

**Production of Tropical
Products in the
Chapare**

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EXECUTIVE SUMMARY

A fifteen-day visit to the tropical region of the Chapare in Cochabamba, Bolivia, had the objective of evaluating the different quality aspects and handling of the post harvest of the banana, pineapple, passion fruit, pepper and the pejibaye palmheart. During this visit, different growers' associations, private enterprises, individual farmers, and the Bolivian Technological Farming Institute IBTA / Chapare, which is the existing infrastructure in the area, were visited. The coordination was handled by the assigned personnel of the CONCADE project and the IBTA / Chapare personnel.

During the visits to the fields and the grower's associations we were able to verify that the majority of the crops are spread throughout the area without any agricultural zoning consideration, such as the type of soil, rain, or any other criteria. The majority of the farms have very small parcels for farming. Therefore, the less profitable crops or those with marketing problems are being abandoned; those are the specific cases of the palm heart and the Cayena Lisa pineapple for export.

Due to the scattered offers, great variety in quality, and the lack of production plans, the storing of the fresh produce ready to be processed or sold turns out to be an expensive and slow process; therefore, the quality of the produce is in danger.

We were able to observe multiple deficiencies in the production process, such as: lack of fertilization, pest control, and nonexistent or incomplete diseases, very little handling of plantations in terms of pruning, weeding, handling of shade, handling of growing cycles, and plant populations, etc. In general, because of this, the quality of the majority of the products is poor and extremely varied. This situation obstructs all efforts of finding exporting markets.

In terms of the handling of the post harvest, the system of scattered production and the lack of training of the farmers and most of the technicians contribute to the

deterioration of the quality. The few implemented practices do not have the necessary work discipline to be able to be effective. On the other hand, although there is the adequate infrastructure for the handling of many products, they are faced with many supply problems which obstruct their regular performance. The most evident is the lack of water supplies of an acceptable quality for the packing and / or processing.

Given that the production, at this moment, is the main restriction to the development of the local and export markets, we suggest that groups of farmers or neighbors join a common enterprise which, with the appropriate technology, would allow them to improve their performance and the quality of their products. In a second phase, they would have to regulate the process of the handling of the post harvest of individual growers. This system would seem to be more advanced in the banana cultivation, where there are strong associations which are joined with an exporting group and the results for both sides seem satisfactory.

We include in this report a review of the observed problems, short and long-term actions to be taken and suggestions to improve the organization of the production in order to obtain a more competitive quality.

Throughout this work we examine the role of IBTA as a research organization for the area, and we propose some organizational options in order to improve the transfer of technology and assure the economic sustainability of the crops and agro-industries of the area, where the private enterprises must play a prevailing role in the agricultural development of the Chapare.

INTRODUCCION

The elimination of the production of the coca leaf in the tropics of Cochabamba, known as the Chapare, has allowed for the introduction of some programs of eradication and the development of activities leading to the founding of a substituting economy for the production of the coca leaf and its illicit by-products. These programs are not only strongly influenced by political factors, but also by technical decisions which, in one way or another, determine the course and the rate of the development of the Chapare area.

The political pressures and the need of promoting an alternative economic development for the former coca growers, led to the dissemination of crops into hundreds and thousands of farmers who have received seeding material and some support to establish small areas throughout the region. As a development strategy, this has proven to have serious limitations for the undertaking of exporting projects, industrialization and the improvement of the quality of life of the farmers of the area. The alternative development plans did not consider, as a priority, the economic sustainability and the social efforts of production.

On the other hand, the characteristics of the grower who is established in the Chapare, who is a former coca grower, used to little effort, high income, and a reliable market, who also comes from the valleys and the altiplano, and in many cases, from mining areas with no agricultural tradition, with limited adaptation (physical and cultural) to those tropical characteristics, make him a little receptive to these changes and, in many cases, he opposes openly to the substitution of the coca leaf and the alternative development.

Both aspects together: the alternative development plans, whose main objective were to eradicate the coca leaf, but not the economic growth, and the farmers who are a little receptive to these changes, become the reason why the real economic growth of the Chapare area is below the real expectations of the farmers and the institutions.

In this new and apparently last-support phase of the United States government to the programs of eradication of the coca leaf and the alternative development, we pretend to consolidate the up-to-date achievement. For these reasons, we have established ambitious objectives and defined our evaluation parameters and our performance goals.

Although we have observed many problems in the area, there are inspiring tendencies in some areas that, if well guided, would help meet the objectives of the CONCADE program in the areas related to agricultural production and the commercialization of agricultural goods.

For each of the analyzed crops, we have tried to make a critical exercise from the perspective of production, handling of the post harvest, quality, and opportunities to improve technology, incorporating the extension and research aspects that could contribute to the goals of the CONCADE program.

Diagnosis of the Situation

BANANA

Field and quality situation

Most of the plantations are relatively small and spread apart. A great majority of them are not receiving the required attention in terms of fertilization, pruning of suckers, pest control, bagging of bunches, defloration, removal of floral pieces from the fingers, and age control of the clusters with the use of ribbons. Throughout the years, millions of plants have been distributed to different commercial cultivars, such as Dwarf Cavendish, Grand Naime, Valerie, and others; this being the reason why some farmers have a mixture of plots. The little attention that the plantations have received and the diversity of care, if there is any, make the quality of the commercial offer uneven.

Nonetheless, the farmers are organizing blocks with cableways and small, corporate packing facilities which allow a better management of the plantation, including the air application of chemicals. However, there is an offer of consolidation which could bring good results in a short term if there is still an attempt to export. Some of those blocks are found in areas (region 6) that have drainage problems, which in a banana growing country, would be considered fit for cultivation. However, because of the cultivation of this area and the flooding problems reported by the farmers, it is necessary to take care of the drainage problem through the construction of, at least, one drainage system that would minimize the low yields problems and the acceleration of the speed of the ripening process, if these plantations are destined to be exported.

At his moment, a great majority of the bananas that are produced by small farmers are being sold through the system of “chipas” to a middleman who picks the fruit from the roads leading to the farms. Sometimes this middleman must deal with the area

association, and this one, with the participation of a promoter, deals with volumes and prices, and guides the middleman towards the farmers who have harvested that day. The banana price greatly depends on the supply and demand of the final markets. However, it also varies according to the degree of technology used on the production of the banana. For instance, a banana proceeding from an unattended plantation, which usually produces hands with small and thin fingers, receives a lower price than those bananas proceeding from plantations with a certain degree of phytosanitary, bagging, and ribonning care; and the price can be even higher if a washed “chipa” is offered, which means banana bunches proceeding from plantations with some degree of care, previously washed, and having received an application of a fungicide solution (Benomyl), and an anti-latex agent (Alum).

Somehow this reflects the fact that the internal market is beginning to value the quality derived from the good handling of planting and the adequate treatment of the post harvest.

In spite of the efforts made by some of the communities, and the obvious improvements on the quality of the product when compared with plantings lacking any kind of attention, it is still evident that under the current circumstances, the competitiveness of the small banana growers of the Chapare, is still marginal in the international market and barely acceptable in the markets of the “Cono Sur.” This statement is based upon four basic facts:

1. The price of the storing of the product in sufficient quantities to be able to maintain an export market, if one could be opened is still high due to the spread-out of the offers.
2. The unevenness of the quality makes it extremely difficult to get credibility in the market, since the quality changes within the associations throughout the seasons of the year, etc.

3. The various shipping reports that have suffered a commercially-significant deterioration.
4. In the best of cases, the plantings lack the adequate fertilization, which causes low yields and eventually causes soil depletion.

In spite of this apparently difficult situation, some private enterprises in the area, particularly Chapare Export and Banabol, have been able to open markets that are fairly safe, and are being able to obtain acceptable qualities of bananas. However, they are able to do this through their own production of bananas on farms that receive complete attention, including the fertilization of the crops in the case of Banabol. Although the quality obtained by these enterprises could hardly compete with the quality obtained in Central America or Ecuador, its quality allows them to compete successfully in the Argentinian market compared to the Ecuatorian banana, which is considered to be of second quality in the European and the United States' markets.

The bananas produced by some of the associations who market their goods through the Andean Group, is originally of acceptable quality. However, a lot of work is needed in the fields to improve the uniformity or the quality and the productivity; also there are improvements in the packing shed installations as well as in the processes, which need to be implemented to increase the quality of the product, as long as these are exported to regional markets only.

