population (EAP), particularly the rural EAP. With this, the sample is calculated considering an error of 5% and 95% confidence level, which shows more than 1000 farmers participating in the study, whose detail by canton is referenced in the results.

As source of primary information we find the producers of the fruits chosen in each canton. The information is going to be obtained through surveys. In addition, the study is supported on previous research, data collection applied to farmers previously in similar studies.

Finally, in this method "is to analyze the particular in this case the concept ..., from the general"[25]. For the development of the research will be used empirical techniques as the analysis of documents and studies of the various cases by which the associations of producers are currently going. The information is analyzed using Descriptive Statistics.

2.2 Fruit orchards in Tungurahua

The province of Tungurahua is known mainly for agriculture, where families base their economy on agricultural products of the region where they harvest healthy food such as mulberry, strawberry, tangerine, avocados, vegetables, milk, eggs, meat, boosting agriculture and increasing the economic income for the families that are engaged in this activity of the sector. [21] In Ambato, the branch: Agriculture, livestock, forestry and fishing, has 18.9% of the employed population, is the third work activity. [26]

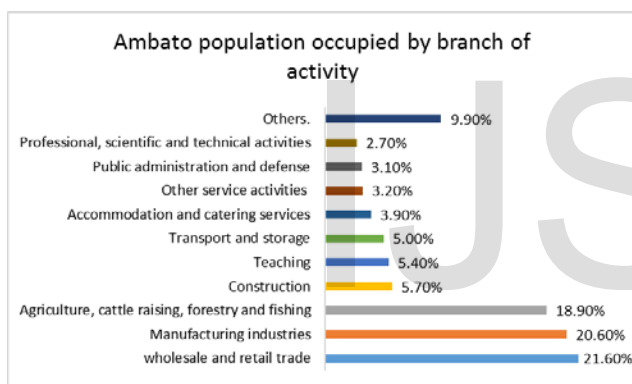


Figure 1. Occupied Population by Branch of Activity. Source: Inec - Population and Housing Census 2010.

Therefore, in order to revive fruit orchards in the Cevallos, Mocha, Tisaleo and Montalvo parishes of the canton of Ambato, the Rural Good Rural Living Program of the Ministry of Agriculture, Livestock, Aquaculture and Fisheries has been implemented [27].

Growing potatoes (*Solanum tuberosum*) in Ecuador is traditional in the inter-Andean region and constitutes one of the basic products in the diet of Ecuadorians. Throughout the potato chain, an estimated 250,000 people are involved, linked to the direct and indirect activities of the crop. As a result, this activity occupies 5.2% of the agricultural EAP and 0.4% of the total EA [28].

The cultivation of blackberry is an activity that demands manual labor, generating employment, making producers and workers as direct beneficiaries, but in addition there are other activities such as intermediation, transportation, marketing of agrochemicals, making baskets, yarn, which indirectly also benefit from this productive activity. [31]

Tangerine (*Citrus nobilis*) has its origin in the tropical zones of the Asian continent, belongs to the group of the hesperidias

and its pulpa is formed by several portions full of juice that contain great amount of vitamin C. [29] The chain of producers of the economy is based on the primary sector in the different products of the economy that distinguishes productive tasks from the source and obtaining of raw materials, "such as agriculture, livestock, aquaculture, fishing, mining, forestry and Logging. "[30]

3 RESULTS

3.1 Study of potato production chains (*solanum tuberosum*) and sweet tomato (*solanum betaceum*) in the social development of the cantons Mocha and Pelileo.

The actors are identified, the links of the productive chain of potato and sweet tomato and their respective characterization. The information is obtained from 212 producers in the cantons Pelileo and Mocha.

63% of men work in the agricultural field and women participate in 37%. None of them belong to an association, that is, they are self-employed.

34.43% produce the superchola variety and 12.74% produce other varieties such as papa pucza, gabriela and semichola.

44.34% give their production to the market 1 to 2 times a week, the other farmers or producers make 1 to 3 times a month, 17.92% men. This is mainly due to the interval in culture time, which can vary between 150 and 180 days.

35% get an average harvest of 10 to 15 sacks per plot or lot and 19% harvest from 15 to 20 sacks generating from \$ 600 to \$ 1000 per large plot and from \$ 200 to \$ 600 per small plot.

Whose price is negotiated directly with the intermediary. 58.02% indicate that the potato is destined to the wholesale market.

The climatological and agrochemical benefits based on the production sectors and the information provided by the respondents have resulted in the production of all the months of the year according to 51.89% of respondents.

