2.3 VEGETABLE CLUSTER

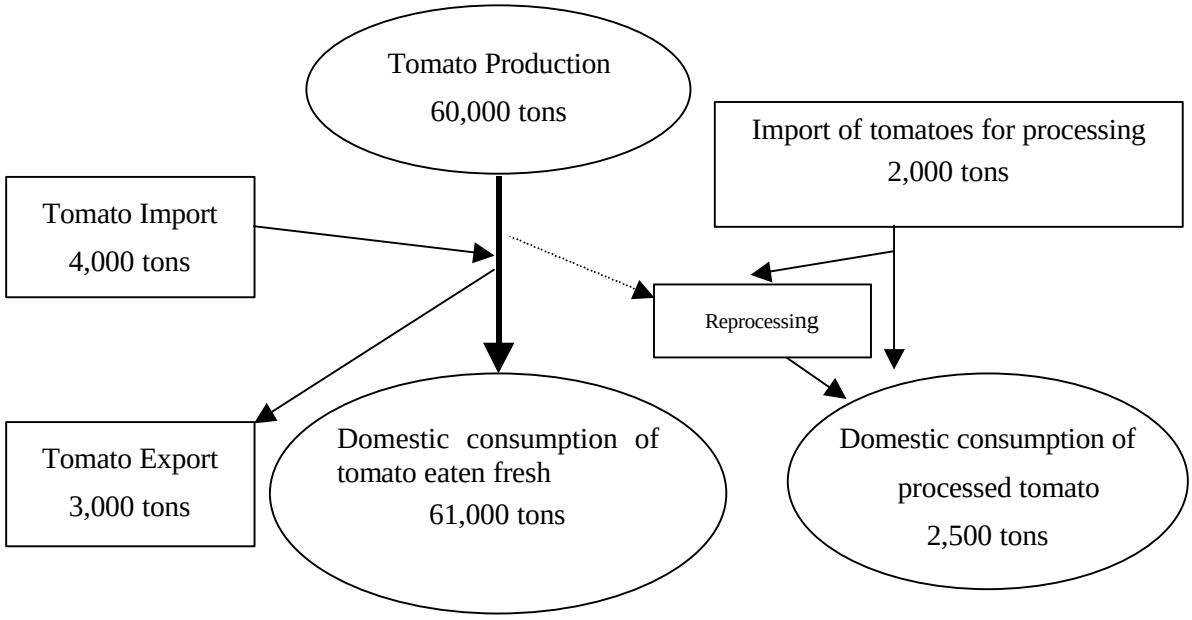
In terms of raw materials production and processing, we cannot say that the vegetable cluster exists in Paraguay. However, there is a potential of expanding production of raw materials. Processing can start with relatively small investment. In comparison with soybean and corn, cultivation of vegetables is rather labor-intensive and suitable for small-scale farmers. Therefore, we take up this as a cluster to be formed.

2.3.1 Analysis of current situation

(1) Overall structure of the cluster

In the Central Bank industrial statistics, the production of vegetable-processed products was not included. According to the industrial census, only eight companies produce vegetable processed products. Five of them process buds of palm trees. Only one company processes tomato, which is the most harvested vegetable in Paraguay. If we take up tomato as a target of the vegetable cluster for explaining its overall structure, the production of tomato is 60,000 tons; import of fresh tomato amounts to 4,000 tons while its export is 3,000 tons. As for processed tomatoes, 2000 tons of them are imported and a part of them (tomato puree) is reprocessed. Domestic consumption of tomato puree is estimated to be 2,500 tons. There is no tomato-processed product using local tomatoes as raw materials.

Figure 5 Structure of Tomato-processing and Production, Export and Import



(2) Analysis of current condition

1) Raw materials supply -primarily tomatoes-

More than 75 % of the production volume of major vegetable in Paraguay (tomatoes, bell peppers, onion, carrot) are produced in the central region comprised of Caaguazu, Central, Paraguari departments where many small-scale farmers are dispersed, and the eastern region containing Alto Parana department.

Co-operative of the "Cooperativa de Produccion Horti-Fruticola Petei Chapa" and the "Blas Garay" located near Coronel Oviedo in Caaguazu department have independent small-scale tomato processing operations using their own tomatoes. The Co-operative de Produccion Horti-Fruticola Petei Chapa produce 500kg/day of canned tomato sauce. Similarly, the Cooperative del Norte Ltd. in San Pedro department in the northern region produced processed melons and tomatoes with a Spanish company in the past, but due to a shortage of raw materials, operations have ceased.

2) Processing

Only eight companies are concerned with the vegetable cluster as follows.（1998 Industrial Census）

Table 9 Actual State of Manufacturing Industry Related to the Vegetable Cluster

Department	Plant	Processing Item
Asuncion	3	Fried Potato, Buds of palm tree
Alto Parana	1	Buds of palm tree
Central	2	Jam, tomato-processed product
Canindeyu	1	Buds of palm tree
Pdte. Hayes	1	Buds of palm tree

As vegetable processing methods, there are canning, freezing, drying, salting and so on. According to the Table in the above, there seem to be canning, bottling and freezing in Paraguay. Five companies that process palm trees are all export their products, however, the company that is processing tomato in Central does not export them. In Caaguazu, which is discussed in 2.3.2 as a suitable location for the vegetable cluster, there is no plant for vegetable processing.

(3) Bottlenecks and advantage

1) Raw materials

Accelerating clusters of small-scale farmers through improved cultivation techniques

Tomatoes are produced by more than 80 % of the total number of 5,000 vegetable-producing farms operated mainly by small-scale farmers. Among the vegetables produced, tomato farming is the largest in terms of cultivated land area and production volume. Productivity per hectare of tomatoes in Paraguay increased from approximately 20 tons in the later half of the 1980s, to an average of 39 ton in the 1990s. However, per capita productivity over the same period decreased from 18.5kg to 9.8kg as the number of laborers employed on tomato farms has increased, and production costs have risen accordingly.

Moreover, vegetable cultivation in Paraguay is based on rainy-season cropping that is carried out in high temperatures and in heavy rain. Production under these conditions has propagated bacterial diseases and lowered quality. In order to the strengthen competitive viability of the product, improved cultivation technology, suited to current production conditions, and improved yield and quality are issues that must be addressed for the short-term.

CETAPAR, as part of the supporting research body of the small-scale vegetable project sponsored by JICA, has developed bacterial disease resistant varieties, improved cultivation technology and implemented extension activities with the objective of improving the yield and quality of tomatoes since 1995. The demonstration farm has produced a yield of 84 tons per hectare using cold shade technology. In addition, it has been proven that increased yields and improved quality have been achieved by small-scale farms using this technology and prolonging the harvest period. The success of this trial cultivation not only contributes to improved productivity at the raw material stage that is required in order to strengthen the competitive viability of the vegetable clusters, but promotes the export of fresh vegetables to the markets in Argentina and Brazil, which utilize a prolonged harvest period stemming from seasonal differences (off-crop season). It also suggests the potential to accelerate entry of small-scale farmer clusters.

Economic viability of improved tomato cultivation and bottleneck marketing costs

The results of the CETAPAR trial cultivation by small-scale farmers show that improved yield per kilogram reduces production costs. The production costs (shade sheet, fertilizer, pesticide, labor cost, seed, etc.) for 600 planting stock using this cultivation technology was about Gs1,100,000. When this production cost was calculated in terms of per hectare, it was about Gs20,000,000 and the production cost per kilogram was Gs238. The cost per kilogram in a comparison of production costs between the Coronel Oviedo agricultural cooperative and CAH showed a reduction of more than 30 %. With the

introduction of this cultivation technology, financial assistance is essential as initial starting capital in order to purchase production materials.

Presently, 78 % of vegetable producers, including tomato producers, depend on transporters to ship their product, and 2 % of the producers transport their vegetables directly to the wholesale market. The distribution cost of using transporters is 60 % of the total production cost. The ratio of vegetable producers who consign their products through agricultural cooperative is 20 %. In analyzing the case of the agricultural cooperative, Coronel Oviedo, the distribution cost is high and comprises about 30 percent of the production cost. A breakdown of the distribution costs according to expenditure item shows: 50 percent for retail handling fees of the agricultural cooperative, 30 % for transport cost, 7 % for packing (boxes), and 13 % for wholesaler handling fees. Consigned shipping through the agricultural cooperative is advantageous for the small-scale farmer who has difficulty obtaining market information and access. However, if transport costs and wholesaler handling fees, etc. can be eliminated, the agricultural cooperative would achieve a large reduction in their distribution costs. In order to accomplish this, it is necessary to secure processing facilities and markets near the vegetable producing area.

2) Processing

In terms of processing, following points can be bottlenecks.

- There is no vegetable processing plant in Coronel Oviedo city nor Caaguazu department. CIPAR, which is the only tomato processing plant, is located in Central department. It is necessary that a plant is located near Coronel Oviedo in order to ensure long-term competitiveness. It is essential to attract a plant building.
- There is a large potential of increasing production of raw material vegetables. However, the production of tomato is not big enough even if it is most commonly cultivated. Since it is essential to expand the cultivating area in order to promote processing, it will take time to attract a plant.
- Although vegetable-processed products for export are assumed to be canned vegetables and frozen vegetables, few plants have that kind of technology.
- In the case of canned vegetables, they have to get cans in one way or another. If they cannot purchase cans in the country, they have to depend on import or manufacture cans near the processing plant. In the former case, distribution cost is high. In the latter case, investment on facilities is required.

On the other hand, following points can be advantages.

- As is mentioned in 1), they have established a cultivating method that raise quality and yielding of tomato while slashing cultivation cost. It is highly possible to create the vegetable cluster centering

on tomato if they are motivated.

- Since it is relatively easy to acquire processing technologies such as canning or freezing vegetables, plants can start operation early.
- Capital investment in refrigerating plant would be millions of dollars, however, canning plant can start in a small scale with thousands of dollars.
- Domestic demand for tomato-processed products is covered by import. If tomato-processed products are produced in the country, they can expect not only the export market but also domestic demand.

2.3.2 Model of the cluster

(1) Location

1) Raw materials

Tomato, the most commonly produced vegetable in Paraguay, is cultivated in the four departments of Caaguazúu, Central, Alto Paraná, and Paraguaríi, a region where the total production volume comprises more than 75 %. Although freshness is a major factor of product viability, the high water content of tomatoes in comparison to other agricultural products has made storage difficult and contributed to increased transportation costs. As a result, there is a 30 % loss during the distribution stage and there is a noticeable drop in quality after the tomatoes are harvested. Another distinction is that it is also a labor-intensive product that is cultivated by small-scale farmers, a relatively surplus source of labor. Therefore, it has been concluded that the four departments mentioned above, which have easy to Asuncion and Ciudad del Este, the two large consumer markets, are appropriate as a vegetable cluster in terms of labor, product quality, transport costs, and as an established main producing area.

Caaguazú department, in particular, is located between the two consumer markets. The agricultural cooperative, Coronel Oviedo, which is located in this department, has been the focus of a JICA project to improve the produce distribution system. It has received technical assistance to strengthen its organization to implement cooperative shipping. As a result, the total shipping volume of the cooperative rose from 233 tons in 1992 to 3,000 tons in 1997, an increase of 12 times; and it is becoming the largest domestic vegetable producing area.

In addition, Coronel Oviedo, along with the Blas Garay Cooperative in the same department, have been designated model projects for the "Promote the Production and Export of Non-Traditional Crops" (Programa Nacional de Desarrollo de las Exportaciones de Ruburos No Tradicionales), a project based on the Paraguayan government policy on crop diversification. The area in which these two cooperatives is located has been proposed as priority vegetable cluster site in order to effectively promote agricultural policy and its related projects.

