

ANALYSIS OF THE FUTURE CASSAVA STARCH POTENTIAL IN VIETNAM

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I. Introduction :

After rice and corn, cassava is the third most important crop in Vietnam accounting for 30-40% of secondary food production (Thang, 1993). The total production of cassava was 2.47 mill. tons of fresh root in 1992 (Statistical Yearbook of Vietnam, 1993) planted on 277,200 ha. The Vietnamese government has shown interest in this root crop as a cheap raw material for further processing. In 1989, a Vietnamese Root and Tuber Research Program was founded as the first step toward a strategic reorganization of the root crops research in Vietnam. In the past, most efforts in agriculture research and development in Vietnam have concentrated on the production side but little is known about consumer and user needs. From 1990 onward, with the assistance of CIAT, a series of cassava production, processing and marketing analyses were conducted in Vietnam with the objectives to identify and analyze constraints and opportunities for the cassava sector. The cassava benchmark study conducted in 1990 included household level surveys focussing on cassava production, on-farm processing, utilization and consumption, and rural, semiurban and urban marketing and processing surveys focusing on both technical and socioeconomic aspects of different

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products processed and major marketing channels. The major constraining factors in the cassava production, productivity, processing, and marketing were analyzed by Henry et. al., 1993. These results could serve as basis for strategic research planning in Vietnam. Cassava based products seem to have a significant potential for utilization in the future. Henry et.al. also discussed the products and market opportunities of cassava in Vietnam, however this was based on very sketchy data and incomplete information. For decisions regarding future cassava research and development in Vietnam, it requires additional in-depth studies that analyzes current and future potential demand of different cassava based products. The research on market demand is important since the needs and requirements of the consumers (including industry, on-farm use, etc.) should first be assessed and then production, processing, and marketing technology should be geared to address the specific opportunities. This study will focus on the cassava starch market potential in Vietnam, as a first step to assess the current and future demands of this important product.

It is the purpose of this study (1) to analyze the current utilization and starch shares of different end products, (2) to estimate starch demand of these products for the future and (3) to recommend issues for future cassava research and development activities.

II. Methodology :

The data collection was conducted by interviewing different processors, traders, export companies, and different producers using cassava starch as a material in their production. The interviews with these producers have been done using interview schedule which included information on production level, current inclusion ratio of cassava starch, production technology, technical requirements on cassava starch, growth rate, future demand of cassava starch... Since there are no reliable and/or consistent time series data available on cassava starch consumption on each end product and on production of some products, the estimation of future cassava starch demand has been done using a simple estimation method based on population and income growth estimates.

III. Current Cassava Utilization.

Cassava roots have been used for different purposes as animal food ration (flour), starch production (wet and dry starch), fresh root for human consumption, dry chips for export and other home processing purposes such as maltose, alcohol etc.. The estimated shares of fresh roots for different consumption is presented in table 1. The consumption of cassava in both fresh root and cassava flour form for animal production (both at the farm and by the industry) take the major part (59.8%) of the total cassava production in Vietnam. The total production of pigs and poultry was 13.8817 mill. heads and 124.5 mill. heads, respectively. This use represents almost 1.43 mill. tons of cassava roots. Cassava starch

production is the second largest usage which represents about 20% of the total cassava production. The consumption of cassava in the form of fresh roots for human consumption, chips for export, and for other home processing purposes (dry chips is not included) are 12.2%, 4.2% , and 3.8%, respectively.

Currently, cassava dry starch is used for different purposes in the food processing, home consumption, exports and for several industrial purposes as textile, pharmaceutical, carton, monosodium glutamate (MSG), glucose, maltose, plywood, etc. The total demand for cassava roots for starch production (both wet and dry starch) is about 395,077 tons in 1992. About 20% of this is used for wet starch production which is mostly used for local processing into low quality nodels (Binh et.al,1992).

IV. CASSAVA STARCH PROCESSING AND MARKETING.

During the Vietnamese cassava benchmark survey in 1991, cassava starch processing was found to be practiced in most of the surveying provinces. However the largest cassava starch processing area is in the provices of Dongnai, Tayninh and Ho Chi Minh City. Cassava starch is produced in two form, namely dry and wet starch, with about 80% and 20% of the total starch production respectively (Binh et.al).

Majority of cassava starch production takes place at the household or village level. Village or household level processing is limited by traditional technology (low conversion rates), limited and fluctuating root supplies, seasonality and constrained capital, which implies fluctuating quality, low profit rates, and

fluctuating starch supplies. There are also some large processing factories which utilize old processing technologies. Currently there is a interest in investing in cassava starch processing to improve processing technologies.

Cassava starch industry in Vietnam is facing several constrains. The relatively most important are fluctuating supply of raw material which include price, low product quality, and poor market organization.

V. CURRENT CASSAVA STARCH UTILIZATION.

Current cassava starch utilization is summarized in table 2. As it is demonstrated the largest starch usages are home consumption and food processing, accounting for 56.95% and 35.59% of the total starch consumption, respectively. Other uses accounted for only 7.46% of the total starch consumption.