There is a possibility that the cold southern winds, which enter the area sometime throughout the year, could cause damage to the fruit that is, at that moment, growing. If those winds last a long time and the average temperature is low, it is possible that the bananas might get damaged by the cold, and this could also cause a delay in the plants' growth. This situation could cause a lack of supply for periods of up to six months after the winds have ceased. The effects on the quality could vary from severe damage – due to the cold (chilling injury) to mild damages – such as the loss of brightness of the fruit.

However, even though everyone is aware of the problem, nobody has kept track of the real economic impact that this causes.

Infrastructure for the handling of the post harvest

There are some installations in the area that have been donated by production associations and UNABANA. In general, these are small packing sheds which are equipped with piles of de-handing and washing, and with fruit packing tables. These installations seem adequate, in terms of design and functionality. However, some of the ones that were observed were semi abandoned. Some of the associations' representatives mention that this situation is due to the lack of water and to the badly installed cableways, the lack of transportation to collect the fruit from the farmers, etc. In other cases, some of these installations are being used in bad conditions due to the lack of safe water and the adequate quality.

There are also fruit storing stations that have equipment for pre-cooling with a system of "humi-fresh" (forced humid air). These installations apparently have the capacity to store 5,000 boxes of bananas, and behind them, there is a packing shed for the process of banana production. Neither of these installations is being used as they should; this is a problem in terms of real production costs.

The exports through the Andean Group have not been as continuous as we would like them to be. However, it seems that in the short term the situation tends to improve and the farmers seem optimistic about the future of the bananas and their income.

The observed packing sheds have serious problems of water supply, therefore the water is not changes as frequently as it should. We observed accumulations of latex in the bottom of the pools which, when mixed with dirt and solid banana waste, make these pools an important source of infection for the fruit and it is also risky for the health of the employees, and consumers. It is evident that there is a lack of personnel training in the day to day work in the packing sheds; there is no work discipline, nor are the workers

aware that the produce could decay, and the supervisors of the Andean Group lack the training to be able to improve the quality of work.

Before sending their bananas to the national markets, farmers treat and wash the banana hands in plastic containers. Although the principle of washing and disinfecting the bananas in the farms is good for the national market, the sanitary conditions in which this is done are deficient, and do not substitute the fungicide and alum as frequently as it should, thus making the treatment uneven. The water resources that are being used are also contaminated or even worse than the ones being used in the packing sheds.

Current situation of the organizations

Although we have visited only a fraction of the growers' organizations of the area, it is evident that there are various limitations to undertake successfully the process of commercialization.

1. The majority of the associations seem to be artificial, which means that they have been created under the direct influence of the development programs operating in the areas, or by farmers that are trying to obtain assistance from those same programs. We did not observe the development of a sense of ownership on the part of the farmers, nor the establishment of common objectives and goals.
2. The excessive paternalism of the development programs, make the associations dependable on them. The growers' organizations cannot invest nor make minor repairs without the mentioned external help. In fact, the conversations reveal that the farmers consider that these development programs are responsible for giving them the necessary tools to operate their installations. This paternalism has not been favorable for the development of the organizations' own capacities.
3. The lack of group goals make them have a short-term vision, which obviously pretends to obtain high economic rewards for the short-term farmers. The price paid

to these farmers is quite a bit higher than the one paid in Central America and, obviously, higher than the one paid in Ecuador. This is not compatible with the banana business which, in general, has a low income per unit produced, since the real business lies in the efficiency and volume of the medium and long-term production. The only organizations where we saw a small improvement in this sense, are the ones belonging to the banana blocks in Region VI, where it is possible to observe a greater degree of identification with the process. These farmers have already invested in their own cableways and are paying for at least part of their technical assistance.

4. The lack of coherence as an association makes it difficult to think about production blocks that are **evenly** attended, which could offer a concentration of demands and an even quality of the products, so that they could think about export markets. Nonetheless, we were able to observe small improvements in this sense.
5. During the week of November 15 through the 21, the associations were not exporting, even though they had contracts with the exporter. The reasons that were given, were that the exporter did not have a reefer trailer in order to do so, that the market does not want Bolivian bananas, and that the buyer has not followed the contract. However, when asked if they could provide bananas for export, the answer was no – that there were not enough bananas, and that the packing sheds were not functioning. According to the associations, the exporter states that there is not enough volume of good-quality fruit to justify their export. However, during the week of November 22 through the 28, the associations of Region VI announced that they would begin packing bananas for the Andean Group during the week of November 29 through December 5, and now they seem very optimistic.

IDENTIFIED PROBLEMS

1. Uneven attention of the plantings. The most noticeable fact is that they are not being adequately fertilized; therefore the yields is based on the capacity of the native soil.

2. On those plantings which have received attention, the density of the sucker population and the handling of each production unit are deficient.
3. The bags used to cover the bunches are not impregnated with insecticide and the bunches seem considerably damaged.
4. The transportation of the bunches from areas where there is no cableways causes the fruit to have excessive mechanical damage.
5. Growers and exporters report the failure of exports due to the accelerated ripening of the fruit while being transported, its bursting and, in some cases, the rotting of the crowns. Banabol also reports some complaints regarding the quality and reduction of prices due to a chilling injury of the fruit that grew during the low-temperature months.
6. The drought of the area has considerably affected the plantations in the dryer areas causing considerable reductions of growth, poor foliage, and the burning of the fruit due to sun exposure, therefore affecting its quality.
7. Although there is information about the areas to be cultivated, based on the type of soil and precipitation, the banana is found throughout most of the Chapare region, with obvious deficiencies of growth in some regions, due to the poor drainage, drought, and inadequate soil.
8. Installations are deteriorated and need small investment to get rehabilitated and / or make them adequate. Poor water supply is especially noticeable.
9. After observing different associations' plantations, we were unable to observe any inarching of the plants, in other words, to provide additional support so that the plant will not lean due to the weight of the bunches nor the action of the wind.

Nonetheless, the Chapare Export and Banabol do inarch and they believe it is necessary to do so in some of the farmers' plantations. We were able to observe at least 10% of the plants leaning.

D. Short-term Actions

The only way to consolidate the banana exporting processes from Chapare is through the consolidation of production blocks that receive an even attention. Ideally these blocks should be of at least 50 hectares. This would allow the obtainment of enough boxes of quality and exportable fruit (based on the low yields of 1,250 boxes per year, per hectare) to be able to maintain a market. Based on the existing blocks, we suggest:

1. The administration and operation of these blocks should be centralized for all members of the association. Therefore, the organization should receive intense training on administration, control, records, and harvest practices which are compatible with a real banana industry. Ideally, they should have a full-time technician who would direct the operations and would be paid for the commercialization benefits, as well as a group of specialized consultant technicians at the company, which is something CONCADE plans to do.
2. It is necessary that these blocks be sowed with no more than one type of well-identified banana, such as Cavendish.
3. The installations should be restored for the handling of the fruit and, if possible, the cableway installation process should be consolidated. According to distribution parameters, this is something that is usually accepted in the banana industry (a bunch should not be carried by a worker for more than 75 meters). It is necessary to have a water pumping system that assures the abundant supply of water.
4. The water used in the packing sheds should be renewed constantly. We recommend that the water should be changed after three hours of work, or after 300 boxes, with

the idea of eliminating the dirt that gets accumulated and reduce contamination of the pathogens that cause the crowns to rot. Chlorine should be added to the water of the de-handing pools and the de-latexing tank, but it should be done with 100 ppm of active residual chlorine, and not with the 6 ppm which is being used now (6 ppm can make the clean water potable, but it will hardly be able to do so with the quality of water which is being obtained from wells and rivers. On the other hand, the necessary dosage to be able to control banana illnesses is substantially higher). One possibility is to be able to collect rain water to fill the pools. This water is usually much cleaner than that of the wells and rivers.

5. A special detergent should be added to the pool used for the de-latexing in order to facilitate its removal and the removal of other dirt. The one that is most commonly used in Central America has the chemical name of alkyl-aril-sodium sulfate, which is mixed with an anti-foaming substance. This product is the soapy base of many liquid detergents. In Central America its commercial name is BACTEROL –100 from the CEQSA company. However, there are probably other similar products which can be purchased locally.
6. A part of the reported problem of the bursted fingers is due to two factors:
 - a. The fruits that are being harvested are too full.
 - b. The plastic used in the box has none or very few holes. In this case, it is recommended that the plastic being used in the boxes should, at least, have a perforation of 10 mm of diameter for each are of 100 cm² and, if possible, reduce the degree of the cuts in one week.
7. The boxes being used for the transportation of the fruit come from Ecuador, and were originally designed for 18.5 kilos. These are being used to pack up to 22 kilos for the Argentinian market. This over packing must be causing a high incidence of damage to the produce. We recommend, since the market needs 22-kilos boxes, that the height of the boxes should be increased at least 2.5 centimeters and the ventilation

openings should be adjusted. Obviously, this would depend on the height of the trailer, and whether it is boarded or not.