2) Processing

Following four points are considered in determining location of the vegetable cluster including

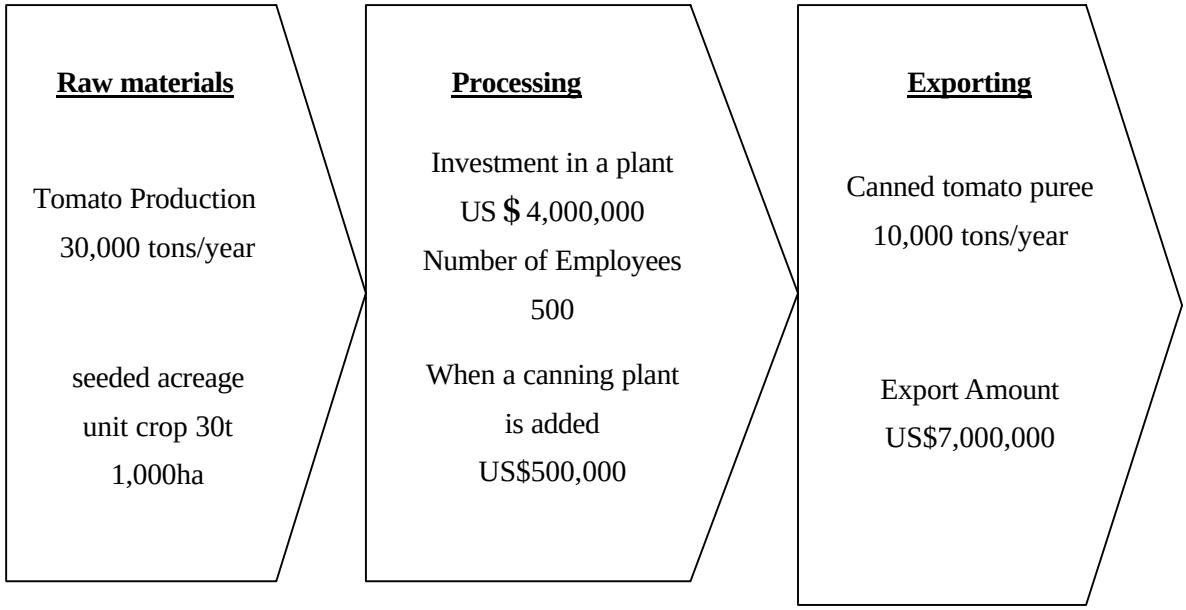
processed products. a) It is desirable that producing region of raw materials and processing plants are adjacent to each other in order to minimize deterioration of the vegetable and loss of yield. This condition is particularly required in Paraguay, which is located in the subtropical zone and does not have smooth distribution in the country. b) It is preferable that the place can get a stable sufficient supply of raw materials at a low price. In this aspect, it is likely that fresh vegetables for the consumer market and raw material vegetables compete with each other in Central department located close to the capital with a large population. Consequently, it is expected that both prices and amount of raw materials will be unstable because farmers put priority on vegetables for the consumer market, which can be sold at the higher price. c) It is desirable that a plant processes several kinds of vegetables that are harvested in different seasons in order to raise the plant's rate of operation because year-round culture is impossible for most of open-field vegetables. If a plant processes one agricultural product, a region with longer harvest time can be a good location. d) It is preferable that a region has a considerable experience of cultivation. Even if they attempt to create the vegetable cluster, it is extremely difficult to ensure raw materials and invite plants in a region with little experience of cultivation.

To sum up, it is desirable to create the vegetable cluster in a location with a large amount of raw materials supply or potential of them. If we give consideration to these and what was mentioned in 1), regions around Coronel Oviedo in Caaguazu department are promising as a location of the vegetable cluster. Coronel Oviedo, which is a point where trunk roads running from east to west and from south to north cross, is a good location to collect and store vegetables and there is no hindrance in terms of processed goods distribution for exports.

(2) Model

Assuming that 10,000 tons of tomato puree is exported in a year, the simulation model is as follows.

Figure 6 Vegetable Cluster Model



In terms of export amount, 10,000 tons of tomato puree would be equivalent to US$ 7 million. Reasons why we chose tomato puree are; a) tomato is the most commonly produced vegetable in Paraguay, b) in the cases of tomato ketchup and tomato juice, each consumer country has its own preference of taste, and brand loyalty is relatively strong. These trends are weak in the case of tomato puree. More than half of tomato processed products traded in markets around the world is tomato puree or tomato paste. We set 10,000 tons of export because 1,000 tons or 2,000 tons of export is too small in the world market. Small amount of export would make Paraguay a limited export country and leads to unstable conditions.

1) Production of raw materials

In order to produce 10,000 tons of tomato puree, raw materials three times as many as the amount of tomato puree is required. In order to produce 30,000 tons of tomatoes, 1,000ha of area is necessary with 30 tons of yielding per hectare, and 750 ha of area is needed with 40 tons of yielding per hectare. Cultivation method of tomatoes for processing does not need any pole, which is different from the method to produce tomatoes eaten fresh. At the moment, yielding of tomatoes for processing in Caaguazu department is 40 tons per hectare.

In order to strengthen competitiveness, it is essential for the vegetable cluster that raw materials producing areas and processing facilities are close to each other and industries are concentrated in the region. Firstly, freshness of raw materials is important for producing good products. In the case of tomatoes, they must be processed within 24 hours after harvesting. Secondly, the distance between raw materials producing areas and plant facilities is a more important point than the distance between consumer places and plants in terms of distribution cost in the case of products like tomato puree, whose

yield rate is one third.

2) Plant scale

It is estimated to cost US$4 million to build a plant to produce 10,000 tons of tomato puree including land, building and machinery. Operation cost may amount to US$4 or 5 million at the highest. Operation cost reaches its peak in February and March, it falls gradually since then and becomes almost zero around October because tomatoes are processed from November to February and exported throughout a year on average.

If they import cans to fill tomato puree in, the cost is high. However, the freight can be curbed if trucks used for exporting carry empty cans on their way back. It is necessary to import tin plate and produce cans on their own so as to strengthen competitiveness further. To do so, another US$500,000 should be invested.

The number of employees is affected by the extent of mechanization. Assuming that value added ratio of tomato puree is 50 % and it is divided by US$7,400 dollars, which is the past result of the annual value added, the number of employees is estimated to be 500 people. 500 people are required on average throughout a year. In actual, during 4 months of period when tomatoes are processed, about three times of this will be required since they take triple shift for 24 hours.

3) Export

The price at which tomatoes as raw materials are sold to factories is very important keypoint in forming this cluster. Since the international quotation of tomato puree is about US$900 per ton in CIF, price below US$800 will be required if they enter the export market by featuring low price. In addition, it costs some US$100 per ton as land freight to the port of exit in Paraguay, which makes FOB US$700. In calculating backward, in order to produce competitive tomato puree, raw material tomato should be sold to plants at US$120 per ton at the highest.

(3) Potential market

As export destination of 10,000 tons of tomato puree, Argentina and Uruguay are promising. The period when tomatoes can be cultivated in open field with low cost is not long in Argentina and Uruguay due to the climate. Many of tomatoes eaten fresh are cultivated in greenhouses, which is high cost production. In Argentina, about 1 million tons of tomatoes are produced. The supply is not enough so that 30,000 tons of them are imported. In Paraguayan super markets, tomato-processed products produced in Paraguay are sold. However, it appears possible to export Paraguayan tomato processing

products to Argentina by comparing fundamental conditions.

2.3.3 Tasks to strengthen the cluster's competitiveness

(1) Raw materials - issue of planned cultivation (contract) -

The Empacador Del Sur and HISPASA are two examples of vegetable processing companies that are located near the vegetable producing area and directly connected to production. Due to the difficulty of reducing costs and maintaining the quality of vegetable produce, both processing companies attempted to contract the production of vegetables directly with the farms. Due to the inability to secure a stable supply of raw ingredients to cope with such issues as quality, grading, and shipping period, they were forced to abandon this plan and to rely on directly operated production fields with irrigation and basic production facilities for their supply of raw ingredients.

According to a survey conducted by HISPASA, the buyers from Spain purchase produce (tomatoes, green peppers) of a distinct quality and hotness; and in order to meet their demand, producers have had to utilize seeds produced in Spain. Vegetable seeds are generally produced for the production area. Although the northern and southern hemisphere are on the same latitude, there are numerous problems related to cultivation and trial production and measures to acclimate the vegetable produce are needed before implementing export activities targeting seasonal differences.

In contrast, vegetable clusters provide an advantage for small-scale farmers. However, operating capital which will assist farm management such as technical supervision and extension activities in cultivation technology that will enable farmers to cope with the terms and demands of contracted cultivation with processors is essential. If such improvements can be implemented, a stable connection with the agricultural processing industry becomes a possibility.

(2) Processing

In Paraguay, there are eight vegetable processing companies in Paraguay at present; however, no plant is located in Caaguazu department. In this section, we discuss how to invite a plant to this province smoothly. Plant invitation can be categorized into two types, national capital and foreign capital. In the case of national capital, two cases can be assumed. One of them is that producers of raw materials such as agricultural cooperative associations enter the processing industry. The other is that food companies enter that business. We discuss what conditions are required to attract plants in each of these three cases.

1) Plant affiliated with agricultural cooperative association

If an agricultural cooperative association starts plant management, raw materials are produced by members, therefore, supply of raw materials can be ensured better than other two cases. In this respect, it is easier to overcome the issue that made existing vegetable processing plant suffer. However, they have a huge handicap in terms of people, money, technology and the market. They have to begin getting plant managers, production engineers, funds for plant construction and operation, production know-how, sales network and so on from scratch.

Assuming that these points are solved, agricultural cooperative association affiliated plants tend to lose competitiveness due to lack of market-oriented mind. It is because agricultural cooperative associations are originally the organizations to raise living standard of producers. In many cases, they hope to raise prices of raw materials sold to the plant, and they are reluctant to spend much money on plant facilities. They have little idea of curbing raw material prices to gain competitiveness in the market or of investing newly to raise quality of the products.

Of course, it does not mean all the agricultural cooperative association affiliated companies have such tendency. In New Zealand, agricultural cooperative association affiliated companies produce and export most of dairy products and vegetable processed products with world-class competitiveness. In short, their business depends on whether they have full-fledged business mind and marketing oriented mind.

2) Domestic food companies

Domestic food companies win an advantage over agricultural cooperative association affiliated companies in terms of human resource and technology. In gaining access to the market, they can get better position by utilizing their experiences. However, there is a great constraint in ensuring fund for plant construction. It is a problem whether they can repay their debt if they have the loan in the guarani currency with high interest rate. If they can continue exporting smoothly, real interest rate may be lower than expected as long as the guarani keeps falling against the US dollar. However, smooth exporting is the precondition in this case.

It is a realistic approach to produce tomato-processed products in an existing plant facility and to take a wait and see attitude. Even if delivery cost of raw materials is high, they should go through the stage where they confirm whether they can get stable supply of raw materials and they can export smoothly. When they get good prospects in these points, they can determine to build a plant in the neighborhood of Coroned Oviedo City.

3) Foreign companies

It is usual that foreign companies with experience enter the business. They have little trouble in ensuring human resource, fund, technology and marketing. The problem is whether a foreign company finds merit in building a plant in Paraguay. Under the current circumstances, there are not enough conditions in Paraguay. Since the market of tomato-processed products in Paraguay is small, it is not expected that foreign companies come to get the local market, as is often the case with Latin American countries. Even if there is the MERCOSUR market, foreign companies cannot help but be cautious in starting operation in Paraguay, where the supply of raw materials are not ensured in the past record.

It will be necessary to show that domestic companies export tomato-processed products by using raw materials cultivated in the country, or disseminate information in and out of the country that agricultural cooperative association will cultivate raw materials on a contract basis.

4) Conclusion

To sum up, agricultural cooperative associations and domestic food companies are complementary to each other. In ensuring raw materials, agricultural cooperative associations have an advantage, and companies get the upper hand in terms of human resource, technology and the market. In terms of funds, agricultural cooperative associations are in a better position by comparison.

It may be a realistic starting point for an agricultural cooperative association and a domestic company to set up a joint venture of tomato processing. In order to promote such project, it is necessary to make full use of Law60/90 for investment and build a plant with low operation cost. Some supporting measures are also required such as preferential loans to such joint ventures, local governments' provision of plant sites, or prior development of infrastructure.

(3) Influence on the environment

In tomato processing, wastewater released after washing raw materials, tomato skin and seed left in the concentration process may affect the environment. Since there is no substance regarded as a problem in BOD or COD in wastewater, it has little impact on the environment. Skin and seed are not problematic either because they can be recycled by drying and mixing with fertilizers used in the field.