3.2 Socio-economic study of the chain of strawberry farmers in the canton Cevallos.

In an analysis of the current situation of strawberry farmers in the canton and the identification of collection centers, it is possible to determine the socioeconomic impact of agriculture in the canton. For this is considered 190 farmers.

The production of strawberry is in the months of October to December, whose demand increases by the festivities of end of year. Followed from July to September. Of which they benefit from this activity within the family, from 0 to 1, 49%, from 2 to 6 29%. Being the 91% of work without an association that potentiates its commercialization.

The monthly value per person that is perceived of this activity is from \$ 80 to \$ 100, 65%, followed by \$ 100 to \$ 250, 25%. With monthly production ranging from 1 to 50 boxes, 48%, from 51 to 100 cases 31%. Approximately 30% of the production is large size strawberry, 31% medium and 39% small

strawberry. The majority of strawberry farmers are traded in the wholesale market of the city of Ambato 93%, and a small part in their canton 5%.

The 93% of respondents assure to have an income equal to or superior to the basic remuneration like effect of the cultivation of strawberry. In addition, 75% of farmers perform strawberry planting on leased land.

3.3 Study of the products *rubus fruticosus* (blackberry), *solanum tuberosum* (potatoes) and its productive value in the canton Tisaleo.

The canton Tisaleo has a fertile soil which allows the production of these products. In the sector is produced a number of agricultural products but the most prominent are potato and blackberry. Where, it is desired to determine the volume of production in the income received by the blackberry and potato, considering 97 growers of blackberry and 106 of potato.

The percentage of male gender that helps in the harvest is 44.3% while 55.7% is the female gender. 71.1% indicated that the economic contribution provided by the blackberry is high since there are fairs in the sector that are well known by the province and 28% mention that the contribution is medium.

The highest production is obtained between September and December, with cultivated areas between 4 and 7 blocks, with production from 1 to 20 baskets per month, 35%, 44% from 21 to 31 baskets and 40% from 31 to 40 baskets. Being its sale 56% in Ambato, 42% Quito through intermediaries.

69.1% indicated they sell the Mora de Castilla as it is more commercial and known for its taste and texture by buyers and 30.9% sells the Mora de Castilla without spines.

56.7% indicated that their income covers their basic needs, 43.3% do not manage to cover their basic needs since they are engaged in other types of crops.

Potato

99.4% of the respondents indicated that the economic contribution provided by the potato is between High and Medium. With 20.8% of monthly production is 1 to 10 sacks, 42.5% is 11 to 20 quintals and 36.8% is 21 to 31 sacks

47.2% indicated they sell the super chola potato, 28.3% sell the chola. 8.5% sell fripapa and 16% Cecilia. 23.6% are men in production and 76.4% are women.

58.5% market in Ambato, 39.6% go to Quito; 94.3% directed to wholesalers and 2.8% to supermarkets. 76.4% of producers sell at a price of 5 to 10 dollars and 23.6% between 11 and 20 dollars.

3.4 Study of the potential of the chain of agricultural producers of mandarin and avocado in the Patate canton.

To gather information on the economic and agricultural growth of the mandarin and avocado farmers, 347 producers of mandarin and 347 of avocado are part of the sample.

Tangerine

According to the surveys applied to farmers we can say that 44% said that their highest production is from July to September, 35% from January to March, 15% from April to June,

and 3% from October to December. 76% cultures from three to four blocks. Throwing 42% of production over 226 boxes, 32% from 151 to 225 cases, 18% from 76 to 150, 7% from 1 to 75 cases per month.

The producers classify the crop by its size, in six categories, being the biggest of first category and the smallest of sixth. As for the workers in this sector, 81% need between 6 and 10 people to produce mandarin, 17% from 1 to 5 people and 2% need from 11 to 15 people.

Most of the fruit (91%) is marketed in the wholesale markets of the province of Tungurahua, 9% of it is sold in the Canton market, at prices ranging from 5 to 8 dollars the first categories and from 1 to 4 Dollars the smaller categories, which also depends on the time of year. As for the gender that is dedicated to this activity, 54% women and 46% men.

Avocado

According to the data we can say that greater production of avocado occurs in the period from January to March with 28, 81% and in July to September 23.05% where men and women agree with the information. In the canton Patate, they produce from 1 to 50 cases per month 43.23% and from 51 to 100 cases with 25, 94%.

According to 34.58%, the avocado box price is 1 to 2 dollars, 43.23% from 2 to 4 dollars and from 5 to 6 dollars to 22.19%.

According to size classification.