8. Regular trucks are being used to transport the fruit from the small packing sheds to the central storing area. At least the boxes on top are being exposed to high temperatures, wind, dust, etc. These trucks should at least be covered with an awning and the boxes should be placed in a way that would allow the air to circulate.
9. The packing shed personnel hardly even know their job and the de-handing operations; the arrangement of the clusters is deficient as well as the way the boxes are packed. The personnel requires constant training. Ideally, at least one type of worker from each area should be brought from one of the packing sheds in Ecuador or Central America, so that they would work along with and train the Chapare workers until these are able to do their work well. The lack of some basic tools is also obvious among them; something should be done about the lack of curved knives, pallets or well-sharpened de-handing spoons, as well as the lack of equipment to measure the volume and weight needed to get the exact dosage of fungicides or other chemicals.
10. The use of Benlate (benomyl) should be eliminated, since this product is forbidden for its applications on the post harvest. It should be substituted with thiabendazole or imazalil.

Short and Medium-Term Research Actions

Technical Aspects

1. Fertilization programs for the banana should be established for the different types of soil in which the production blocks could be placed.

2. The growing patterns of the fruit should be reviewed according to the areas, and the age of the harvest should be adjusted according to the distance of the markets and the unexpected problems that could be faced during the process.
3. Experiments in order to substitute Benlate for an approved fungicide for bananas (Thiabendazole and / or Imazalil).
4. Tests for the use of a latex removal agent (detergent), which would allow the removal of latex and better the brightness of the fruit.
5. Packing tests, especially on the plastic that covers the boxes. It is possible that this material might be causing an excessive accumulation of humidity, which will lead to the bursting of the fruit being transported. It is recommended to work with a greater number of perforations per area.
6. Tests on the delaying of the ripening using ethylene absorbents, such as Potassium Permanganate ($KMnO_4$), over a porous base (clay, silica gel, etc.). (Retarder, España; Ethysorb, England, Ethykiller, United States), given that in some areas the drought or flooding problems can speed up the ripening process. On the other hand, the land transportation to Argentina is experimenting unexpected delays, which could cause problems in the ripening of the fruit.
7. The establishment of a simulated transportation system and quality monitoring for each shipping that comes from packing sheds, which are supervised by the project with the objective of detecting problems, and coming up with adequate solutions.
8. It is necessary to establish an extension of the problems that are caused by the southern cold winds in aspects such as growth reduction, damage to the quality of the fruit, etc. for the most important varieties in the different areas.

9. It is necessary to have a monitoring study of the mushrooms found in the water of the pools at the banana packing sheds, which cause illnesses to the post harvest. Changes need to be made on the substitution of the water and the use of chlorine, based on this information.
10. It is necessary to develop a project that tends to minimize the problem of the bananas in the fields which get frost-bitten during the cold season months. To start with, one could work with thicker bagging materials and with a system of bagging which is closed in the bottom.
11. The farmers who prepare washed chipas should substitute the alum + fungicide solution after a certain number of chipas to avoid contamination and the loss of the adequate concentration. The frequency with which this should be done, must be determined after some research.

Sociological and Marketing Aspects

12. The development of work models, based on blocks, must have a professional who evaluates the groups' sociological characteristics and suggests a type of organization which is compatible with the members' way of thinking and their needs, but one which also leads to models of self management, the development of a business sense and commercial aggression.
13. The real study of the marketing opportunities and the establishment of contracts with serious enterprises is critical to be able to advance. Ideally, the international client should be able to participate in the exporting enterprise in the Chapare.

Collateral Aspects

1. Recently, banana materials have been introduced to the area, from clones FHIA – 1 and FHIA – 18. These clones were distributed to the farmers without the necessary try-out periods.
2. FHIA – 1 and FHIA – 18 were originally developed as cultivars which were resistant to the sigatoka and some kinds of Fusarium. In spite of the positive properties of these aspects, some characteristics of shape, color, taste, ripening patterns and post-harvest behavior make them difficult to handle in the export markets.
3. the farmers who have changed their banana plantations to introduce the FHIA clones, should not be considered within the exporting programs. This banana, if accepted by the local market, should only be used for this market or just for self-consumption.
4. Nowadays, it is estimated that there are many hundreds of hectares of this type of cultivars. It is necessary to give those farmers a basic technological packet which will allow them to produce these materials successfully, if the local market accepts them.

Major Investments:

1. Improvement of the system of water provision to the packing sheds.
2. Improvement of the drainage system of those areas susceptible to flooding.
3. Refrigeration equipment of at least 5m³, with a temperature which may be regulated in order to do research through simulated transportation tests at the IBTA – La Jota.

Strategies:

A Regional Banana Commission should be created. This should include representatives from DAI, Private Enterprises, Associations and Labor Unions, IBTA, Extension Companies, and the necessary political representatives, so that together, they can come up with regional strategies to face the banana production problems and to define general strategies for the development of each activity.

Diagnosis of the Situation

Passion Fruit

Field Conditions and Quality:

It is estimated that there are about 80 to 100 hectares of passion fruit, especially the Golden Star variety, on the hands of small farmers, with an average of 0,5 hectares each and spread out throughout the region with a higher concentration on the Eastern parts.

In general, the plantations we visited showed the severe effects of the drought which has affected the area in the last few months. However, it is also obvious that the condition of the plantations is not only due to the drought, but also to the various production technology aspects that should be taken care of. Among these factors is the low sowing density being used. Even within a system of low input, a higher density of population than the one observed will contribute to the increasing of low yields (7,0 T.M / Ha / Year). The espalier structures are not designed to support a higher population density nor a bigger crop with the actual population density. It is obvious that work is needed to improve its design. The plague control and illnesses seem to be inadequate to judge due to their incidence in the fruits. Although they grew during the dry season, we observed the high incidence of seedless fruits and juice, which was caused by the deficiencies in the fertilization and pollination. Also, they are caused by insects' attacks during the earlier period of the development of the fruit. A high incidence of fruits that were burnt by the sun was also observed. In general, considering only those fruits attached to the plants during our visit, we were able to observe no less than 25% of damaged fruit, which would make them inadequate for the market.

It might be supposed that these plants could have much more foliage than the one observed once the rains begin. But the reality is that the drought and the loss of foliage will have a low yields, and in general produce low quality fruits. This is especially important because a great majority of the harvest starts during the months of November, January and February, when the plant should be investing a great deal of time and energy in the development of new foliage in order to produce. This loss of time and energy makes these plantations inefficient.

Due to the Fusarium attacks at the base of the stems, the plantations have a relatively low durability; so much that they have been handled as an annual cultivar instead of a semi-perennial one. IBTA has developed a technology packet to deal with this illness; it seems to be working. However, more extension efforts are required so that this becomes a universally-adopted and well-conducted program.

The great majority of farmers used to harvest the fallen fruits and the ones on the plant at the same time, and send this mixture to the market or to the processing plant. However, the rotting problems were very big, considering that the plants are not always processed on the same day they are received. In some cases, they are processed three days later and then they calculate the yields in order to pay the farmer. This was the reason why the IBTA recommended that the fallen fruits should not be harvested to be sent to the markets, and that they should be harvested directly from the plant, with a defined color of ripening, of between $\frac{1}{4}$ yellow up to $\frac{1}{2}$ yellow. This is essential since these fruits are less contaminated and can withstand their transportation and the waiting period before being processed.

Once the product has been harvested, the farmer transports it in synthetic fiber sacks to a specific place or to a place near his house, where the fruit is unloaded on an awning or on sacks placed on the floor. It is then when the product is classified and the fruits which were damaged by insects, the ones which are ill, burnt by the sun, etc., are eliminated.

The already classified produce is packed to be sent to the markets on trucks which will pick it up at the farms. This packing system in sacks causes physical damage, especially on a produce of hard, but fragile skin, such as the passion fruit.

Processing Plant:

Since the harvest season is just beginning, the farmers are sending their fruit to a fresh-produce market which, at this moment, is paying good prices. Therefore, the processing plants are not receiving passion fruit. However, the necessary technology for the processing of the passion fruit is simple and the facilities that were visited have enough capacity to handle the process hassle free. In addition to this, among Santa Cruz, Cochabamba and Chapare, there is an excessive amount of capacities installed to process more passion fruit than the amount being produced in the area. Nonetheless, the biggest limitation is the market, since the consumption of the passion fruit or its juice is limited in the country, the export markets are small, and are faced with other countries' competition. The existing processing plants can either produce frozen passion fruit juices or prepared beverages, but do not have the proper equipment to produce concentrated juice, which could possibly be more accepted in the international market.