2.3.4 Strategy to strengthen the cluster's competitiveness

As mentioned in 2.3.3, there is a potential to form the vegetable cluster in Paraguay. However, there are many challenges in terms of cultivation and processing at the moment. As a prerequisite of the cluster formation, private companies must take initiative. However, just waiting for private companies to join takes them nowhere. Since this cluster can be a trump card to raise living standard of small farmers, the government should actively support and engage itself in it. Following measures should be taken to this end.

- At the moment, agricultural cooperative associations should be taken as promoters of the cluster operation and provided funds for cultivation and processing.
- If the government guarantees an agricultural cooperative association and invites a private company to build a joint venture plant with the association, it will be easier to attract private companies. The government's guarantee of the cultivated amount, selling price and so on would facilitate starting of plants as well as farmers.
- In order to differentiate Paraguayan products as niche products for EU and the North America with large vegetable processed products markets, PROPARAGUAY will conduct a market survey in terms of breed and processing method to narrow down the target. In the case of tomato products, there are puree, whole tomato and ketchup. There is a variety of can size. Sugar content, acidity and color are different depend on the tomato quality. Organic cultivation can be an option for differentiation. They should pay attention to the function of lycopene, a substance making tomato red, that removes active oxygen and control carcinogenesis. They should discuss introducing tomato breeds with much lycopene for differentiation of the product. Some Japanese manufacturers have already started this kind of differentiation.

2.4 FRUIT CLUSTER

Products of this cluster could be fresh fruits or processed fruits. In general, fresh fruits can be exported when a destination country cannot produce the fruits, or produce very little of them or the country is in between-crop season. In such cases, fruits can be exported at relatively high price, and it is easy to obtain high value added even if they are not processed. On the other hand, processed products can be exported throughout a year. However, competition of processed products is more fierce than that of fresh products, which makes cost conditions severer, and value added can be raised only by the productivity improvement. Fresh products and processed products of the same kind of fruits can be complementary to each other for strengthening competitiveness. Fruits with good quality can be sold as fresh fruits and the second grade products are passed on to processing. Consequently, this cluster will carry both fresh products and processed products.

2.4.1 Analysis of current situation

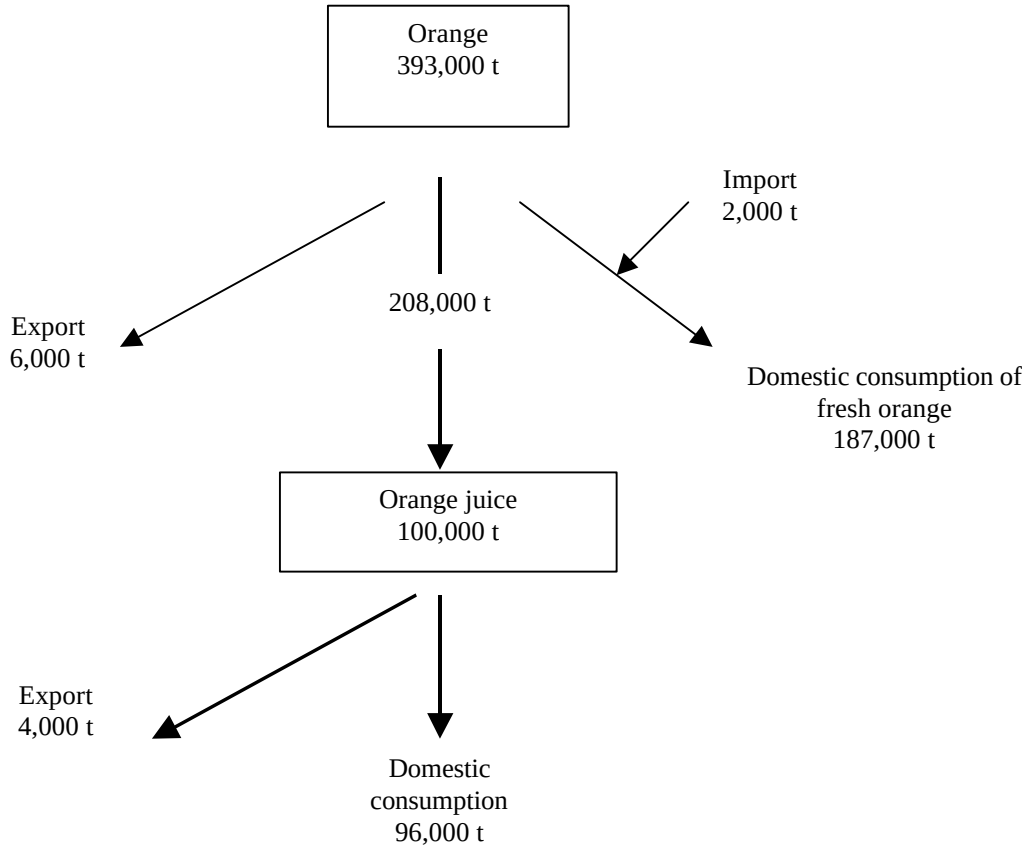
(1) Overall structure of the cluster

In this cluster, orange juice has the largest share of processed products. In Paraguay, 446,000 tons of citrus fruits (orange, mandarin orange, grapefruits, lemon and so on) are produced in a year. 393,000 tons of them are orange. Orange is categorized into sweet orange (Naranjo dulce) and sour orange (Naranjo agrio), each annual production is 208,000 tons and 185,000 tons respectively. Sweet orange is a growing segment. The production increased by 20.6% in 2 years from 1996 to 1998. The reason of growth is that trees planted several years ago have started to be harvested. The number of trees has hardly increased.

Sweet orange, which is used for processed product, is processed into juice. When they squeeze the juice out of washed oranges, the yield would be about 50 %. Since they have to make juice throughout a year even though the harvest time of the orange is limited, the juice must be concentrated to one eleventh under the reduced pressure and intermediate temperature. The concentrated juice is filled into drum can and frozen. It is thawed as the need arises and diluted with water to the original ratio (which is referred to as concentrated and reconstituted juice). The reconstituted juice is packaged into the container under the germ-free condition. As byproducts of juice, orange oil (aroma substance) is extracted from the orange skin and dried lees, which remain after squeezing, is used as a raw material for the mixed feed.

Orange Supply Chain can be demonstrated as follows.

Figure 7 Orange Supply Chain



(2) Analysis of current condition

1) Raw materials supply -fruit-

There are very few commercially cultivated fruit in Paraguay. Industrial crops such as mate tea and tung tree and recently, bananas and coffee are the only products that are commercially grown. However, the annual production volume of these crops has decreasing annually. The number of farms cultivating oranges is 28,000, about 10 % of the total number of farm households (1991 Agricultural Census, MAG). This is nearly a 20 % drop from 1981 statistics. The number of orange trees that was replanted in 1991 was about 680,000 a 30 % decrease from 1981 statistics. These farms are mainly small-scale farms located in Itapúa and San Pedro departments. MAG has encouraged fruit cultivation in the semi-arid region of Chaco.

In 1981, a large-scale processing factory to produce fruit juice was constructed in La Colmena district in Paraguarí department by an Italian firm. Due to the inability to secure the raw materials of plum, grapes, and melons, the factory was forced to close down following its construction and before its operations could commence. Due to the higher demand for fresh rather than processed juice, it is difficult to procure limited fruit crops cultivated in fixed areas for processing. Therefore, large-volume,

easy-to-supply fruit such as oranges, which are cultivated nationwide, are more suited for processing. The largest fruit processing factory in Paraguay, located in Itapua and owned by FRUTICA, utilize oranges from its own orchards, in addition to oranges collected from other regions.

2) Processing

14 plants are connected with the fruit cluster.（Based on 1998 Industrial Census and Interview）

Table 10 Actual State of Plants Related to the Fruit Cluster

Department	Number of Factories	Processed Products of Plant
Asuncion	4	Fresh juice
Cordillera	3	dulce and jelly of orange or guava
Caaguazu	1	dulce and jelly of orange
Itapua	3	Juice
Paraguari	1	dulce of fruits
Central	2	Juice

As processed products of fruits, there are juice, canned fruits, marmalade, dulce and jelly. Juice, canned fruits, frozen fruits, dried fruits and marmalade are suitable for exports. Juice would be a main product. Among juice plants in Paraguay, a company in Asuncion seems to produce juice by squeezing fresh fruits and filling it, which is not good for exporting because its open date is short. Only two companies in Itapua department are actually exporting juice. Most of juice exported from Paraguay is produced in one of the two companies. The company used to export about half of its products to Brazil. When exporting to Brazil became impossible due to depreciation of the real (Brazilian currency), the company started exporting frozen concentrated orange juice to EU. Another company is a start-up, which began operation several years ago. The company is dealing with niche item such as acelora juice.

(3) Bottleneck and advantage

1) Fruit production

It should be considered in the production of orange that it is a perennial crop and a period of five years or more is required before a profit is generated. Based on the MAG production costs, a comparison of production costs according to fiscal year and profit-making season is shown in the table below.

Oranges are harvested from the fifth year of mature trees and a stable profit is achieved from the seventh or eighth year. Marked successive diminution of the harvest volume occurs from the 15th year. In view of these characteristics that occur in the management of orange production, companies with relatively surplus capital or medium to large farm operations are suited for the fruit cluster. In order to enable small-scale farmers to begin the production of oranges, conglomerate management or financial

assistance in the form of operating capital from companies is required.

Table 11 Comparison of Production Costs and Yield

Year	Production cost (Gs)	Year	Yield (volume)
1	1,426,857	1-4	0
2	429,571	5	29,000
3	558,547	6	38,000
4	723,551	7	53,000
5	973,126	8	72,000
6	1,333,126	9	87,000
7	906,710	10	87,000
8-15	7,253,680	11	83,000
Total	13,605,168	12	77,000
		13	72,000
		14	68,000
		15	59,000
		Total	725,000

Source: Compiled by MAG, Elaboración por Genaro Coronel, 1999

2) Processing

Following points can be bottlenecks of this cluster.

- The production of oranges as raw materials is not enough to increase exports of processed goods. It is impossible to increase the production of raw materials because it will take long time between tree planting and harvest.
- Two Itapua companies that export juice cannot operate their plants at full capacity due to lack of raw materials. In order to create and strengthen the cluster in this region, increase in fruit production is precondition
- They don't have much experience of exporting frozen concentrated juice, which is a popular form of fruit exporting. Only one company started it in 1999.
- Location of the largest exporter of juice is 20km away from the national road. Since the plant and the national road are connected by a dirt road, the company cannot export fresh products and have a heavy loss when rain continues.

On the other hand, following points can be advantages.

- EU countries highly evaluate the quality of orange juice produced in Paraguay.
- They have a large potential of expanding production. In addition to Itapua, San Pedro and Caaguazu departments, Boqueron has a suitable location.

2.4.2 Model of the cluster

(1) Location

1) Raw materials supply - oranges and melons-

The citrus fruit, orange (naranjo dulce) is suited for cultivation in tropical and subtropical climates. As in the case of vegetable produce, the ratio of deterioration and loss following harvesting is high and long-term storage is difficult. Subsequently, processing facilities that are adjacent to the orange producing areas and located within a radius of several kilometers are ideal. Presently, Itapua department in the southern region is climatically suited for orange cultivation and this production area produces 25 % of the total production volume. The largest domestic fruit processing company, FRUTICA, has utilized this characteristic of the department and carries out comprehensive operations that cover the production of the raw ingredient to processing; and it actively exports their product to MERCOSUR and the EU. Based on these circumstances, this department has been determined to be suited as a cluster location.

Although melons are transacted as fruit in the market, they are handled as a vegetable during the production stage. Hence it fulfills the site conditions for a vegetable cluster. A small-scale irrigation project by JICA and supervision in high quality melon cultivation by CETAPAR is presently under implementation in La Colmena district in Paraguarí department. As a result, it has become the most advanced district in melon production technology. As mentioned earlier, it has also been targeted for the "Project to Promote the Production and Export of Non-Traditional Crops" by the Paraguayan government. It is suited as a priority district for a fruit cluster similarly to the Coronel Oviedo district in Caaguazú department.