Food Processing and Home Consumption :

The largest starch consumption is the home consumption (about 60000 metric tons per year). For the home consumption, cassava starch is used for making different kind of cakes, cooking, frying of meat and fish, and soup in the traditional Vietnamese diet. Cassava starch produced in processing centers is transported to the whole sellers in urban market centers and in local markets and go to consumers through the retailers system.

In the food processing industry, cassava starch is used as an ingredient in producing different products such as in bread making, rice chips , and other kind of cakes. For example in making rice

chips about 30% of total starch used is cassava starch. At present there is very high diversification of products using cassava starch in the food processing industry. Mostly high quality starch is used. For making cakes, cassava starch is used as mixture with other starch from soybean, green bean, rice, and wheat flour. The estimated quantity of cassava starch used in this industry is about 25,000 metric tons per year, which is currently the second largest starch use in the country.

For home consumption and food producing industry, high starch quality is required. Cheap price and acceptable quality are the two major factors making this starch competitive with other starch.

Monosodium Glutamate Production .

The total monosodium glutamate (MSG) in Vietnam is currently about 40,000 tons per year. Most of it is imported from Japan, Taiwan, Singapore, etc and only a small amount is produced nationally. In the 1980's, Vietnamese companies produced MSG using cassava starch and byproducts from the sugar industry as raw material. These companies used old technology with very low conversion rates of 6-6.5 tons of cassava for producing one ton of MSG. The inclusion rate of cassava starch and byproduct from sugar industry was 75% and 25%, respectively. For producing MSG, cassava starch was supplied from processing centers through whole sellers. Starch quality of 90-92% purity was required. During that period, there were some problems in using starch produced from starch processing centers such as fluctuating in starch quality because of different technologies used by processors and seasonality of

supplies because of root availability depending on harvest seasons. The MSG companies had to store starch for their production, but lack of good storage facility and inhomogeneous and low quality caused quality losses.

Low conversion rates, low quality of MSG, and very high production cost made local MSG loose competition with the imported MSG. Hence, many companies have ceased production and/or attempted to modernize their technology through own investment or joint venture with foreign partners. The production of MSG decreased from 2,003 tons in 1987 to 721 tons in 1992 (Statistical Yearbook of Vietnam, 1993). In 1987 almost 12,000 tons of cassava starch were used in this industry. But with the transformation period from old to modern technology, MSG is produced mostly from imported glutamate azide and no cassava starch is currently being used.

From 1990, several foreign initiated businesses in the MSG sector. In the first years, all of them imported MSG to sell in Vietnam. After conducting market research, they concluded that it was a viable option to produce MSG in Vietnam rather than import it. Currently most of them have projects to invest into MSG production using local raw material. As a first step, they produce MSG using glutamate azide imported from the mother company and at the same time conduct research to see market potential and to see how the market reacts to their product. Most of them believe that there is a very good potential for MSG production in Vietnam. They are looking further into raw material availability, market environment, site selection and production organization after which further construction will commence. The available raw material

could be cassava starch, byproducts from the sugar industry, and other source of starch. Foreign joint venture interest in the domestic production of MSG has currently led to the planned construction of four new MSG factories with a planned capacity of 35-40,000 tons per year.

Cassava Starch Consumption in Textile Industry.

Cassava starch is also used in the textile industry as glue material for weaving cotton fabrics of all kinds. Currently about 1,550 tons of cassava starch is been used annually in this industry. Other substituting starch could be corn starch, wheat flour, potato starch, and rice starch. Years ago, some textile factories in the North of Vietnam used corn starch since this starch was available in the Red River Delta while cassava starch supply was limited. But later they changed to use cassava starch when there was sufficient starch supply. The starch quality satisfied their requirement, and the price of cassava starch was relatively lower than that of corn starch. Another reason was that the government had encouraged the use of cassava starch as substituting material for other food crop in the industry. Currently, most of the textile factories use cassava starch in their production since the price of cassava starch is relatively lower than that of other starches and the starch supply is sufficient. In addition, cassava starch quality satisfies technical requirements.

Starch supply from the processing centers arrives at the factories through wholesaler system. The average price of cassava

starch is about 2,000 VND to 2,200 VND/kg for the best quality. The technical requirements of the textile industry for the starch quality are homogeneity in quality, high adhesiveness, purity (92-95%), whiteness, and other requirements such as no fermentation, no change in color, and no other quality losses when stored for later use. The best quality from some processing factories can satisfy these requirements.

At present, some textile factories have invested in modern weaving machineries with high production capacity and high weaving speed. This modern technology requires glue with high quality which is imported. This type of glue material is made from starch and chemicals to reach certain characteristics. Cassava starch could be used to produce chemical modified starch to use in this industry. It is expected that in the future chemical modified starch will be used in the whole textile industry instead of using raw cassava starch. However cassava starch will still be used in small weaving factories and for producing the new glue material.

Cassava Starch as Glue Material for Carton Production and other Purposes.