Farmer's Organization:

Given that the production is spread out, there are no growers organizations in the Chapare area who specialize in passion fruit. Instead, the farmers belong to bigger organizations that have the same problems we mentioned for the industrialization of other products.

Sociological Aspects and Market:

1. Most of the farmers, when faced with the high prices at the beginning of the season, seem to be willing to sow larger areas, as long as they are given the wire to support the espaliers.

2. The national market, which is limited, is able to consume approximately 450 Tm of passion fruit on the year 2000. However, it is estimated that the production of passion fruit in the Chapare will reach 700 Tm this year. Therefore, we expect an over-production which could worsen in the future.

Immediate Actions:

1. A decision must be made, based on the market's perspectives, to see if the passion fruit should be encouraged as a cultivar or simply try to maintain the actual number of hectares being sowed.

Supposing that it is desired to improve the productivity and quality of the passion fruit, the quickest way to do so would be:

2. To instruct the farmer so that he would collect the fallen fruits periodically and would eliminate them appropriately (burying them), and thus eliminating the contamination focus of illnesses and plagues which could damage the quality of the product.
3. The harvest and the manipulation of the produce should be done in packages, such as a plastic box (box for chickens), piling them up no more than four layers (four fruits high).
4. The harvested fruits can be treated with a fungicide to reduce the losses incurred during its transportation to the fresh food market, or during the waiting period before being processed. An adherent should be added to the fungicide.
5. The fruits that are sent to the fresh fruit market are packed in polyethylene bags of 100 units. Ideally these bags should have some perforations. The passion fruit is one of the fruits that requires more air, since if they are kept in closed bags they could

easily start fermenting. The number of perforations should not be excessive, since it allows the fruit to lose water, thus getting wrinkled.

6. It is necessary that the processing enterprises need to be advised on how to enter the markets with new and quality products in order to encourage its national consumption.
7. Ideally, the processing plants should process the passion fruit as quickly as possible to avoid losses of the product due to rottenness and dehydration.
8. In the international tropical juice market, no juice can be successful on its own. Its success is more probable if the passion fruit is included within a variety of juices, for instance papaya, mango, coconut, pineapple, lemon, orange, and passion fruit. On the other hand, if it was mixed with more traditional juices, it could have some advantages in the national market.

Extension – Research Actions:

1. The farmers need to be trained to fight the Fusarium, trained on harvesting methods and index, the handling of the post harvesting produce (treatments and packing).
2. IBTA must continue dealing with the production problems due to the Fusarium attacks.
3. Research must be done on the type of packing of fresh produce and the types of packing that is needed to send it to the processing plant, and also its effects on the quality and industrial yields.
4. Work must be done on the density of the sowing since it seems that the actual one is too low. Likewise, work must be done on the pruning systems.

5. In the agro-industry field, work must be done to find more resistant packing techniques, especially with regards to the plastic bags used for juices, and the possibility of developing juice mixtures that the national consumer likes.
6. Some work may be done to deal with the problem of seedless fruits or those with little juice. Part of this problem can be dealt with through studies dealing with the; necessity of the manual pollination, fertilization and irrigation.
7. It is necessary to establish the benefits and costs of the implementation of irrigation systems for these cultivars.

Investments:

1. Assuming that it is wished to encourage the culture of passion fruit, small irrigation systems will be needed which would substantially improve the yields and quality of the fruit, which would lead to a concentration of production in the irrigated areas.
2. Materials and supplies to be able to carry out with the proposed research.
3. Plastic boxes to reduce the deterioration of the produce and to facilitate its transportation.

Strategies:

1. Do not encourage the sowing of passion fruit, since it could provoke a bigger imbalance between the supply and demand of the produce.
2. Do encourage the industry people to find creative ways of using passion fruit to adapt themselves to the market's taste.
3. The creation of micro-basins used for irrigation, which could improve the productivity and concentrate the offer.

Diagnosis of the Situation

Palmheart

Plantations:

We will not describe the conditions of the palmheart plantations in detail. Those aspects were already covered by Dr. Mora Urpi. However, it is important to point out some of the problems that affect the industrialization and exportation possibilities of this product.

1. Most of the production is in the hands of those farmers that have relatively small and spread-out areas throughout the Chapare.
2. The initial sowing density of 5,000 plants per hectare diminishes after the first harvest in about 40% and are not renewed by the farmers. This is due to the lack of attention given to the plantations.
3. Because of the lack of fertilization the growth is slow and the economic gain is very low for the farmer. It is estimated that the average yields is of about 2,000 to 3,000 palmhearts per hectare per year.
4. The prices paid to the farmer seem low compared to other producing countries.
5. The technical support that they have received seems to have been inefficient, since productivity and production are stuck, even though a market exists.
6. The only competitive plantations in the Chapare area belong to the processing companies FAVOPAL and INDATROP. Even though they have their own

production on a high capacity installation and are not being appropriately supplied with raw materials, their financial costs are increased.

Harvest:

It seems that, because some other trained cutters have been brought from other countries, and because of the pressure on the processing plants, the farmers are handling the harvest indicators, such as the base of diameter and the height of the “flag leaf”, reasonably well. Although there are many differences in terms of the palmheart production, the harvest and the quality, it has not been questioned by the processors who state that they do not have serious problems with the quality of the raw material, as long as the harvested palmhearts get to the processing plant no later than 24 hours after being harvested.

Transportation:

The transportation of the palmhearts to the processing plants is provided by the buyer. The palmheart is counted and placed in the truck carefully, so as not to damage it. In order for the transportation to be cost effective, the truck must collect at least 2,500 palmhearts. Many times, long distances have to be driven to be able to get this amount of palmhearts.

Processing Plants:

There are many processing plants in the area, many of which do not operate due to a lack of raw material. FAVOPAL only operates three times a week and INDATROP operates occasionally. They would both like to operate five days a week, but then cannot do so due to the lack of raw material.

FABOPAL, which is the processing plant that has been operating steadily since it opened, has been able to get the palmheart supply through an intricate net of agreements,

and contracts with producers' associations and individual producers. This company must get the supply constantly as long as they have a safe market. In spite of all their efforts, sometimes throughout the year, they fell the lack of raw material.

INDATROP owns approximately 100 hectares of plantations which allow them to operate sporadically. However, they have had marketing problems and also problems with the supply of raw material.

In terms of technology processes, the companies that have established themselves in the Chapare have enough technology and human capacity for the processing of the palmheart; and the quality they obtain is internationally competitive. Also some of them have begun the instauration of HACCP plans, which will allow them to get access to the United States, the Brazilian markets and others, by following the norms of CODEX ALIMENTARIUS.

Social and Marketing Aspects:

As well as other organizations in the Chapare, the palmheart growers are extremely sensitive to external influences, and they have a short-term vision. The farmers want to get the maximum economic benefit with a minimum effort. On the other hand, the Alternative Development Programs continue providing the farmers with seeds and Pejibaye plants in the areas where the coca leaf cultivars have been recently eradicated; thus continuing with the problem of inefficient farmers with small areas which are getting further away from the processing plants.

The international palmheart market, especially in Argentina, seems to be good, and its production in the Chapare has been placed in that country without any problem. Apparently, the demand has not been satisfied. However, there is not the necessary offer to supply that market and expand to others.

Immediate Actions:

1. Palmheart growers should be classified depending on their level of commitment, efficiency and interest in the cultivars; and the best farmers, located in the areas with the best agro – climatological characteristics, should get technical support for the expansion of their cultivars, trying to form productive blocks that are more or less compact.
2. The more advanced groups should receive technical support on the handling of the plantation and re-population. Ideally, this support should go hand in hand with the results obtained through research by the IBTA. IBTA should coordinate research on the proposed themes by extension agents and the farmers' organizations.
3. In order for the economical earnings to be assured, contracts should be negotiated with the more advanced groups in the processing plants. Ideally, the processing plants could contribute with some of the necessary inputs and deduct their value from the price paid to the farmer.
4. The consolidation of the palmheart in the Chapare should consider the importance of the survival of the processing and these would be able to do so as long as they have enough raw material to operate using their regular capacity. This raw material must be reasonably priced. Because of this, the priority is the consolidation of the areas of palmheart production which should be much more efficient than the actual ones, increasing the population according to IBTA's research results, incorporating fertilization, handling of suckers, plague and illnesses control, etc.