2) Processing

In Paraguay, oranges are the most commonly produced fruit. 393 tons of oranges were produced in 1998 alone. Besides oranges, bananas and pineapples are popular. Dried banana is a typical product processed from bananas. Pineapple can be processed into canned or frozen pineapple and juice. However, production of both of them suffers from lack of supply of raw materials. Therefore, we focus on oranges in this paper. Oranges can be categorized into sweet oranges and sour oranges. Sweet oranges are suited for juice, with 208,000 tons annual production. Itapua (23%), San Pedro (16%) and Caaguazu (13%) account for 62% of total production.

Fruits generally deteriorate less through aging than vegetables. In this respect, the distance between producing areas and processing facilities of fruits need not be as short as that of vegetables. However, if

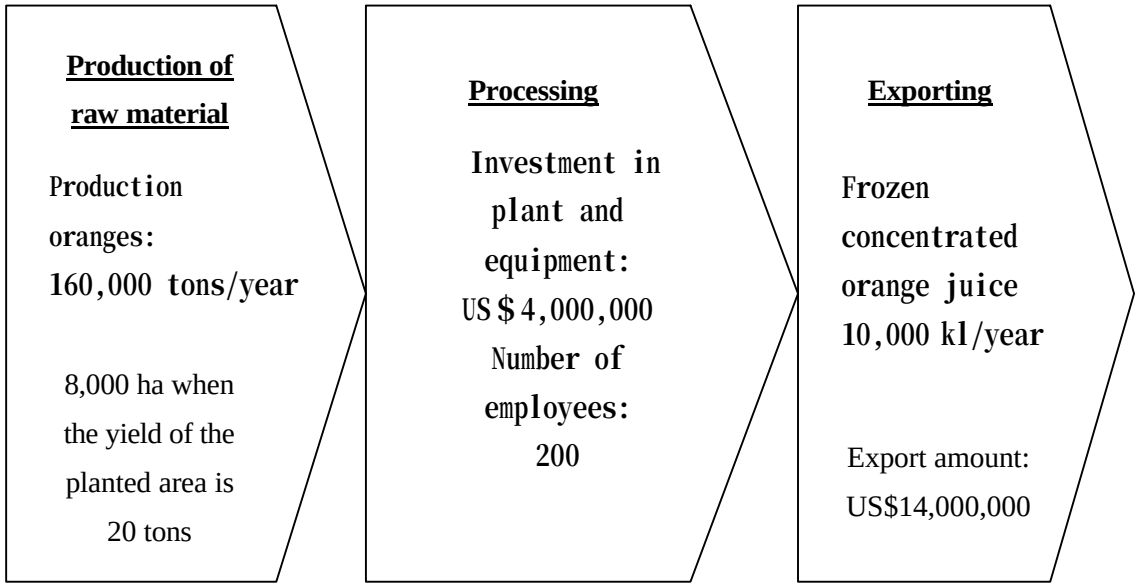
the producing area and the plant are located close to each other, the physical distribution cost can be curbed. As a result, it is usual to locate a plant where fruits can be harvested. In the case of Paraguay, Itapua is realistic as a location for the fruit cluster, with oranges at the core based on the above-mentioned distribution of producing areas.

(2) Model

The largest exporting country of frozen concentrated orange juice is Brazil, which exports 88 % of their production, or nearly 1.2 million tons a year (1997/1998). On the other hand, Paraguay exports about 4,000 tons of that to Argentina and Brazil as consumer products contained in tetra packs. It appears that Paraguay and Brazil coexist as exporters in segregated markets by focusing on products differentiated from each other. However, the geographical scope of the Paraguayan exporting market is extremely small (within a radius of 1,000 km from Paraguay) due to the short open date of tetra packed products. Since major markets of Orange juice are in the EU, North America and Asia, it is necessary to process their juice into frozen concentrated juice. Therefore, we create the fruits cluster model with frozen concentrated orange juice as the subject.

The figures below are based on the precondition of exporting 10,000 kiloliter (kl) of juice a year.

Figure 8 Model of Fruits Cluster



The export price of frozen concentrated orange juice is about US$1,400 per kl. Export of 10,000 tons of juice amounts to US$14 million. Capital expenditure on plants can be separated into investment on juice extraction plants and on freezers. It is necessary for existing plants to increase freezers in order to export 10,000 kl of juice. In that case, investing 1 million dollars would be enough. About 80 % of employees are seasonal laborers needed during the orange harvest time only. 160,000 tons of raw

materials are required to produce 10,000 kl of frozen concentrated juice assuming that its density, concentration ratio and yield are 1.33, one sixth and 50 % respectively.

(3) Potential market

The largest export market of frozen concentrated orange juice is the EU, followed by USA and Japan. In the USA, Florida is a major orange producing state. In the past, damage from cold weather in this state doubled or even tripled the international market price of oranges. However, as their orange production has shifted to the southern part of Florida, which hardly faces damage from cold weather, the orange production has increased and stabilized. As a result, exporting to USA has become less favorable. Recently, exports to USA and Japan have grown but the market, on the whole, is stagnant due to the shrinking US market. Price competition has also become intense.

As mentioned, Brazil is the largest exporting country of juice, but its domestic market of orange juice is rapidly expanding. Though small, the market of paper packed juice has grown especially rapidly, at an annual rate of 50 to 100 % in the late half of the 1990s. More than 90 % of orange juice plants in Brazil are concentrated in Sao Paulo. Enough tetra packed orange juice is produced in Paraguay to expand export to neighboring countries' markets. In Brazil, the states of Parana, the west half of Santa Catarina, Mat Grosso do Sul, and Rio Grande do Sul can be Paraguayan markets. Uruguay and Argentina are also potential markets.

In the case of frozen concentrated juice, it is necessary to differentiate Paraguayan products to compete with Brazil. A major orange juice manufacturer in Brazil built tank farms in harbors of the EU and Japan to reduce costs by transporting and storing products on single-purpose ships. Since Brazil has established the system suited for mass production and mass transportation of uniform products, they have a handicap in producing differentiated niche products. Paraguay must use 180-liter-drums, but it is easy for Paraguay to make niche products.

In order to differentiate products, orange juice can be produced through organic cultivation, there can be differentiation by breed (Valencia orange is common in the world), or differentiation by the degree of ripeness (the more ripe, the more sugar content).

2.4.3 Tasks to strengthen the cluster's competitiveness

(1) Raw materials - melons and oranges -

1) Strengthening the competitiveness of fresh melon production

The fruit cluster for melons mainly target the export of fresh melons. The export of melons and other produce must take into account high quality and seasonal differences. As explained earlier, the survey results of the "Project to Promote the Production and Export of Non-Traditional Crops" which targets MERCOSUR and EU show that melons have the optimum potential as an export product that utilizes seasonal differences.

In the case of the melon-producing district, La Colmena, cultivation throughout the year became possible with the implementation of the small-scale JICA irrigation project. Subsequently, the district achieved a record yield of 19 tons in comparison to the national average yield of 10 tons. In addition, due to the introduction of variety improvement technology, high quality melons that are disease resistant and able to withstand long-term storage were introduced by CETAPAR. The cultivation of the variety, sunrise, which was difficult to export in the past, has spread. Irrigation and variety improvement technology have made it possible to cultivate high quality melons throughout the year; and these two combined factors are vital to strengthening the competitiveness of export activities that target seasonal differences.

2) Strengthening the competitiveness of orange production

The annual production of oranges (naranjo dulce) has decreased after achieving a peak production volume of 370,000 tons in 1981. Annual production volume has remained at about 180,000 tons for the past decade. The cause of the fall in production is due to the spread of the cancro disease (*xanthomonas spp.*) from Brazil. Cultivation technology that aims to eliminate diseases and insects is vital in order to increase orange production.

Despite a decrease in the domestic production volume, FRUTICA, mentioned above, possesses 11,000ha of land and presently cultivates oranges, peaches, grapes, and other fruits from a farm encompassing 7,500ha. that is directly operated by the company. FRUTICA not only produces processed products, but exports fresh mandarins from February to March, oranges from March to May, peaches from October to November, and grapes from November to December to MERCOSUR and EU, and targets the seasonal differences. The cultivation of fresh fruit has been made possible by the use of irrigation facilities of the company-operated farm, adjustment of the harvest period, and quality control measures.

(2) Processing

In Itapua department, there are two large-scale juice plants with facilities to produce frozen concentrated juice. However, the freezing facilities are to produce frozen concentrated juice as intermediate material for making consumer type juice in the plant. If they focus on frozen concentrated juice for exporting, lack of freezers is expected.

Another major challenge is their shortage of raw materials. There are two points. One of them is that the production of orange raw materials is less than the plant capacity. The other is that it is necessary to raise other kinds of fruits for producing juice besides orange, whose harvest time is only three month long, in order to improve operating ratio of the plant.

(3) Influence on environment

Orange lees remain as industrial waste in this cluster. Orange aroma substance can be extracted from the lees, and dried lees can be used as feed or fertilizer. Such reduction cycle would reduce influence on the environment to almost zero.

2.4.4 Strategy to strengthen the cluster's competitiveness

In order to strengthen this cluster, we should tackle following tasks in fresh products and processed products.

(Fresh Products)

- In producing areas for exports of fresh products, roads should be developed at least not to cause obstruction of distribution even if it continues raining.
- By setting up quality standard for exportable products (degree of ripeness, sugar content, color, flaw, shape, size etc.) or using standard of destination countries, official approval mark should be attached to products that meet the standard.
- For the products meeting above-mentioned standard, design, material and size of container should be unified.
- The agricultural test laboratory should take initiative in pursuing the potential of organic cultivation and spreading the results.
- PROPARAGUAY should take initiative in the campaign to promote exports of fresh oranges and grapefruits to Argentina and Uruguay.

(Processed Products)

- Contracted cultivation farmers can loan public fund for operation fund required for the period from the planting trees to harvesting. It shall be possible to get loan without land registration as long as a contracted company guarantees.
- A breed of orange that can be harvested, processed and exported in off-season should be found and grown. Technical guidance should be provided. Promotion should be made to communicate with companies.
- Since harvest time of acelora is seven-month-long and it takes laborious work for harvest, we recommend the cultivation of acelora as a promising item along with orange. Acelora has much vitamin C. It is possible to differentiate acelora by highlighting its healthy image through organic cultivation.