Monthly avocado production is 1 to 15 boxes equivalent to 23.05% and 16 to 30 boxes is 36.89% and 31 to 45 boxes represents 21.61%. This represents the monthly amount of the production of avocado. The fruit of the second category, the monthly production of avocado 1-15 boxes is 37.46% from 16 to 30 which represents 25.07% and from 31 to 45 is 20, 17%.

The varieties that are grown in the Patate canton are: Hass 33.72% and Zutano 43.23%, Bacon is 23.05%. The fruit growers because of its greater resistance to the different pests and its fast coupling to the climatic conditions prefer Zutano.

Regarding the need for staff to grow and harvest avocado, 69.16% of those require between 1 and 5 employees, between 6 and 10 employees, 19.31% and between 11 and 15 employees, 11.53%. Their sowings are between 1 to 2 stonemasons 34.58% and in 3 to 4 stonemasons 42.37%, 5 to 6 stonemasons 23.05% ..

The commercialization of the fruit is carried out more frequently in the Wholesale Markets 40%, market of the canton 48.12%, stores 11.52%. Small farmers have received training in avocado production on the following topics: Improvement of the plant with 47.83%, improvement of productivity 27, 10% and pest control 25.07%.

3.6 Study of the potential in the agroindustrial chain of the plum fruit in the Canton Ambato.

The growth of the production of the plum in its agroindustrial chain, leads to analyze the associations, taking the study to 115 fruit growers.

85% produce between 10 and 25 boxes of 8 kilos and 15% between 26 and 50 boxes, being 93% in the months of December to March. That coincides with the production of 87% of pears, 9% apples and 4% with strawberries. This crop is carried by women in 83% of cases. Which are marketed through

wholesale market.

92% have between 1 and 2 hectares of land 7% between 3 and 4 hectares, 80% produce the Nelly variety and 20% Mango or shiro. With weekly sales 80% of cases, 9% biweekly and 6% daily. In addition, 52% of them produce more pears, 35% produce more plums and 13% produce more apples.

3.7 Study of the potential of the production of certified strawberry (strawberry) in the canton Tisaleo.

The strawberry varieties that are most cultivated in Tisaleo are: Diamante 84%, Albion 13% and Camino Real 3%. For this, 136 surveys are analyzed.

The largest concentration of strawberry production in Tisaleo is located in the sector of San Luis and San Juan with 28% and 25%, and at the same time we can see that in Quinchicoto and Santa Lucia la Libertad there is a lower concentration of production with 2% and 3% respectively.

Of those engaged in strawberry production, women occupy an important percentage, 77%, and 23% are men. It is presumed that it is because in the rural sector women are the ones who are mostly engaged in the tasks of the field and men work outside the home.

46% of the surveyed producers have sown between 1000 and 2000 m² and only 7% have crops between 4000 and 5000 m². 67% of producers harvest only once per week and 33% do so twice a week. In a strawberry crop must be harvested at least once a week because as soon as the plant produces the fruits it is necessary that it is harvested or these begin to be damaged, for that reason they harvest at least once a week.

56% of fruit growers perform pruning monthly, 33% fortnightly and 11% weekly. In terms of production, the fruit harvested is classified by its size, in five categories, most producers produce more than 5 to 10 buckets of each category. Whose sale is through wholesale market.

It is important to note that about 51% of the respondents use agrochemicals in their crops on a fortnightly basis and 15% do so on a monthly basis. Strawberry is a crop that requires a large number of agrochemicals, which is why at least they should use this type of products on a fortnightly basis. Of this, 64% are not aware of cleaner production alternatives.

The agricultural sector has participation of institutions and associations, 37% visited on a quarterly basis, and only 3% is visited weekly. The frequency of visits depends on the logistics of each institution and that the producer is immersed in some program according to information provided by producers and some public institutions.

Table 1
Distribution of producers by gender

Canton	Female	%	Male	%	TOTAL
Mocha	44	40	66	60	110
Pelileo	40	38	66	62	106
Tisaleo	54	56	43	44	97
Patate	264	70	112	30	376
Ambato	115	50	115	50	230
Tisaleo	105	77	31	23	136
Total	622	59	433	41	1055