Actions of Extension – Research:

1. The agricultural extension must have as its only focus to maximize the yields per area, incorporating the already developed technology and, eventually, new technology developed by either the IBTA or another organization.

2. IBTA must continue its studies on the fertilization of cultivars on the different types of soil throughout the Chapare.
3. The work on the density of the optimal sowing must continue to be strengthened throughout the different regions.
4. Post control (weevil) threatens to be a short-term major problem. Research must continue in this field and an entomologist should be added to the planning team.
5. The handling of the suckers and the plant selection for the production of suckers continue to be very important in order to maintain adequate population density in the palmheart plantations.
6. A study regarding the consequences of the delay on the shipping of palmhearts from the farm to the packing sheds, should be initiated in order to establish the maximum waiting period between the harvesting and processing.

Strategies:

Due to the inaccuracy of the available statistic information at the beginning of the projects, the processing plants in the Chapare have had to face shortage of raw material; because of this, they have had to start establishing their own plantations. In this process, with many technical and economical resources available, the farmers have been able to gain experience in the harvesting process and they are even developing their own research. FAVOPAL also offers technical support to some groups of producers. This experience should be taken advantage of to develop an extension strategy.

This strategy must be centered in the canning enterprise as the axis for development, and from this one, technical support must be given together with the planning of the areas to be sowed, the channeling of inputs and the buying contracts of

the produced palmhearts. This way the farmer would be giving his land and his work (which are his only capital), and the enterprise would be giving supervised production contracts. If every enterprise is in charge of cultivar areas which can be processed and sold, an integration model of integrating production-process-sale would be the results. This would easily assure the self-support of the areas surrounding the palmheart cultivars. Obviously, at the beginning, there should be a type of subsidy that would allow the canning company to have enough capital to confront this new way of working.

The research needs detected by the farmers, the growers' associations, the extension agents, and the processing plant should all be channeled towards the IBTA, who would have the responsibility of conducting an efficient research and this would quickly be transferred into the extension agents.

Ideally, a Producers' Chamber and the palmheart Exporters from the Chapare should get together with the canning companies, the growers' associations, and the IBTA, so that together they could develop a regional working agenda, regarding extension and research, making sure that the economic interests of the Chamber's members are respected.

Diagnosis of the Situation

Pepper

Plantations:

Actually, it is estimated by IBTA, that there are approximately 90 Ha of pepper in the Chapare, 15 out of which are actually producing.

The majority of the plantations are small, less than 0.5 Ha and are being sowed using live stakes (Erytrina sp.) as well as dead stakes (out of hard woods). In general, we observed plantations with intermediate technology which were relatively healthy. In spite of this, it is obvious that the drought in the area, which has lasted for many months, has affected the plants. These seem yellowish and de-foliated. None of the farmers has irrigation methods. When asked if they believe it would be helpful to irrigate the soil, their answer was unanimously: “yes”, but to be able to do so, they would need financial aid (donations) from some institution.

We did not observe serious problems of fungous illness, since the environmental condition has not been favorable for their development. However, we believe that once the rains become regular, the problems will worsen. We did observe a moderate incidence of lichens and sea-weed growing on the pepper plants. Sometimes, under certain circumstances, these can reduce the photosynthesis, thus lowering the yields. Some severe problems with Fusarium and Phytophthora have been reported, but IBTA assures that they have enough information to deal with the problem. In the fields, we observed that the farmers have been advised to sow in small hills to make drainage easier on the basal area of the plant.

At the time of our visit, most of the harvesting season was over, and according to the farmers it was a good season, since they were able to harvest 10 quintals of dry

pepper from an area of 2,000 m². They sold each quintal for \$ 320 and they got a gross income of \$ 3,200. However, they had no idea of the production cost but seemed satisfied with the income, and showed interest to sow more pepper in the coming campaigns.

According to what the farmers and the IBTA personnel stated, the main problem they are faced with in this cultivar, is related with the establishment costs, especially regarding the posts, since pots made out of dead, hard wood cost about 40 Bolivianos each. If we consider 2,000 plants per hectare, this represents a significant investment. On the other hand, the Erythrina species, which has been recommended as a live post, is not as abundant and there are some limitations regarding the possibility of getting pieces of the trunk to get live stakes. However, IBTA, as well as some farmers, have already established special orchards which will provide the supplies needed for the sowing of living stakes, since in the near future the high cost of the establishment could be reduced. Other types of live stakes have been tried, but the establishment periods are too long.

In the case of the plantations which use live stakes, it is necessary to develop different pruning practices of the plants and the stakes as well. This has to be done in such a way that a micro-climate that is too humid and shady is not created, since this would be favorable for the development of illnesses.

It is possible that some areas might need work creating a drainage system to avoid the accumulation of water and to reduce the pathological problems, especially because the pepper is extremely sensible to the accumulation of water in the soil.

Harvesting:

The ripeness degree of the harvest is critical for the obtaining of good, quality black pepper. In the area, according to the IBTA, it is best to harvest the pepper when the bunches of small fruits have a greenish to yellowish color, until the fruit is half way yellow. The idea is that once the fruits obtain this color, it is the ideal time to get black

pepper, since at this time the fleshy part of the fruit will not come apart when being dried. On the contrary, if the fruits are more ripen, the fleshy parts will come apart and the seed would stay naked. It would then only be good for the production of white pepper (which has a lower market value). The harvest is done by cutting the bunches of fruits, and placing them without shelling, into sacks for their transport towards a dry area.

Drying Process:

Nowadays, there are no processing plants for the drying and preparation of the pepper to be sent to the market. The farmer carries the harvested product to his house or to a nearby place, where he fulfills one of the following processes:

- a. He shells the bunches and places the individual fruits on an awning for them to dry, and from time to time he moves them around, so that the fruits dry evenly. In general, 4 or 5 days of hot and dry weather are required for an acceptable degree of dryness.
- b. He prepares hot, boiling water and places the bunches of fruits in it for 7 to 8 minutes, then he takes the bunches out and shells them, placing he individual fruits on top of an awning for them to dry at room temperature. The process of preheating he fruits has been recommended by IBTA, since it helps the ripening of the fruits, it makes the process of shelling the bunches an easy task and, in a way, it accelerates the drying process. This is the most commonly used method.

In both processes, the optimal humidity of the grain should be of 11 to 13%, in order to be able to pack it with the certainty that the product won't be deteriorated by fungus as *Penicillium* during its transportation and commercialization. Since the farmers have a very precarious way of processing, it is probable that the optimal humidity is not reached, and that the product may be re-hydrated a short time before it is packed and sent to the market.

Once the product is dry, it must be cleaned from impurities such as little stones, dust, left-over bunches, leaves and any other type of impurity. Once the product is cleaned, it is packed into 50-kilograms plastic bags that need to be sealed immediately after being filled.

Some farmers stated that they sell their fresh produce to middlemen who then transport it to Cochabamba, where it will be dried, since the produce dries faster in the high-valley areas than in the Chapare, and the drying process is quicker and probably closer to its optimal condition.

Processing:

Nowadays, except for the drying process fulfilled by the farmer, the pepper is not undergoing any process before its final sale. The whole grain produce has a higher market price than the one which has been previously ground.

Farmer's Organization:

Pepper farmers, who are relatively few and are spread out, are not as organized as other farmers. Instead, since they have other cultivars in their farms, they belong to larger organizations.

Immediate Actions:

1. It is needed that the farmers improve the drying system in the following ways:
 - a. They need to ensure that the drying process is begun on the same day or no later than the following day the product is harvested. This should be done in order to avoid the ripening of the fruits and that the dark shell gets separated. On the other hand, the fresh produce placed in sacks could undergo fermentation problems, if the produce's processing is delayed.

- b. To improve the drying installations. Nowadays the drying process is done in awnings over the floor, which makes the product run the risk of microbiological contamination that, since the product has not undergone any type of washing or processing, it could affect the consumer. On the other hand, the system of drying on the floor does not assure that the grains will be evenly dried. We suggest that they build wooden frames with a screen at the bottom, preferably made of nylon. These should be placed at, at least, 1.5 m in height and far from animal reach, ideally in a room that is completely covered by a screen, which is warm, well-ventilated and not exposed to the rain.
2. The final product obtained by the farmer probably, given that there is a high humidity level in the Chapare, does not have the ideal humidity level required by the market. This could represent a risk for the deterioration of the product. However, if the sale to the final consumer is quick, it could also mean that the producer would get a lesser income, since he would be selling a heavier product, due to its water content. If they wish to store the pepper for long periods of time, it would be best if the product was artificially dried before being bagged.
3. It is indispensable that the extension services insist on the pruning importance of the pepper plants, either in order to increase the production through the adequate formation of the plant, or to reduce the incidence of sicknesses through the elimination of sick tissues. In the same way, the producers that use live poles must have a constant pruning system of the plants so as to avoid extreme shade and the accumulation of humidity in the plantation. IBTA has developed a number of recommendations about the handling of the plant and the live stakes. In the same way, they must insist that the drainage systems be improved during the rainy season to avoid the rotting in the basal areas of the plant, since they could destroy it.