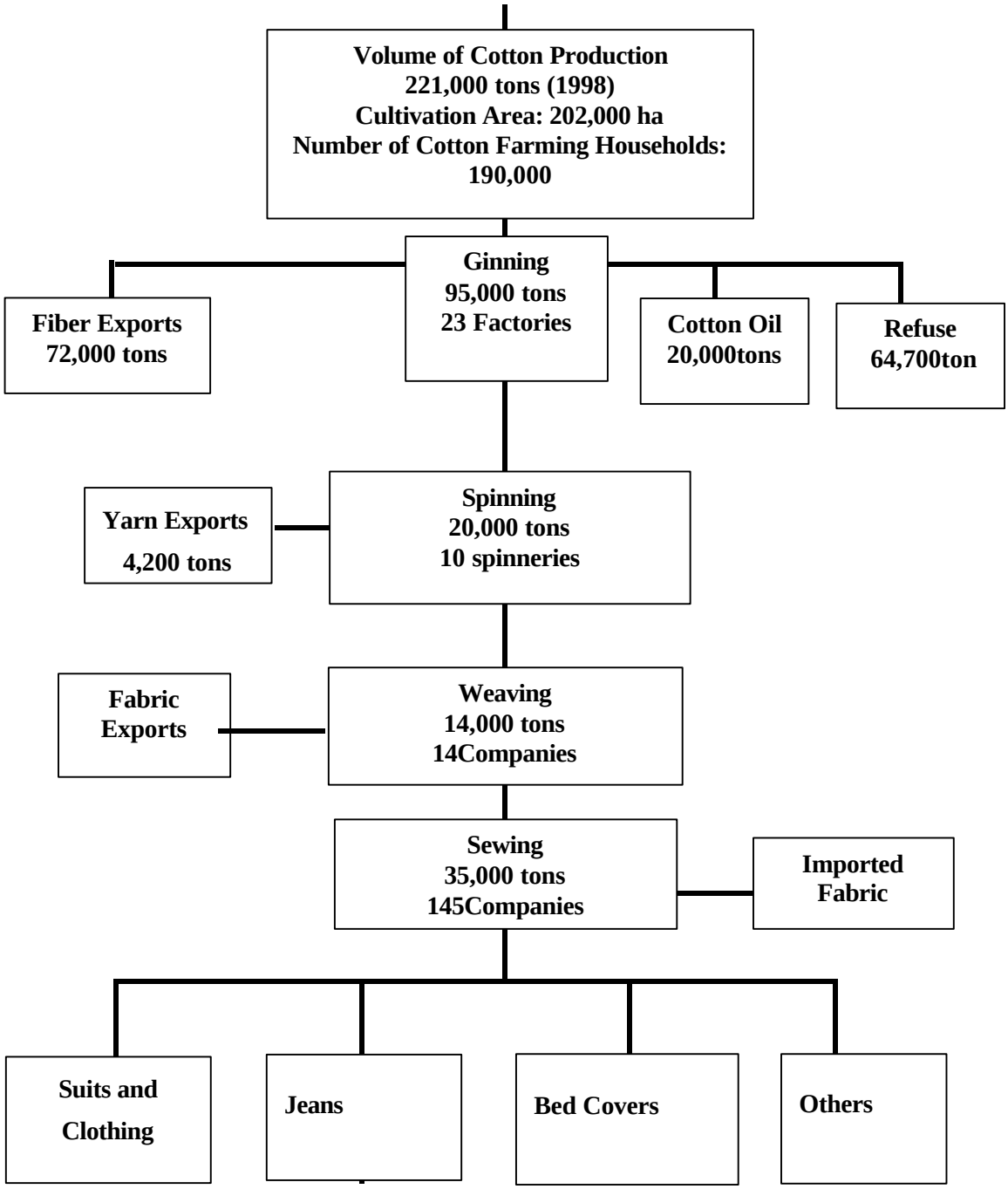
2.5 COTTON CLUSTER

2.5.1 Analysis of current situation

(1) Overall structure of the cluster

The cotton industry in Paraguay obtains its raw materials domestically and is one of the country's leading export industries. The figures in the diagram are based on information provided by the Central Bank of Paraguay.

Figure 9 Structure of the Cotton Industry



The raw cotton contains 33-36% of fiber and 55-60 % of seeds, the price of the latter is around US$35 per ton as an oilseed. The rest, around 10% of the raw cotton, is the short fiber and the refuse, which don't have any value.

As shown in Figure 9, 23 ginneries owned by 12 companies are operating in Paraguay. This number has been halved from 46 since 1991. 6 ginneries have a processing capacity of more than 10,000 tons per year. There are a total of 21 spinneries and weaving factories. There are few factories engaged in continuous operation from ginning to weaving. It is said that only 40% of processing factories are in actual operation mainly due to the serious crisis of the financial sector. As a whole, the cotton industry in Paraguay is exporting 80 % of the produced cotton fiber, while importing 70- 80% of textiles that are used as the material for clothing industry.

There are 120 clothing companies, mostly located in the central area. While the industry has relied on exports in the past, a series of order cancellations due to the Brazilian currency crisis, import restrictions by Argentina and the bad image of Paraguayan products have all contributed to a downturn of exports. Companies are now trying to survive by marketing their products in the domestic market. Large manufacturers have business tie-ups with jean manufacturers in the USA. To make the situation worse, imports of cheap garments and second-hand garments from Southeast Asia have completely eroded the price competitiveness of Paraguayan products, as the domestic wage level is four times higher than that in Southeast Asia.

(2) Analysis of current condition

1) Raw materials

Cotton is cultivated mainly in the eastern region where small-scale farmers are widely distributed. The seven departments of San Pedro, Caaguazú, Itapúa, Caapazá, Paraguarí, Concepción, and Alto Paraná located in this region produce about 80 % of the total production volume. The total production volume over the past 10 years peaked in 1989 at 640,000 tons and has annually decreased thereafter, dropping to only one-third of the 1989 total production level in 1998. The major underlying cause, pointed out in Interim Report 1, was lowered soil fertility and the onset of the picudo insect.

As in the case of the vegetable cluster, it is easy for small-scale farmers to enter the cotton cluster. Hence the entire eastern region, which has a concentration of numerous small-scale farmers is potentially suited as a cluster location. However, the recovery of the declining production volume of cotton is a priority condition in terms of promoting the cotton cluster. A short-term solution is to

promote the cotton cluster in the three departments of Caapazá, Alto Paraná, and San Pedro where soil fertility is high and increased production can be anticipated at an early stage.

2) Processing

As shown in Table 12, many ginneries are located in Caaguazu and Itapua departments where the raw cotton is produced in large quantity. On the other hand, the most clothing industry as well as spinning and weaving factories is located in Central department and Asuncion. As for the clothing industry, it will be easier to obtain various technical information in terms of popular designs and leading fashions in the central area of the country. A total of 189 companies operate in the cotton industry in Paraguay.

Table 12 Number of Cotton Processing Factories by Department

	Ginneries	Spinneries	Textiles	Spinning and Weaving	Clothing and Others
Alto Parana	1		2		6
Asuncion		1	3	1	58
Caaguazu	4	1	1		1
Central	2	4	2		63
Concepcion	1		1		3
Neembucu	1	1	1		
Guaira	1			1	5
Itapua	6		1		
Misiones					2
Paraguari	2			1	5
Presidente Hayes	1				1
San Pedro	2				
Boqueron	1				
Amambay					1
Cordillera	1				
Total	23	7	11	3	145

Source: MIC and CADELPA, Hearing Information

As of April in 2000, there are only 6 or 7 spinning mills operating, the most of which are producing traditional thread and fabric for agricultural bags and covers and for the traditional handicraft clothing. Only two manufacturers are producing normal threads of the numbers 24.3 0, they are Manufacturera Pilar and Manufacturera Central. Manufacturera Central exports most of its products to Brazil, while Manufacturera Pilar manufactures gabardine, sheets and tablecloths, and is the only supplier of the thread for the domestic industry. In this sub-sector, many companies have already closed and the purchase of the machinery is proceeding. The weaving and knitting factories are also suffering seriously from the recent recession of the cotton industry.

(3) Bottleneck and advantages

1) Raw materials - from yield to strengthening competitiveness

A characteristic of cotton production is that approximately 98 % of cotton producers cultivate cotton under contract with cotton manufacturers and shipping companies; and traditionally, it is a crop that can be easily tied into clusters. Increased yield based mainly on improved productivity and quality control during the production stage is important in developing cotton clusters. However, the raw materials producers of a cotton cluster are small-scale farms of under 6 ha and 80 % are petty farms of less than 2 ha (average land area of cotton farm is estimated 2.2 ha).

Furthermore, the average cropping area of one household is 1 ha and the scale of petty farming operations has increased since 1990. This increase has brought on continuous cropping of cotton that has contributed to lowered soil fertility. Compounded by the onset of the picudo insect, this has resulted in lowered yields. Short, medium, and long-term solutions to improving the operations of the small-scale farmer are required in order to improve this situation.

2) Processing

From the viewpoint of quality, Paraguayan cotton is slightly yellowish and has an average length of 1.332 inches (33.83 mm). Accordingly, it is classified as high quality long fiber cotton based on the HVI classification criteria. For reference, Egyptian cotton with an average length of 35 mm or longer is described as ultra long fiber cotton and rated the highest class in terms of quality.

Cotton production volume in Paraguay was ranked in 22nd in the world and export volume was ranked 18th as of 1997 (World Atlas 1999/2000).

The local price of cotton is affected mainly by quotation in New York. For example, the price in 1993/1994 hit a low of US 53 ¢ /pound but recovered to US 116 ¢ /pound by the early summer of 1995 before falling again. The income of cotton growers in Paraguay reflected such price fluctuation, hitting a bottom of US$ 104 million in 1992, recovering to US$ 230 million in 1995 and again dropping to a new bottom of US$ 61 million in 1997.

To revitalize the cotton industry, it is necessary for the government to (i) strengthen cotton growing capacity in combination with other agricultural products, (ii) prevent excessive imports of cheap clothing, including smuggling from neighboring countries and (iii) introduce preferential funding for processing companies and exporters.

Transportation in Paraguay is largely dependent on trucks. One exception is the case of the major spinning factory in Pilar that uses boats to transport its raw material from Argentina and to export its products. Most factories that are located inland use trucks. However, road transportation costs in Paraguay are said to be higher than in Brazil.

Tedious export procedure in Paraguay is sometimes said to be a problem. One exporter said that it took him one month to prepare the export documents and security for a loan. In addition, as the boxes containing products were delivered without being sealed for customs inspection, measures to prevent theft, i.e. hiring guards was required. The delivery time was, therefore, shortened, making it practically impossible to meet the delivery deadline. In the end, the export was cancelled and the equipment investment was wasted. Meanwhile, one major manufacturer with confidence in its export quality can complete the export procedure in several days.

There is a shortage of experienced engineers and technicians. In general, those who have completed courses at government-run training schools lack sufficient skills and many companies conduct in-house training through OJT, etc. after recruitment. In view of this situation, the government should adopt practical training methods and should invite engineers with working experience in the private sector to act as training school instructors. Another requirement is a survey on the working situation of those who have completed training courses at vocational training schools and who have been employed by private companies.

2.5.2 Requirements to improve competitiveness

(1) Aspect of raw materials

1) Strengthening competitiveness over the short, medium, and long-term

The average yield for over the past decade has been 1.3 ton/ha which is nearly equivalent to the average yield of Brazil (1.0 ton) and Argentina (1.4 tons). But the average yield of Bolivia centered in Santa Cruz has increased markedly in recent years to 2.1 ton/ha. The underlying cause for the disparity in yield between Bolivia and Paraguay is attributed to the lagging dissemination of disease and pest resistant crop varieties, guaranteed varieties, inadequate mechanization during the harvest period, and lowered soil fertility.

The introduction of disease and pest resistant varieties, and thorough pesticide spraying, are needed in order to increase production in the short-term in the three departments mentioned earlier, and in other areas which are suited for cotton cultivation due to high soil fertility. In addition, under the current cropping system, the harvest season falls in February and March, which has the highest rainfall.

Subsequently, this has been the cause of harvest loss and deterioration in crop quality due to inadequate drying. Although the manual labor of hand picking is important to maintaining quality, mechanization is essential in order to decrease harvest loss. Recovering soil fertility is vital over the medium term and in order to achieve this, direct sowing and green-manure crops must be introduced. The long-term measure is to improve single crop farming of cotton by small-scale farmers. Diversification using formula feed and vegetable clusters is an effective means of improving farm management.

2) Improving competitiveness through production costs

The following table 13 shows an analysis of the MAG and CAH production costs of cotton in terms of manual and machine cultivation. In a comparison of MAG and CAH production costs, both indicate that the yield increases with the introduction of mechanization. This is surmised to be due to reduced harvest loss. In the case of CAH, mechanization increased the yield and decreased production costs. Reduced labor costs during the harvest season is a contributing factor. A marked curtailment in costs per kilogram was seen for both institutions. In terms of production cost, the introduction of mechanization is essential in order to strengthen the competitiveness of the clusters.

Table 13 A Comparison of Production Costs according to Production Type

	Manual production costs		Mechanized production costs	
	MAG	CAH	MAG	CAH
Cost of materials (seed, fertilizer, pesticide, etc.)	450,339	422,750	551,046	532,978
Labor cost (sowing, harvesting, management, machines, etc.)	1,017,000	1,021,600	966,240	608,412
Total cost (Gs)	1,467,339	1,444,350	1,517,286	1,141,390
Yield (ton/ha)	1.8	1.6	2.2	1.8
Cost per kg (Gs)	815	1,031	690	634

Note: In case of manual production of cotton, labor cost is included farm income.
Source: 1) MAG, "Elaboracion por Genaro, Asesor Tecnico", 1999
2) CAH, "Gerencia Tecnica", 1999

(2) Requirements to strengthen processing industry

The present absence of linkages between the cotton production and the processing industry, as well as in the processing industry from the spinning to the manufacture of final products, is a critical issue to be addressed when we consider the cotton industry as a cluster. The cotton fiber is one of the major export items of the country, and the final products of clothing have the export potential in the markets. The weakness is in the middle stream of the industry, the spinning and the weaving. From the viewpoint of raw material suppliers, there is no difference in the export of cotton fiber and the supply for the domestic manufacturers. The problem is in the textile industry from spinning to weaving. They have been affected by the severe crisis of the commercial finance.