3.8 Economic impact of agriculture

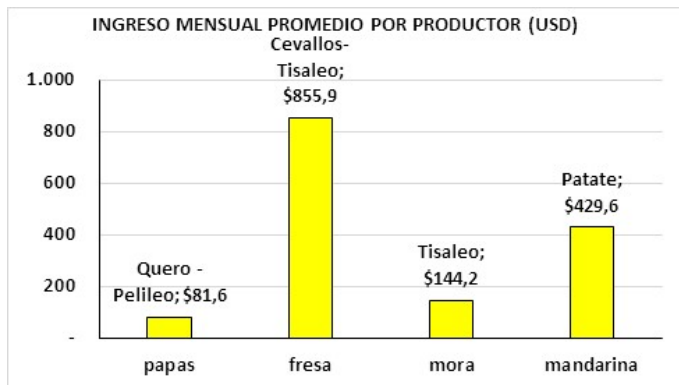


Figura 3. Ingreso mensual promedio por productor (USD). Fuente: Investigadores

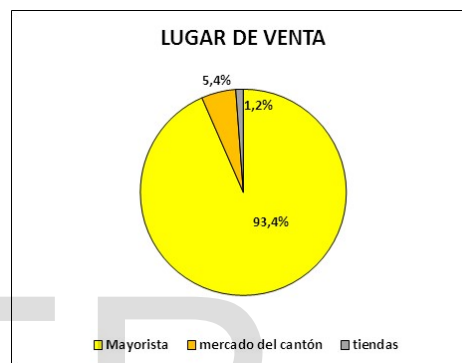


Figura 5. Lugar de venta. Fuente: Investigadores

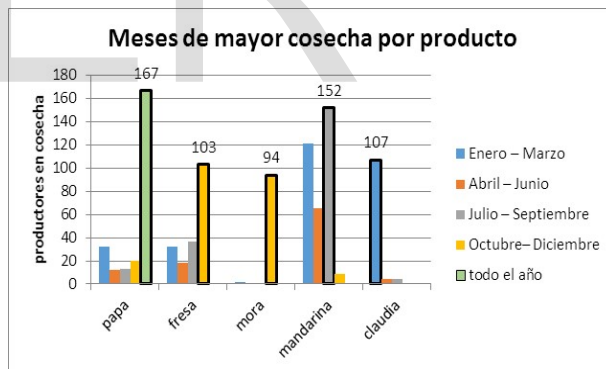


Figura 6. Meses de mayor cosecha por producto. Fuente: Investigadores

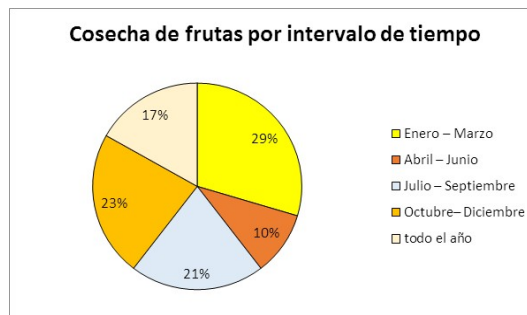


Figura 7. Cosecha de frutos por intervalo de tiempo. Fuente: Investigadores

4 CONCLUSION

The economic dynamics of the rural sector is based mainly on agricultural activities, on average 85% of the inhabitants are engaged in this activity as a means of support for the economy of their family.

The complexity of strawberry cultivation lies in the use of chemicals that must be properly managed, but they are vital to obtain a more suitable product for the market.

The four public institutions that provide support to producers, among them we can find the MAGAP, UCALT, Agro Quality and finally the Provincial Government. The latter is the one that performs a greater support management according to the respondents and this is due in large part to the agreements made between the Provincial Government and the municipal GADs throughout the province.

Farmers do not know the potential of each fruit within the agribusiness chains that exist in the canton Ambato, being the main destination the sale of classified product to the wholesale market to intermediaries. The province of Tungurahua in agriculture has grown by 20% for a good management and use of the technology these in the years 1996 to 2012.

The associations have been strengthened with the help of MAGAP who provide trainings and help manage agriculture in a technical way; this entity has also contributed with fruit plants to the farmers so that their production is in large quantities thus achieving good rural living.

Farmers to improve their finances use mixed and cross production, thanks to their fertile lands also are dedicated to the production of sweet tomato, kidney tomato, maize, beans, among others which help the subsistence of farmers each of sectors.

The productive chain is made up of social segments, the possible actors and the different links that characterize the productive chain, obtaining as results the application in each information search for suitable information to obtain coherent results that allow us to cover each of the indices to be investigated including Suppliers of inputs, producers of tubers, marketing segment, price and the link of final consumers.

Fruits in the cantons are produced all year round, as long as it is differentiated by frequency cycles to allow harvesting at different stages and thus to be released to the market without accumulating production that is damaged.

Farmers use their own resources, since one of the main problems is the lack of credit and low economic resources, which makes it difficult for them to expand their crops. The data indicate that the lack of economic resources is one of the main problems in the area of production.

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