Extension – Research Actions:

1. In a plant, as susceptible as the pepper to sicknesses and rough handling, it is essential that cultivar practices of fertilization, agro-chemical applications, sowing systems (density and stake), handling of pruning, etc., be integrated in a program of integrated plague control and illnesses, that would assure the sustenance at the time of production. This MIP program should be put to work by the IBTA researchers as soon as possible.
2. IBTA should continue with the variety of tests, focusing especially on the illnesses and yields problems. They should incorporate a bigger number of tests on the varieties and origins, since until today, most of the evaluations come from Central America and Brazil. However, there are some varieties from Southeast Asia, India, etc., that could adapt well to the Chapare.
3. IBTA should be in charge of the sowing material certification, in such a way that they would only take those healthy plants and adequate varieties to the fields.
4. IBTA should put its major efforts in the zoning of pepper production, focusing in factors such as flooding risks, soil fertility, micro-climate, and risk to illnesses, etc. I do not believe that the drier areas of the Chapare are adequate for this cultivar. Also, the amount of water accumulation is not beneficial to it. This zoning task should be based on the existing information on the banana plants, and try to place the pepper plants in places that are more adequate according to their requirements.
5. IBTA should try to find low-cost live or dead stakes and should work on the integration of the pepper to agro-forestry systems.
6. Research should continue to be done on the sowing densities.

7. A study should be made on the real quality of the Chapare pepper. This study should be based not only upon its chemical attributes, but also on its physical ones, such as the size of the grain, the purity of the packed material, color, evenness of color and size, the presence of separated grains (pepper powder), and others. This should be done with the objective of evaluating its competitiveness in the international field. This is important because the chemical quality is particularly high, and there might be some opportunities in the foreign market.
8. The farmers must characterize the drying process and determine the real content of humidity with which the product goes to the market, as well as the development of illnesses throughout a period of storage. IBTA has the equipment to measure the humidity levels in grains such as rice, maize, and beans. This same equipment could be used to measure these levels on the pepper plants.
9. The use of irrigation should be evaluated against the productivity and quality of pepper.

Investments:

1. Evaluate the economic feasibility of the establishment of irrigation systems in the most problematic areas.
2. Think about the installation of a small drying plant that would sell the final drying stage to the growers, and would help concentrate the offer of the product. If there was only one pepper commercialization place in the Chapare, it could give the market some “transparency” and thus avoid the speculations from the middlemen.

Strategies:

1. Given that Bolivia has a great internal market for the pepper and given that more than 90% of it is imported, this cultivar could be more encouraged, as long as the best

areas are chosen to do so, and as long as the farmers could commit themselves to take the adequate care to this delicate cultivar.

2. The Spanish Government Technical Cooperation is considering the possibility of establishing a pepper drying plant next to a field with a common boundary with the Bolhispania-palmheart factory and is encouraging its sowing in the area of Chimore. It is necessary to have the adequate coordination so as not to squander the resources.
3. IBTA's research work on the pepper production is worthy and should be encouraged, especially on the areas of plague and illness control, stakes, and the improvement of yields via fertilization, pruning and irrigation.

Diagnosis of the Situation

Pineapple

Plantations:

Two varieties of pineapple are planted in the Chapare area: “Cayena Lisa” and “Pucalpa.” The former is more adequate for export and the latter is more accepted by the local market. There are approximately between 250 to 300 Ha of “Cayena Lisa”, and about 600 Ha of “Pucalpa.” These are distributed in small plantations of about 0.5 Ha each, located near villages of Eterazama, Sinahota and Mariposas. The average sowing density is of 20,000 to 25,000 plants per hectare.

As we mentioned before, the great majority of the plantations are small, approximately 0.5 Ha, and usually the farmers only own lots of the mentioned varieties.

The farmers classify the sowing suckers in some way, but the process is not good and small, weak suckers are sown. Therefore, the plantations’ development is uneven. Also, because of the bad techniques used, in the case of the Cayena Lisa, approximately 35 – 40% of the suckers are lost, causing discontinuity in the planting process. These suckers are not replaced by new ones. In the majority of the cases, the cultivar receives none or little fertilization and the pineapple, specially the Cayena Lisa, is a cultivar that demands nutrients, but has a small capacity of absorbing them from the soil. This is the reason why they must be supplied via fertilization and, preferably, via foliar fertilization. Due to the scarce fertilization, the development of the plants is poor. Consequently, the fruits will be small, with a tendency to fast ripening. The Pucalpa variety is much more tolerant to poor soil, scarce fertilization, and its rooting capacity is much better than that of the Cayena Lisa. This is the reason why it is able to adapt to a system of low input. Weed control is poor, and because of the Cayena Lisa’s slow growth rate I low input

systems, they compete for space and nutrients with the pineapple. The low sowing density makes this a bigger problem.

The average temperature goes down to 8o C because of the cold southern winds. There is a high incidence of natural flushing of flowers. This flushing of flowers causes the fruits to have different levels of development at the same time, thus making the concentration of the harvest very low. This means that the harvest of the same lot would have to be done during many weeks. The problem is worsened because of poor fertilization, the area's drought, and because of the unevenness of the sowing material. On the other hand, the fruits that began to develop in the fields during the cold months' season, suffer from chilling injury and it is possible to see this without having to cut them off the plant. This phenomenon limits the export possibilities, which is only possible during certain months of the year, when the temperature is adequate for the pineapple's development and growth. Fortunately, these good harvesting months coincide with the best marketing opportunities in Argentina.

The plague and illness control also shows some deficiencies. We were able to observe that there are other insects' attacks as well, which may be provoking fruit and crown deformations (trips, mites, scales, etc.). However, we were not able to determine this fact due to the severe drought and the plants' yellowing.

The German Busch and Mariposas' plantations that were visited are being handled through the induction of the natural flushing of flowers. Therefore, they have a very staggered harvest. Nonetheless, it was commented that they have reverted to artificial flushing of flowers, using Ethrel (acid-2-chloroethyl-phosphonic) whenever they have had an opportunity to export. However, the natural flushing of the flowers on uneven size plantations, would also be subject to producing extremely uneven sized fruits, and this size would be proportional to the development of the plant.

Harvest:

Apparently the farmer is aware of the optimum ripening levels needed for export and for the national market, which is an improvement. The harvesting is done by hand since the harvesting areas are small and not too dense. The fruit is removed from the plantation either by hand or on wheel barrows, leaving the fruit exposed to the sun for long periods of time, which can affect its quality. We were also able to observe a canvas backpack, with compartments where individual fruits can be placed. This would allow the worker to carry about 12 pineapples at a time. However, the problem is the unloading, since many of the fruits are dropped.

The recently harvested fruit is arranged and a fungicide solution is sprayed on them. This is done since if it was not, they would have high incidence of *Penicillium* and other unidentified basal rottenness.

Transportation:

The fruit is transported to the national markets, on trucks, without being counted. It is arranged so as to avoid excessive movement. However, the height in which the fruit is placed and the mechanical damage is extremely high. Some merchants inform us that they lose about 20% of the fruit during transportation. This extreme piling of the fruit causes, not only physical damage, but also an increase of temperature, which accelerates the ripening process, rotting, and even fermentation.

Packing Sheds:

Although the observed packing sheds in the areas of production lack a design problem, they are fit for the packing of fresh pineapple if they have enough water to operate. The packing sheds are too big for the real productive capacity of the associations to which they belong. Because there is no exportation, the packing sheds are literally without use.

The observed plants in German Bush and Eterazama have a Colombian design, which is already in disuse and that requires, for its adequate operation, that all the fruit is handled in plastic boxes; those boxes are expensive and many of them are needed so that the flowing of the process will not stop. In general, the drainage areas are very reduced, if we take into account that the washing pool can do up to 4 boxes at a time. The plant in Mariposas is based on a Costa Rican design and it is basically a transporting band on which different operations are done. This plant has some dimension problems because the area of classification and accommodation is too short, and the packing area should have lateral exits that would allow the packing of the fruits of different sizes without agglomerating them. Taking into account these problems, the observed plants could easily pack up to 1,000 boxes per day if they have an adequate working organization.