The marketability of Paraguayan cotton products is currently far from ideal as the clothing industry is suffering from a recession worsened by imports of cheap overseas products. Nevertheless, there are idle facilities in the country and the local labor market is believed to have sufficient capacity to support the cotton industry. As the domestic supply of raw cotton is an advantage, the restoration of this industry should be possible with the introduction of appropriate government measures and integrated efforts of the private sector.

The rich workforce and electricity supply capacity is another cost advantage. Maximum cost reductions should be attempted by making the best use of these advantages in addition to the adoption of efficient transportation.

The insufficient technologies relating to yarn, woven cloth, dying and sewing can be quickly solved by the introduction of advanced technologies from industrialized countries. The most important, as well as urgent, issue is the improvement of the image of Paraguayan products through introducing quality control to ensure that products meet all relevant international standards. Moreover, technical cooperation with companies in industrialized countries and the import of advanced technologies through joint ventures are other options.

2.5.3 Strategies to strengthen the cluster's competitiveness

Cotton growers currently face a disadvantageous legal situation in terms of finance, making it essential for the government to provide them with fiscal assistance. As cotton growers have no choice but to rely on external finance, careful consideration is required in regard to arranging fair finance while not making them lose their incentive to work.

For the future development of the manufacturing, the textile master plan was revised in 1994 by the Ministry of Industry and Commerce with the technical cooperation of UNIDO (United Nations Educational, Scientific and Cultural Organization), concluding with four investment proposals. They are a) an indigo denim factory, b) a T-shirts and sewing thread integrated factory, c) three jeans garment factories, and d) two terry towel factories. The total projected investment cost was about US$125 million, and would create 3,000 direct jobs and demand an additional 21,500 ton/year of cotton fiber. The proposed projects were oriented to the export market and large scale integrated ones. None of them were implemented up to the moment.

At present, there is an investment project of towel factory from an existing knitting company, which is being applied for the Law 60/90 and for the FDI (Fondo de Desarrollo Industrial) finance. Since the towel is one of the recommended products in the previous master plan, it should be permitted promptly

though the investment scale is rather small around US$3 million.

It is also recommended that a new master plan be conducted for the reactivation of the textile industry, taking feasibility into more account.

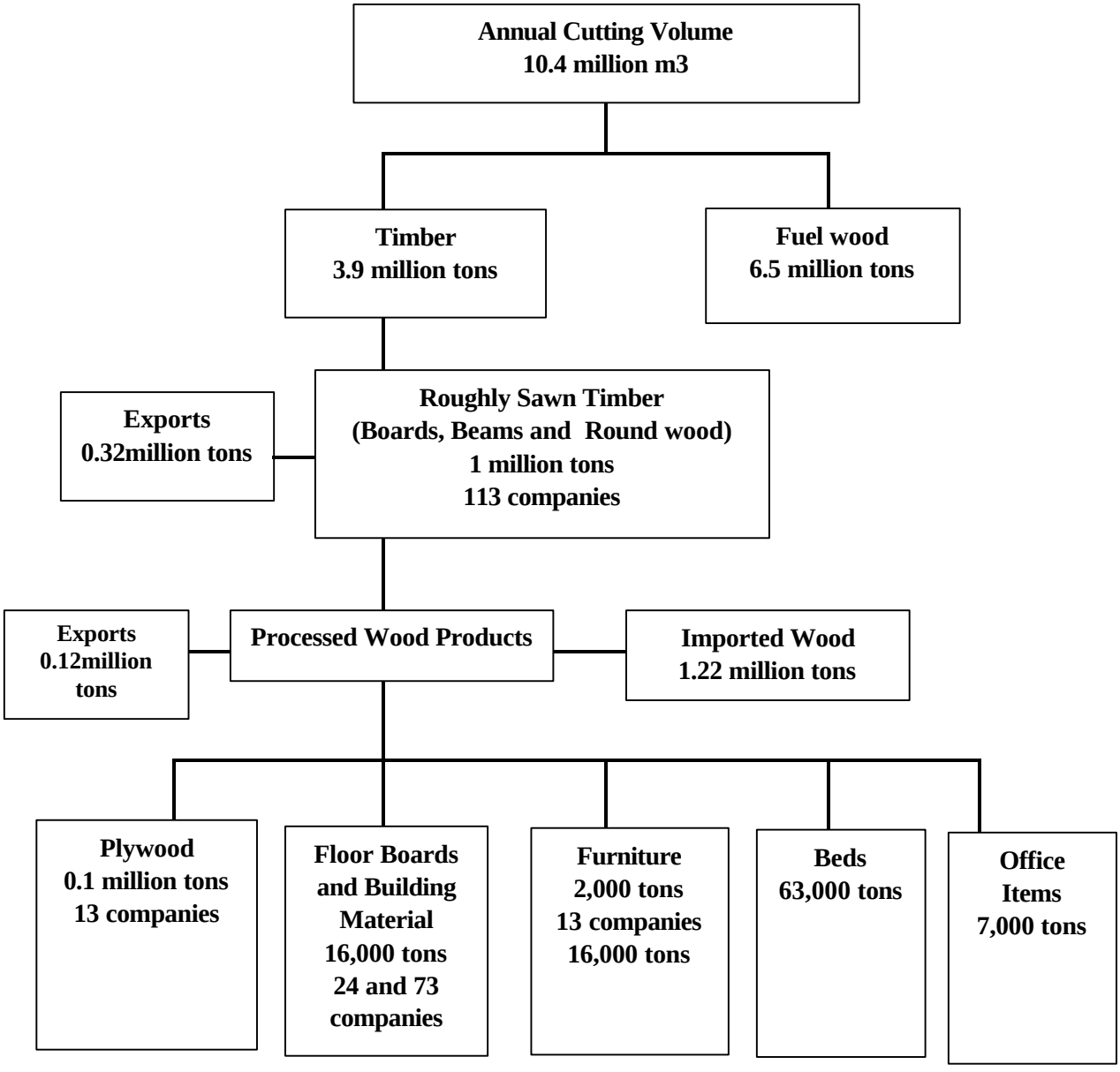
2.6 WOOD CLUSTER

2.6.1 Analysis of current situation

(1) Overall structure of the cluster

The wood processing industry obtains its raw materials domestically and is a major exporter. This industry produces primary products (logs, sawn timber, etc.) and secondary, or finished, products (building material, furniture, household items, etc.).

Table 14 General Structure of Wood Industry



The figures for production volumes of timber and fuel are cited from the World Atlas 1999/2000.

Production volumes of primary and secondary products are based on information provided by the Central Bank of Paraguay, MAG and the Paraguayan Timber Association (Federacion Paraguaya de Madereros). The overall balance is not clearly established because of discrepancies among different statistics reflecting the wide practice of informal trading.

The volume of wood used for fuel is currently 70% more than the volume of wood used for timber. The export ratio of wood products to MERCOSUR countries is very high. The figure was 94% or higher in 1996 and 1997 in the case of primary products. Other destination countries are the USA, Italy and the Netherlands, although exports to Italy show a declining trend. In the case of secondary products, more than 50% of exports go to Brazil and Argentina (Uruguay is another wood producing country). 0.7% of wood exports in 1997 went to Japan. The export volumes of primary and secondary products in 1997 were 321,000 tons (sawn timber) and 122,000 tons respectively.

(2) Analysis of current condition

1) Raw materials

The soil in the eastern region of Paraguay is fertile and contains a flourishing growth of trees. The useful species of trees in the country, such as the Cedro (*Cedrela odorata*), Lapacho (*Tabebuia spp.*), Incienso (*Myrocapus frondosus*), Paraiso Gigante are largely found in this region. The forest, which occupied an area of 7 million ha in the eastern region in the mid-1970s, decreased to 2.40 million ha by 1991. The underlying cause was the conversion of forestland into farmland cultivating soybeans, wheat, and other crops, as well as pasture, due to the fertile soil. The creation of a road network comprised of Highway 1 and 7 from the latter half of the 1970s has been an undeniable factor in the accelerated conversion of land use.

This rapid deforestation has also been the cause of soil erosion, overflooding of rivers, and other new environmental problems. These factors must be considered when promoting and determining the location of a wood cluster.

2) Wood processing

The distribution of wood processing factories by department and product is shown in Table 15. Many primary processing factories are located in eastern departments, near mountain forest areas, while many secondary processing factories are located in Asuncion and other departments in the central part of the country.

Table 15 Factories by Department and Product

	Sawn Timber	Flooring Material and Laminated Veneer	Building Timber and Carpentry Timber	Boxes and Containers	Furniture and Household Items	Others	Total
Caaguazu	40	10	70	3	4	7	134
Alto Parana	10	7	48	0	0	9	74
Central	3	4	8	15	2	40	72
Canindeyu	19	4	33	0	0	1	57
Itapua	13	3	12	2	0	18	48
San Pedro	15	1	19	2	0	2	39
Asuncion	6	1	11	3	6	11	38
Amambay	2	1	27	1	0	2	33
Caazapa	3	1	15	0	0	0	19
Concepcion	0	3	14	0	0	0	17
Guaira	0	2	11	0	0	3	16
Cordillera	1	0	0	1	1	3	6
Misiones	0	0	2	0	0	3	5
Paraguari	1	0	0	1	0	1	3
Boqueron	0	0	0	0	0	3	3
Neembucu	0	0	0	0	0	2	2
Total	113	37	270	28	13	105	566

Source: Industrial Census (1997)

Although the wood industry as a whole is declining, it should be able to revitalize itself if the steady progress of reforestation programs can ensure an ample supply of wood. The government must abide by existing Laws No. 422 and 536 and thoroughly enforce forest protection measures and rigorously control the illegal export of wood. Cases have been reported in which the certificate of origin issued by the government of Paraguay has been thrown away near the border so that the importing country is assumed to be the originating country of the product. Such illegal practices must be thoroughly discussed among MERCOSUR countries.

The downstream products of the secondary processing industry include chairs, desks, office lockers, bookshelves, cupboards, simple pieces of furniture, household items, toys and play goods. As the relevant technologies in Paraguay are lagging behind other countries, existing products can sell only in the domestic market unless advanced design and processing technologies are imported from outside, particularly from European countries and the USA.

Every company is making efforts to establish and maintain price and quality competitiveness by purchasing their own forest resources. Regarding technology, all the companies interviewed emphasized the importance of the drying process. Consumer demand for light wood products has been increasing in recent years. Companies are investing in equipment to modernize management and also in reforestation to ensure a sustainable supply of raw materials.

(3) Bottlenecks and advantages

1) Raw materials

The ratio of the total forest area in the eastern region dropped from 40% during the early 1970s to 15% today. Forests have decreased over the past decade by an annual rate of 100,000ha. This statistic clearly indicates that the underlying cause is in the afforestation stage and not in the conservation stage. The sustained development of the wood cluster hinges on resolving the issue of how useful species of forest resources are secured for lumber processing or the success of the afforestation policy and activities.

2) Wood processing

The biggest problem of the wood cluster is the rapid decrease of the natural forest. This means that the supply of raw material for the wood processing will be exhausted in the near future, unless reforestation increases quickly. As mentioned above, there have been several government efforts to recover the forest, however, none has been sufficient.

There are several valuable native species in the natural forest, such as cedro, lapacho, guatanbu, and ulau. The materials of these woods are durable and used for furniture, doors and floorboards. These resources are also being exhausted rapidly and prices are going up as the natural forest disappears. It is difficult to reforest these species commercially because they take 30-40 years to mature. Therefore, it is urgent to secure raw material for the further development of the high valued processing industry.

As far as market competitiveness is concerned, simple sawn products and logs offer good competitiveness in terms of the export cost. According to the Timber Association, primary products have better competitiveness than secondary products. Generally speaking, the higher the level of processing, the less competitive the product is. However, the total value of export of secondary products exceeds that of primary products, although the export volume is much smaller.