It is possible, at the moment, that all the electric motors and gear systems of the Mariposas plant require tune-ups or their substitution, due to the many years they have been without use and to the lack of periodical tune-ups.

In spite of the good conditions of the existing infrastructure, it was not possible to consolidate the pineapple exports other than the sporadic shipments. Both Chapare Exporta and Banabol have shown interest in placing the pineapple in Argentina and Chile using their market contacts; however, their shipments are limited to only a few hundreds of boxes from time to time due to the low supply of pineapples with export quality and to the little interest of the farmers in taking care of their plantations. In some of the cases, the exported pineapples have shown pathological problems, browning, excessive ripening, among others. This is why Banabol has shown interest in exporting pineapple in big quantities, as long as Banabol can control the harvesting and packing processes, for it is the company name which backs up these exports, and they cannot risk a low quality product.

The description of the process of preparation of the fruit for export, once it has been done, implies the gathering of fruit from many farmers and its transportation to the

storing centers, by truck. Once there, the truck is unloaded the fruit is classified by sizes, washed, sprayed with fungicides, packed in wooden boxes and loaded in reefer trailers, or it is moved to the packing sheds for its cooling and their future loading. None of the people that described this process mentioned the use of any treatment that could prevent the occurring browning (internal browning).

The main problems which were detected in the case of pineapples and which come from the fields are: inadequate size, over-ripening, multiple crown, physical damage, sun burning, browning, insect damages, damages caused by illness, cracking and fermentation, but the relative importance of each one of these problems is unknown, and even less known are the incidences through the harvesting season; this is why it is impossible to plan the proper attention to the plantations in order to prevent these problems in a cost beneficial way.

Processing:

In Bolivia, there is enough infrastructure to gather a good quantity of the pineapple produced in the Chapare; however, with the exception of some pineapple juices, it was hard to open up markets for the processed pineapple products, in the markets of the “Cono Sur.” In spite of the diversity of industrial products that can be prepared with pineapple, the low supply of quality products, and the high prices that the farmers pretend to get, all this added to the high input costs for the industry, make the prices of the Bolivian growers high and hardly competitive with traditional pineapple products, such as pineapple cut in slices and pineapple chunks in syrup. The exportation of products such as pineapple pulp and dehydrated pineapple are barely getting started and they would have interesting potential markets. However, the amount of money that a processing plant could pay a farmer must be low in order to be able to compete with other countries, this is why the processing of pineapple should be a complementary option to the efforts of commercialization of the fresh fruit.

Organizations:

The organizations are catalogued as of low-level-organizational capacity, having the same problems mentioned before for the bananas.

Sociology and Marketing:

The majority of the pineapple associations are not too motivated with the crop because the different, isolated exportation efforts haven't had any benefits, there have also been unpaid shipments. In general, the majority of the farmers have put their hopes in the Pucalpa pineapple for the internal market with the possibility of obtaining good prices some time in the year, or even lose money because of a very stationary market guided by very specific consuming habits. Farmers insist that they should receive technical support, that their packing equipment should be improved, that they should be given sowing material, inputs and the certainty of a market, if it is wished that they sow, again, some extensions of Cayena Lisa.

Regarding the marketing aspects, the figure is seen as a vicious circle which is necessary to break: the intention is to export, but good quality pineapple is hard to be found in the fields, because of the lack of foresight and the use of technology in the plantations; problems appear and the market gets closed. On other occasions, there has been enough fruit in the area, but with no possibilities of exportation.

Result: The farmers lose money in one way or the other.

For the national market the situation is different. It seems that the accelerated substitution of the Cayena Lisa by the Pucalpa variety is generating an over-supply during some seasons of the year. However, the acceptance of the product is good and, according to the farmers, it tends to grow.

Immediate Actions:

1. To look for an strategic alliance with a commerce enterprise that would assure a minimum volume of the product and that would establish contracts with the farmers; it is evident that Chapare Exporta, as well as Banabol are interested, and it is possible that some other serious groups are also interested.
2. Based on the contracts, plan the area to be sowed, to satisfy this demand. The production must be in the hands of the farmers that are committed and in areas o smaller than 2 hectares, and the farmers should be concentrated in a small area.
3. Only the chosen farmers will be able to export; false expectations on the cultures should not be created. It is only until solid bases of commercialization are established that one can think in improving it again.
4. The plantations that would be involved in this project should have attention through medium and high inputs and a permanent technical assistance, as well as a constant checking of activities with the help of control lists.
5. The waxing of the fruit should be incorporated as a way to prevent the browning. However, it should be clear that if the problem comes from the fields, there is absolutely nothing to do to heal it.
6. The packing shed that they might want to use must be rehabilitated, and one must specially be sure of an abundant supply of good quality water.
7. Besides the technical support, I would suggest to hire a pineapple farm overseer from Brazil, Ecuador, Colombia, Costa Rica, or Honduras; one who would lead the field process for a complete cycle, bearing the idea that the farmers learn how to handle their crops in an organized way.

8. The packing and treatment of the fruit must be supervised by a technician with experience in pineapples and by a supervisor from the exporting company; this one, with full rights to reject fruit lots or even full shipments if they do not fulfill the required quality.
9. It is necessary that the planing for the taking care of the plantations is done based on a quantitative diagnosis of the production and quality problems; that is to say that it is not enough to say that a problem is present, but to determine when, how, and with what intensity it is presented, with the idea of planning the control of the problem. Obviously that information is nonexistent and should be generated by IBTA.
10. Under the actual conditions of sowing density (25,000 plants per hectare), and assuming a system of medium and high inputs, a hectare should produce enough fruit for 1,5 to 1,8 containers, assuming an exportable production of between 15,000 and 18,000 fruits per hectare. Assuming demands of 36 containers, it would mean a “technified” sowing of between 20 to 25 hectares, induced at the right moment and in a planned way.
11. The selected group of producers must have access to a simple irrigation system, so it is convenient to group them as much as possible.
12. For the national market the fruit must, at least, be treated with a fungicide in order to prevent rotting.
13. The sowing of more areas for the Pucalpa pineapple must be stopped until some market studies are done, which would allow to determine the areas that must be sowed to satisfy those needs.

Extension – Research Actions:

1. It is hard to adapt a pineapple culture for export to the small growers, specially because the Cayena Lisa is a product that demands inputs and constant care. In order to obtain good results of the Cayena Lisa cultures, a constant technical support is needed in order to verify that the productive processes are working well. The extension agents must be acquainted with the culture and must elaborate activities and completion lists for each farmer.
2. Although IBTA has conducted a research on the pineapple, this is not enough to sustain the pineapple's production for exportation in an efficient system of production. In order to go further, another researcher should be incorporated to help the engineer Jury Maldonado.
3. The main research aspects would be:
 - The fertilization of the culture by evaluating the yield effects, quality, reduction of the browning problems, acceleration of the growing of the fruit.
 - The determination of the ideal moment in which to induce the flowering, based on the actual condition of the culture's development, the growing speed of the fruit, the marketing opportunities, the desired sizes of the fruit, and the climatic conditions.
 - Pest and sickness control.
 - Quantitative diagnosis of the factors which affect the quality of the harvested product.
4. IBTA must develop a sampling system to more precisely monitor the growing of the fruit and to determine the time that passed between the induction and the harvest.

5. IBTA must quantify the effects of low temperatures during the winter on:
 - The growing of the plant.
 - Natural flowering induction.
 - Browning of the fruit in the fields.
 - General quality of the product.
 - Production's programming in order to take advantage of the market windows.
6. If low temperatures have an adverse effect on the quality and the production's programming, systems to reduce the impact of low temperatures must be designed. It is possible that the flowering inhibition through the application of giberelines, citocinines, of placobutrazol could produce some results.
7. The searching of a model combination of wax and the ideal dosage must begin for the production's conditions in the Chapare. It is recommended to start using waxes such as Stafresh from FMC, Tandem, or Primafresh from S.C. Johnson.
8. The extension agents must have the information derived from the diagnosis stated in point 3, so that with that knowledge, they can determine the strategies to use in order to prevent the problems.
9. It is important to start the testing on the increasing of the sowing densities, taking these densities to the higher limit which would be practical for the conditions in the Chapare. Current densities are relatively low, there is no re-population in the areas of loss and the yield per area is low.

Investments:

1. Rehabilitation of a processing plant in the appointed community for the leading plan.
2. Research funds in IBTA and the hiring of an assistant researcher.
3. Irrigation system for the production's module.
4. Inputs could be financed, but they should be deducted from the fruit's payment.

Strategies:

1. Leading plan for exportation, based on a strategic alliance with the buyer and a previous buying contract.
2. A selection of a group of farmers based on group's commitment and agro-ecological conditions for the cultures.
3. Planning of the process of production regarding the areas to be sowed, kind of the assistance which should be given, the programming of harvest, etc.
4. Supervised packing by the buying enterprise.
5. Constant and convenient technical assistance and verification of completion lists.
6. Development of research to better the system.

ANNEX

In the case of starting any exportation program for the pineapple, there is an excellent market in Argentina, of one knows how to take advantage of it through the planning of activities. The ideal place to execute the packing processes would be the plant in German Busch, since it is equidistant among the pineapple production areas. The general process and the need of materials are described as follows:

Reception of the fruit carried by truck in bulks

Unloading onto transporting bands or rollers

Selection of the fruit on a swivel table

Arranging of the fruit in plastic boxes

Placing the fruit into a washing pool and proceeding to the initial disinfection (chlorated water at 100 ppm)

Taking off the boxes from the pool and quick drainage

Immersion in a small pool which contains a mixture of fungicides (thiabendazole or Baycor at 300 ppm, active ingredient) and a wax for pineapple (Tandem, FMC 7051, Primafresh 31, or some other in a proportion of 1:4)

Drainage of the excessive wax

It goes onto the rollers

Labeling of the pineapple

Packing in cardboard boxes

Piling of full cardboard boxes

Shipment onto a storage shed

Forced air cooling

Delivery into the market in reefer trailers

In order to accomplish this process in German Busch, it would be necessary to buy at least 250 plastic boxes, which is the minimum required to maintain the process's flowing without any problems in the equipment. Approximately 10 gallons of wax would be required (wax that could be used again if properly filtered), and enough chlorine to maintain the concentration in the big pool. This plant, with the adequate working organization could pack up to 1,000 boxes per day.

Diagnosis of the Situation

Institutions

1. DAI:

DAI has an excellent group of people in the Chapare, specially the people in charge of marketing are very motivated and wish to acquire new knowledge. However, at the moment, their capacity is being wasted in small tasks, such as placing the products in very small markets, of low product quality. In a way, this happens because the global working strategy is barely being defined. If we take into account the human and the material costs when using this useful personnel only for small sales, probably the marketing cost surpasses the value of the product sold up to date.

It would probably be more effective to work through the creation and utilization of a database regarding the supply of the Chapare; the same database could be used for the promotion of a little bigger and more productive businesses, and for the attraction of inversion capital to the area.

At this moment, the only possible way for achieving the economical goal proposed in the objectives, is through the attraction of capitals into the Chapare area.

The attraction of investments or enterprises that would commercialize the production of the Chapare is absolutely necessary at this moment, to articulate viable commercial and sustainable chains in the long term.

2. IBTA:

IBTA has an excellent research personnel, however, the bureaucracy of the system and the working instability attempt against the continuity and quality of the work they do. In spite of some of the criticism heard in different opportunities, the quality of the research done is good, and could be better if one overcomes some structural tidings which limit the performance of the personnel. I think that IBTA has the technical capacity to attack a great deal of the research needs of the area. However, its equipment is poor, especially for the post-harvest and the quality, where they would require a minimum investment of \$ 30,000 to buy a basic equipment, such as two cold chambers, refractometers, penetrometers, adequate scales, etc.

3. University Mayor de San Simon:

Even though it is not considered anywhere in the Alternative Development Programs, it is obvious that, as a High-Education Institution, this University has to accomplish an important role in the development of the Chapare. San Simon has a great research potential for the development of agro-industrial products, and has, already, a big amount of studies made on the alternatives for an ago-industrial processing, which includes technical and economical feasibility. On the other hand, an intelligent strategy would be to ensure the continuity of some of the areas of work, regardless of the political pressures that could come out; this would ensure its sustainability. At the moment, Dr. Alvaro Padilla Omiste, Director of Scientific Research and Technology, at the Universidad Mayor de San Simon, is planning to increase, in the near future, the university's actions in the Chapare, in different areas such as agriculture, agro-industry, the using of plant by-products (oils, extracts, etc.), the using and sustainable management of the bio-diversity, sociology, among others, and to lead some amount of the resources which could be obtained from their international agreements. In general, San Simon has a staff of fairly well-prepared professionals and, at the moment, they are working hard in trying to open the University onto a more integrated type of work, with the private enterprise; they are even considering the selling of their services.

The Universidad Mayor de San Simon would be willing to coordinate efforts, as long as its autonomy is respected, and some actions could be suggested which would be beneficial for all the participants. For instance, they are working on a project in order to create small enterprises for the growers, around the extraction of essential oils of eucalipto; the plant has been financed by the University, and will recuperate its money as soon as the farmers start selling their product. The University supports them in the marketing process. Today, around 35% of the oil extraction plants has already been paid.

CONCLUSIONS

1. With the exception of bananas and pepper, the priority sectors are confronting serious limitations for their future economic development:
 - a. Many farmers, with very small areas each, are spread apart throughout the different regions of the Chapare.
 - b. Plantation management with very little technology and poor investment of the farmers' efforts, which leads to poor and low-quality yields.
 - c. Farmers who are totally dependent on the foreign support in order to either start or maintain their plantations. This makes evident the low sustainability of the production projects.
 - d. The concept of "competitiveness" is nonexistent among the farmers and their organizations; the concept seems unknown even for some of the development strategies for the area.
 - e. Some basic aspects regarding post-harvest management, in order to preserve quality, are very little spread and miss-applied among the technicians and the farmers' organizations.
 - f. Private enterprises are not very aggressive in regards to the creation of markets and the securing of raw material's supply.
 - g. The technicians in the areas of extension and research are not very creative.

- h. Paternalist programs and not so focused on the development of production systems which are economically sustainable; for years, they have played the role of benefactors.
2. This situation makes the marketable offer of the zone disperse, scarce, of a variable quality, expensive, and difficult to gather.
3. Even if the post-harvest problems are serious for the different sectors, they are irrelevant since the national market would hardly pay for the potential improvements that could be introduced, and there are no export markets with the sufficient magnitude to justify research and extension on this particular field (except for bananas), they can only manage some simple recommendations which would allow the improvement of the quality without having to invest on plants, research and development.
4. The goals established by the Alternative Development Programs for the immediate future, would seem unreal, and would need a serious restating in terms of the strategies to follow in order to really produce an accelerated improvement on the farmers' quality of life.
5. The goals proposed by the development programs can be considered as macro-economic for the area and do not take into account the subject of the development which should be both the farmer and his family.

RECOMMENDATIONS

1. At this moment, the only viable solution in order to have enough products for sustainable exportation efforts, is to strengthen the conformation of blocks of growers, which is happening with the bananas, and favor the conformation of blocks in other cultivars.
2. Those production blocks should be linked with processing enterprises and/or strong exporters that have the organizational and logistic capacity to commercialize the crops.
3. The flow of correct information among all the possible actors in the development of the Chapare should improve, eliminating the political contamination that this information suffers at the moment. That information, well handled, could be useful to encourage the private investment in the area.
4. If it is wished to start researching in the field of quality and the handling of the post-harvested products, IBTA should have the capacity of answering inside the institution, through the training of technicians in different aspects, such as post-harvest research, and the development of technologies. This training should at least be considered for each one of the technicians involved in the products which are subject to exportation as fresh fruit and it should be done in the mid-term (2-4 months outside the country). At the same time, IBTA should be provided with some kind of equipment to support a research in this field. Probably the minimum required equipment could be obtained with \$30,000.
5. The technicians from DAI and the extension companies should get training in the post-harvest handling of the products they are working with. This training could be extended to the DAI's technicians (2-3 months outside the country), and more to the point (1 week per culture, in the zone) for the extension agents.

6. I believe it is convenient that some kind of relationship with the academic sector of Bolivia be established, especially with the Universidad de San Simon (State University of Cochabamba) since they have very interesting capabilities in some aspects, that would be beneficial for the attraction of investments, such as very complete feasibility studies, as well as some capacity to make a research in the area, or provide the possible investors with specialized services. It is clear that the universities could give the continuity that some projects require, independently from the political changes which are very frequent in the execution of the projects of the alternative development.

7. The specific recommendations have been included as part of the diagnostic for each rubric. However, in many cases, we will find that the recommendations are concurrent.