The wood industry is dominated by simple primary processing due to the lack of technical expertise. There is a distinct shortage of experienced engineers, technicians, and workers. In addition, the technicians and workers who have completed courses at vocational training schools are not immediately useful at the front line. More practical technical education to upgrade the skill of workers is needed.

Most furniture manufacturers have not renewed their production system for more than 10 years, and they still produce many non-specialized items, such as chairs, tables beds, cradles, and closets. Specialization and standardization are needed to upgrade the furniture industry.

Quality control and product inspection standards are not observed in some factories, and therefore, remain inconsistent. The industry should introduce improved production control, advanced processing technologies and highly skilled work supervisors, if it is going to produce high valued products. Furthermore, the introduction of technologies that emphasize the excellent character of Paraguayan wood will be necessary.

The work safety of employees is another area in need of improvement. Management must provide education to make employees properly aware of their own safety. The training of managers for this purpose is important.

2.6.2 Model of the cluster

Here we propose a "Reforestation and Manufacturing Program of Paraiso Gigante" as a model wood cluster. As mentioned, paraiso gigante is a fast growing and commercially valuable specie. Keeping in mind the social aspects of agriculture and forestry, the program is designed mainly for small-scale farmers to improve their income by producing wood for the furniture industry. It involves creating a committee to manage the reforestation projects and to process the raw wood for the commercial material; i.e. the committee will operate a sawmill and distribute the products to the market. In the longer run, it is also designed to strengthen the furniture industry and increase exports of quality wood furniture.

(1) Location of the model

1) Raw material

The area between Coronel Oveido and Ciudad de Este, Itapúa, and Alto Paraná has been determined to be an appropriate cluster site due to the presence of numerous useful tree species, afforestation activities by JICA and FAO, supervision of improvements in the lumber industry, forestry extension activities, etc.

2) Processing

Most raw materials are supplied from production forests in the eastern departments. Many primary processing factories are located in Caaguazu, Alto Parana, Canindeyu, Itapua and San Pedro departments. These departments are relatively near mountain forest areas. Meanwhile, many secondary processing factories are located in Asuncion and Central department. The first processing of wood sawing should be done near the production forest. However, it doesn't matter at the further processing stages of wood products. Any manufacturer or organization of carpenters can be the promoter of the future export industry.

(2) Model

1) Reforestation by small-scale farmers

Paraiso gigante takes 10 years to grow to the point that it can be cut down. Farmers should take care to avoid introduction of unhealthy germs for the first three years to get quality wood. If the young plant is frozen during the winter season, the plant over the surface should be cut off, but after that the plant grows faster. If they are planted in an interval of 8m by 4m, 312 woods can be grown per 1ha. It is possible to cultivate crops in the planted area during the first three years. After 10 years of growing, the diameter of the trunk becomes 40-45cm, and a log without knots of 2-3m long can be harvested.

From the one hectare of plantation, $40m^3$ of sawn wood can be obtained, i.e.60,000 inches. Since the price of paraiso gigante per inch is Gs 450-600 at the moment, sales value will be US$7,700-10,000 per hectare. In addition, it produces certain amount of firewood as a by-product, which will bring in additional income of around US$2,400. Deducting farmer labor costs, cutting costs, as well as the operating cost of a sawmill and transportation cost, it still makes a substantial profit as a business, say US$6,000 per hectare if the first processing of sawing and drying is included together with the plantation.

If the plantation is done each year by one tenth of available land for 10 consecutive years, then the harvest and income will occur every year constantly from the 11^{th} year. It can be started gradually, so not causing a drastic change of existing cultivation. However, it does not bring income until 10 years after the first plantation, how to secure the farmer's income until then is a critical issue. Regarding this point, it is recommended to apply for the reforestation subsidy to cover the initial cost of growing for the first three years of each plantation. The program should be planned carefully for each farmer.

Another point is how to organize the farmers and implement the plantation of paraiso gigante in a well organized manner. It is recommended to organize a managing body, such as committee of farmers, and that this body will control all the management and operation of the plantation as well as the reforestation subsidy. The guidance for the farmers is necessary to implement the program correctly.

The third point is that the managing body should operate felling, sawing and drying of the wood, and selling the products, so that intermediaries can not squeeze the profit. Management and operation techniques should be provided by public institutions, such as SEDEFO. Judging from the efficiency of the sawmill and manageable scale, the managing body would be expected to control about 100ha of plantation. This means that if the average plantation area is 10ha, then 10 farmers are organized and have one sawmill.

If the total scale of plantation of each year is 10,000ha, for example, 100,000ha of land will be reforested in 10 years as a whole. This will bring 400,000 m^3 of quality material for the wood industry each year, and creates around US$60 million income to the growers of paraiso gigante.

2) Manufacturing of furniture

As for secondary processing, plywood, floorboards and frames already have export channels. On the other hand, the furniture industry is trying to export their products, and only a few have succeeded by introducing advanced technology.

In the later phase of the program, a project is proposed to strengthen the furniture industry, which includes the organization of small-scale manufacturers and carpenters to standardize and upgrade the products acceptable in the international market and the training course for technicians and workers.

One of the major problems of export is that when some furniture makers receive orders, they sometimes cannot respond to them because of the quantity of the order. In Central department, for example, there are 50 to 60 furniture makers or carpenters, and some ten companies among them are competitive in the market. There is a project to organize these manufacturers so that they can get orders of certain minimum quantity from abroad. Since some of the leading companies have established distribution channels, they can be in charge of marketing for export.

(3) Potential markets

Some of the furniture makers have already begun to use paraiso gigante for quality furniture and for an ornamental surface for their products. It is well received since it is durable, easy to manage and looks nice. A kitchen system manufacturer is using this material for 50% of the surface, substituting for native wood, and exporting to Argentina. Argentina is promoting reforestation of paraiso gigante in Misiones department for its furniture industry, and has a good demand for it.

It is said that some German institute evaluated paraiso gigante as the second most suitable material for furniture. There were some orders from Germany and USA of floorboards and chairs made of paraiso gigante in the past. But they could not be transacted because of the shortage of raw material. Paraiso gigante has a very good reputation in European and US markets.

2.6.3 Strategies to strengthen the cluster's competitiveness

(1) Raw materials

The Paraguayan government enacted the Forestry Law (Statute 422) in 1973, the Plan Nacional de Reforestracion in 1976, and successive afforestation projects from 1990. However, these measures have drawn numerous negative criticisms due to the fact that a large segment of the forest area belongs to the private sector, government land could not be procured due to budget constraints, and the government policy on afforestation has been ineffective. Subsequently, the Paraguayan government enacted Law 536 in 1995, which promotes afforestation by subsidizing 75% of the afforestation costs to the owner. In order to successfully implement this kind of afforestation policy, it is vital that a cultivation and supply system of saplings exists.

JICA implemented "The Forest Extension Project in the Eastern Region of Paraguay" from 1996 to 2000, which provides technical cooperation that comprehensively includes the production and dissemination of saplings for afforestation, fostering afforestation personnel, afforestation activities, building forest roads, and forestry management. This project has achieved uniform results. It is also necessary to review the selection of foreign sapling species (Eucalyptus, Paraiso Gigante, etc.) which have already been established by afforestation technology and activities. It is also necessary to review the promotion of social forestry, afforestation of perennial crops such as macadamia nuts, and the dissemination of early maturing species which will serve as a lumber resource and provide a stable source of cash over a short-term period.

(2) Processing

While reforestation efforts are being made and expanded, the effective use of the limited resources is also an important issue. At present, eucalyptus and pine are the most recommended species for reforestation. They are used as firewood and building material mainly for local use, but not for industrial use. These products must be connected to commercial channels for the sustained development of reforestation.

On the other hand, the fact that the wood of precious native species is decreasing rapidly increases the need to supplement and substitute these materials when manufacturing high value products. The paraiso gigante, introduced from Misiones province of Argentina about 20 years ago, is supplied commercially from Itapua department with good prices, but they have been increasing reflecting the increase of demand.

In the area of processing, internationally acceptable quality standards should be introduced so that

companies can manufacture high quality products for export. Some efforts should be made to support and provide guidance for each company to manufacture high-class products with excellent designs and international marketability.

For their part, companies must enforce the strict quality control of products and manufacture quality products to differentiate their products in the markets. The public and private sectors should make joint efforts to improve the image of Paraguayan wood products in the international market with the assistance of the government's PR (public relations) body. The manufacture of high quality products with added value will gradually strengthen the competitiveness of Paraguayan products, resulting in improved profits.

It is of crucial importance for the small businesses to reduce production costs through joint purchasing of materials and business cooperation for market development, based on a spirit of collaboration and with a view toward eradicating work duplication and wasteful work.

2.7 METALWORKING CLUSTER

Though the contribution of metalworking industry to the industrial GDP is only 1.8%, it plays an important role as a supporting industry to other productive sectors by supplying machinery, equipment and repair parts as well as installation and maintenance services. In the framework of MERCOSUR, there will be more business chances with neighboring countries, especially in the border areas. It is necessary to strengthen the metalworking industry to support the modernization of Paraguayan industry.

2.7.1 Analysis of current situation

The metalworking industry declined dramatically in 1993 and 1994, and thereafter has remained stagnant. However, the importance of this industrial sector in the economy remains unchanged, it provides goods and services for almost all productive activities. This industrial sector covers iron and steel making, tools and implements, parts and components for agriculture, forestry and agro-industry, as well as passenger and fluvial transportation, power generation and transmission, and other services.

The structure of Paraguay's metalworking industry is different from those of bigger countries such as Brazil, Argentina, Colombia, Venezuela and Peru, where they produce capital goods as well as consumer goods.

(1) Production and trade of metal products and machinery

1) Production

In 1998 the value added of the sector was Gs 5.8 million at 1982 constant prices, and contributed only 1.8% of industrial GDP, which is less than 0.3% of national GDP. The three major groups of products are a) steel bars, wires and gray casting, b) metal structures, and c) transport equipment and parts, followed by aluminum products.

Table 16 Value Added of Metal Products in 1998

Products	GDP at 1982 Constant Price(Gs.)	
371 Iron and Steel	1,575,200	27.1%
372 Nonferrous Metal	610,900	10.5%
381 Metal Products Except Machinery and Equipment	1,614,600	27.8%
382 Non-electric Machinery	277,200	4.8%
383 Electric Machinery and Accessories	89,500	1.5%
384 Transport Equipment	1,640,900	28.2%
385 Scientific Equipment and Medical Instrument	6,200	0.1%
Total	5,814,500	100.0%

Source: BCP

The only steel company, ACEPAR (Aceros del Paraguay S.A.), was privatized in 1997, and is now operating at around 40% (5,000t to 6,000t per month) of its installed capacity. It produces reinforcing rods, steel bars and wires. It is expected to boost exports because the MERCOSUR common tariff system gives it preferential status in the market.

2) Trade

The total export value of metal products from Paraguay was US$23.5 million in 1997. The major destinations were the neighboring countries of MERCOSUR and Bolivia, and the most important items were reinforcing rods and bars of construction materials, mainly the products of ACEPAR mentioned above.

Table 17 Export of Metal Products and Machinery in 1997 (FOB: US$1,000)

Products	Argentina	Brazil	Uruguay	Rest of the World	Total
Basic Iron and Steel Products	5,071	2,235	1,573	550	9,429
Iron and Steel Products except Machinery	466	1,941	45	2,042	4,494
Aluminum Products	1	867	0	1,538	2,406
Non-electric Machinery	478	673	32	647	1,830
Electric Machinery	541	188	806	470	2,005
Vessels	970	0	0	0	970
Total	7,527	5,904	2,456	5,247	21,134

Source: BCP: Economic Statistics

Imports, on the other hand, vary from capital goods and automobiles to domestic electric appliances. The countries of origin are Brazil and Argentina of MERCOSUR (38%), Japan, USA and European countries. While the majority of materials for the sector come from Brazil and Argentina, capital goods are imported from USA, Italy and Germany (as well as Brazil and Argentina). Most of the automobiles from Japan are second-hand.

Table 18 Import of Machinery and Metal Products in 1997 (FOB: US$1,000)

Products	Argentina	Brazil	Germany	Italy	Japan	USA	Total
Basic Iron and Steel Products	28,396	48,263	3,939	2,781	1,743	2,585	107,608
Nonferrous Products	5,504	20,081	835	584	32	850	35,706
Apparatus, Machinery and Engines	34,995	152,758	49,156	62,893	40,211	133,658	614,285
Agricultural Machinery	1,216	29,241	477	30,549	181	3,112	71,715
Transport Equipment	32,115	148,475	22,520	2,771	188,292	20,956	489,895
Total	102,226	398,818	76,927	99,578	230,459	161,161	1,319,209

Source: BCP, Economic Statistics

(2) Metalworking industry

The metalworking industry in Paraguay developed in the late 1970s and 1980s when the Itaipu dam and its power plants were being constructed. Since then, however, the level of technology has not advanced significantly and most metalworking activities are using relatively simple processes such as cutting, bending and welding in relatively large companies. The mechanized processing in general is done by smaller enterprises, which provide repair parts and services, as well as supply parts and components for other companies. Regarding the casting industry, most of them just do gray casting while only a few of the industry can fulfill the technical requirements of the market. The advanced technologies are being introduced in the sub-sectors of welding and fabrication of machine parts. All the capital goods and technologies are imported from abroad.

According to the Industrial Census in 1997, 374 firms in the metallurgy and metalworking industry employed 7 or more workers, about 9% of the total number of Paraguayan industrial enterprises. 42% of them were concentrated in Asuncion, 38% in Central department, and 20% are distributed throughout the rest of the country.

Though the products and activities of the industrial sector vary, 43% of the enterprises, and almost half of the employment, were engaged in fabrication of metallic structures. The second important sub-sector is "other metallic products" that covers various items such as nails, bolts, containers, safes, etc. Another important group is vehicle-related industries such as car bodies, tractors and auto-parts.

Table 19 Products and Activities of Metalworking Industries

Activities	No. of Enterprises	No. of Workers
Primary Products of Iron and Steel	6	1223
Primary Products of Precious and Nonferrous Metals	4	56
Iron and Steel Casting	2	84
Metallic Products for Structure	160	4570
Metallic tanks, depositors and containers	11	263
Boilers	2	108
Forging, Pressing and Rolling	1	11
Surface Treatment	2	36
Other Metallic Products	53	1086
Bearings, Gears and Transmission Parts	10	117
Equipment of Elevators and Manipulators	2	18
Other General Machinery	32	564
Machines for Agriculture, Livestock and Forestry	4	96
Machine Tools	5	68
Light Bulbs	7	108
Other Electric Equipment	3	100
Car Bodies/Tractors	32	727
Automobile Parts and Engine Parts	28	323
Ship Building and Maintenance	10	116
Total	374	9653

Source: Industrial Census 1997

Most raw materials, such as steel sheets, plates, bars and pipes, are imported from Brazil, Argentina, South Africa, Germany and Japan. (More than 80% comes from Brazil and Argentina.) The volume of materials consumed in Paraguay is around 70,000t to 80,000t per year. Large companies use 5,000 to 6,000t of materials at most. Since the amount of 5,000t is the minimum scale to procure materials directly from the producers, Paraguayan metalworking enterprises have to buy from brokers at higher prices.

2.7.2 Role as supporting industry

(1) Automobile and auto-parts industry

In Paraguay there is no automobile assembly. All cars are imported from abroad: 30% come from Brazil and Argentina, while 51% from Asia (Japanese cars represent 40% of the total imported cars).*3 A significant portion of imported vehicles, about 35%, are used and come especially through the free zone of Iquique in Chile.

60 metalworking companies in the country produce vehicle parts and components, and represent 28% of the industrial sector income, but they supply only for the repair market.

In Brazil, on the other hand, the decentralization of the automobile industry is under way mainly because of the aggressive strategies of local governments to attract the new investment of assemblers. Thus, the border states of Brazil such as Parana, Mato Grosso, and Rio Grande do Sul already have secured new investments and the production pole of automobile is shifting toward these states. Taking advantage of this new development in Brazil, there are several studies on the new possibilities of attracting an auto-parts industry to Paraguay. The results show that Paraguayan advantages lie in the fiscal system, geographical position within MERCOSUR, and the low costs of energy and labor. Regarding labor costs, the advantage, though still latent, is that of the metal mechanic technicians, not the unskilled labor of the minimum wage level. The following is a comparison of labor costs of both countries. Here the total cost includes costs of social security, bonus, paid holidays, etc.

Table 20 Labor Costs of Paraguay and Brazil (US$)

	Paraguay		Brazil	
	Monthly wage	Total cost*	Monthly wage	Total cost**
Unskilled labor (Monthly minimum wage)	185	243	105	189
Metal mechanic technician	265	347	560	1008
Plastic technician	600	786	450	810

* Total cost over the wage 31%

** Do. 80%
Source: Material from the Ministry of Industry and Commerce

(2) Agricultural machinery

The major supplier of agricultural machines and implements is Brazil. Domestic manufacture is limited to 9 companies at the moment. Brazilian suppliers in border cities are providing maintenance service to Paraguayan clients within a range of approximately 200km of the border. They are interested in expanding their services in Paraguay and in buying spare parts from the Paraguayan manufacturers as well. In this case the users of the machinery and implements are in the country, and the demand of parts and services will grow as agricultural production expands.

In addition, there are some agricultural mechanization projects going on. In the case of Alto Parana department, the local government is going to implement a project of agricultural mechanization for small producers. This project will mechanize 5,000ha of agricultural land annually with the introduction of 18 tractors with implements (rakes, disks, plows, etc.), 2 bulldozers, 1 excavator, 2 levelers, 8 dump trucks, and so on. The beneficiaries are 2,500 small farmers annually organized by committees, associations and cooperatives. This kind of mechanization will be promoted as they modernize the agricultural production nationwide, which induces the new demand for maintenance services and repair parts, as well as a variety of simple agricultural implements.

2.7.3 Strengthening of the cluster's competitiveness

(1) Specialization

Generally speaking, specialization in the metalworking industry is insufficient, and vertical integration within a company is seen in many cases. In addition, the majority of installed facilities are obsolete and need to be modernized. The demand for the products and services of this sub-sector is growing in the local market. However, imported goods are flooding in because of the devaluation of the Brazilian real. Specialization and linkages among the processes are needed to reduce costs and to upgrade the quality of products and services.

(2) Training of metal mechanic technicians

Training courses for metal mechanic technicians are now limited to Asuncion and Hernandarias, and the latter offers only basic classes and does not meet the needs of the industry. It is recommended to establish a new technical center for training in Ciudad del Este with some cooperation from outside institutions, such as SENAI.

(3) Joint activities for marketing and purchase of raw materials

Since the majority of metalworking enterprises are small-scale industries, it is difficult for them to access market information and technology as well as to develop new products. It is recommended to start some joint activities to get market information and technology, or to purchase raw materials together. Through these activities they can get acquainted not only with information and a wider vision, but also with their partners. They can then evaluate their situation more accurately and tackle the problems. To set up such joint activities and communication, initiative in the private sector is important, as well as some support from the public sector.

2.7.4 Proposed projects for metalworking cluster

(1) Steelmaking by electric furnace from scrap iron

This project uses the abundant resource of electricity. In order to secure the competitiveness of this steel, however, a preferential power tariff should be applied for such power user in bulk.

The international price of scrap iron, the raw material for this project, is around US$110-130 per ton. It can be obtained from the USA and Europe, making use of home bound barges of soybeans. It is necessary to install magnet cranes for loading and unloading at ports.

Electric furnaces are made in Germany, Austria and Italy. However, it may be cheaper to import a used system than buying a new one. There are around 50 electric furnace steel mills in Japan, but they are now restructuring their production and some are closing down.

Reference cost of 50 tons of electric furnace is estimated as follows, assuming a production scale of 30,000 ton/month and a 24-hour operation, 6 days a week:

Cost of the furnace:	US$20 million
Dismantling & packing	US$50 million
Transportation cost:	US$10 million
Total	US$80 million

The selling company wants to hand it over as it is. The trading company will do the dismounting and packing. Installment and operational guidance can be provided by a separate contract, however, it is difficult to guarantee its operation in general. Most Japanese furnaces were built in the 1960s to 70s, and are around thirty years old. Engineers are also aged. But the major equipment, such as transformers, controllers, and electrode elevators were renewed about 10 years ago. The furnace body may be

purchased cheaper domestically or in MERCOSUR.

The production process has two steps. First, steel billets and semi-processed articles are made by continuous casting from the electric furnace. Then, many steel materials can be made through a rolling process. The most probable candidate product using the electric furnace will be reinforcing rods, which the ACEPAR is now producing and exporting. Other candidates are the materials for domestic use. There is another option to export the billet, the international price of which is US$170-180 per ton.

Taiwan and South Korea are importing steel billets in large quantity. Taiwan imports 4-5 million tons of billets each year from Brazil. Taking into account the relationship between Paraguay and Taiwan, there would be some possibility of provision of soft loans or direct investment.

(2) Upgrading of charcoal pig iron

It is possible to make high quality steel that contains low impurity levels from charcoal pig iron, since charcoal has less phosphorus and sulfur contents than coke. Moreover, by using the smelting facilities such as LF or vacuum degasification out of the shaft furnace, it is also possible to make high purity steel that has less non-metal and oxidized constituents. It is recommended to seek the possibilities to make high value products that have less content of phosphorus and sulfur, making use of the merits of charcoal pig iron that the ACEPAR is producing at present.

The first possibility is the steel material for welding rods, for which there is also a constant domestic demand. In the first step, it can be started to produce the billets for welding rods of ordinary use, taking the advantage of the point of less content of phosphorus and sulfur. The next step will be the production of billets for welding rods of special use, with the facility of LF. Then, if the equipment of vacuum degasification is installed, it becomes possible to make the steel with less compound metal for machine structure and the special steel alloy. This way, it will be possible to upgrade the value added step by step.

In the case of the ACEPAR, the existing rolling facilities can be used to make reinforcing rods and special rods for machine structure, expanding the variety of products. The ACEPAR can be a base of steel bar production.

(3) Training course

Access to qualified workers is crucial to strengthen and foster the metalworking cluster, thus development and upgrading of skills is indispensable. However, there are not many training courses offering metalworking technique at this moment in Paraguay.

At the high school level, Gutenberg Polytechnic High School (Colegio Politecnico Johannes Gutenberg) and National Technical High School (Colegio Tecnico Nacional) in Asuncion are the only institutions that offer high school degrees in metalworking. For the training program targeting workers, SNPP in Asuncion (Western Branch) and Hernandaria (Eastern Branch) are the major providers of metalworking courses, although in Hernandaria only the basic level courses are offered. Moreover, the only courses offered at SNPP are welding courses (gas welding and basic SMAW). The provision of the training course in metalworking is not enough to meet industrial needs.

In order to develop personnel skills in the metalworking cluster, a project of opening new training courses for workers and managers at SNPP-Hernandaria is proposed. In particular, opening courses in the areas of foundry, welding, forging, and heat treatment is necessary since they are either insufficient or not offered at the institution.

As for welding, gas welding and SMAW are highly used for agricultural equipment in Paraguay and therefore have high demand. In the case of foundry, particularly a sand-molding course is expected to have high demand.

Parallel to offering the above-mentioned courses, opening of the ones that teach basic mathematics and reading to the workers is recommended. These courses should be a pre-requisite for those who cannot read well or do not understand basic mathematical concepts. For managers and supervisors, opening courses, such as production control and security standards, should be examined.

(4) Metalworking technology center

To develop a competitive metalworking industry in Paraguay technology innovation and improved productivity are needed. In order to achieve this, there should be some institutions such as technical training center, laboratories of metrology and testing, institutions of standardization and quality certification, etc. To supplement these functions, establishment of a technology center, which facilitates the technology transfer and provides technical training courses, is proposed.

The center will assume the following functions:

a) Professional and management training oriented for the innovation of technology
b) Technology information system
c) Quality control and internationally conformed certification of products and processes
d) Laboratory of metrology and standardization, metallography, destructive and non-destructive testing, for the product development of the metalworking industry.

e) Training of specialists and technical services to the enterprises in the fields of:

- advanced machine tool
- foundry
- steel plate works
- welding
- surface treatment
- thermal treatment