For the production of carton and other packing materials, cassava starch is used as glue material. In other countries, where cassava starch is not available, corn starch, wheat flour, and rice starch are used in making carton. In Vietnam, mostly cassava starch or flour is used since it is available and it has a relative low price. Small carton producing units with simple technology use both cassava flour and starch, but in modern carton producing factories

only starch is used since cassava flour can not satisfy the technical requirements. This industry needs cassava starch with a high degree of adhesiveness and purity of 90-92% . Whiteness is not so important in this industry. In general, the starch produced in different processing centers satisfies these criterion. For producing 5 tons of carton about 200 kg of cassava starch is used. Currently, about 15,000 tons of carton is produced annually in Vietnam, which implies that about 600 tons of cassava starch is used. The estimated consumption of cassava starch as glue material for other purposes such as for office, packing, etc., is about 50 tons per year.

Cassava starch consumption in the Maltose and Glucose Production.

The total quantity of cassava starch consumption in the maltose and glucose production in Vietnam is estimated to be about 40 tons and 1,800 tons , respectively. For producing one ton of glucose, about 1-1.5 tons of cassava starch is needed. The average quantity of cassava starch used in producing 1 ton of glucose is about 300 kgs. Starch quality requirment for these two products is 90% of purity. Maltose and glucose produced in this industry have further use in the pharmaceutical and food processing industry. The demand of cassava starch for maltose and glucose depend on the demand of these two products in food processing and pharmaceutical industry.

Cassava Starch Consumption in Plywood industry.

To produce industrial glue for plywood production, beside urea formaldehyde and other chemicals, cassava starch is used as an ingredient. For producing 1 square meter of plywood, about 0.46 kg of industrial glue is used, of which about 30-35% is cassava starch. Cassava starch and wheat flour are the two substituting materials. Because of relative low price, cassava starch is preferred. The technical requirements of cassava starch in the plywood industry are purity (less than 5% of substance remained after burning), PH value of 5.5-6 (not fermented starch), and less than 10% of cellulose. Similar to the carton industry, whiteness is not so important in this industry. With the current plywood production of about 700,000 square meters, about 96 tons of cassava starch is used in this industry annually. The inclusion rate of cassava starch in glue material for producing plywood is relatively high in Vietnam. In the 1980's the cost of glue material was about 30-35% of total production cost. Since the cost of chemicals for glue is high, high inclusion rates of cassava starch (35%) was one solution for the producers to reduce its production cost. However, this also decreased the product's quality. As chemicals for glue material became cheaper, the inclusion rate of cassava starch decreased from 35% to 30% in the glue material.

Cassava consumption in the pharmaceutical industry.

At present, the pharmaceutical industry uses cassava starch in producing tablets and pills. Purity, whiteness, and adhesiveness are the most important criterion of cassava in this industry. The

starch produced by processors using traditional technology in general does not satisfy these criteria. After buying starch from processing centers, cassava starch has to go through further processing to generate starch which satisfies the requirements in the pharmaceutical industry. Annually, about 100 tons of cassava starch has been used in this industry. The reason why this industry uses cassava starch instead of using other starch such rice starch, potato starch, etc. is that cassava starch is lower priced and its supply is sufficient. In addition, the technology of using cassava starch for producing tablets and pills is available.

One constraint is that the adhesiveness of dry cassava starch is not so good compared to other starches. The adhesiveness is good when cassava starch is hydrolyzed. However in producing certain medicine, no water is allowed in the processing process because it may interfere with the effects of this medicine. Therefore, there is a need to investigate technologies that could use cassava dry starch directly in producing tablets and pills without using hydration method. At present there is no cassava processing factory that produces starch for pharmaceutical use and cassava starch in the market does not satisfy requirements of the industry. There exist urgent need to increase the quality of cassava starch and to have starch to produce destine, maltose destine and glucose with high quality for pharmaceutical use.

Cassava Starch Export.

Cassava exports in Vietnam is mostly in form of dry chips and only a small quantity of cassava starch is exported. Annually, about 30,000 tons of cassava chips is export to EC, 10,000 tons to Asian countries and only about 1,000 tons of cassava starch and tapioca pearl is exported to neighboring countries. The export price of cassava chips (120-130 USD/ton) to EC is much higher than to Asian countries (70-80 USD/ton). Because of good export price to EC, the price of local dry chips increased and export to Asian countries can not compete with export to EC. So Asian export companies changed to invest into starch processing and export starch or tapioca pearl.

Major constraints in cassava starch export are the poor starch quality, inefficient processing, inefficient marketing system, shortage or poor storage facilities, relatively high transportation cost and insufficient volume for export when needed. The current conversion rate from fresh root to dry starch in processing is 5:1 in the wet season and 4:1 in the dry season. The dry matter content is high in the dry season, however farmers have their cropping calendar so that they can harvest their crop in the wet season since less labor input is required. When harvesting in the wet season, processor have problems with low starch content and low conversion rates and they don't have a good opportunity to dry the starch because of the high humidity. Many processors can not produce export quality starch. Because of the small scale processing and low starch quality, it is difficult to collect enough starch for export. The above mentioned constraints make

cassava starch in Vietnam not competitive with starch from China and Thailand.

Compared to Vietnam, Thailand has more comparative advantages in cassava starch production in terms of low price of fresh root (The farm gate price is about 20 USD per ton), highly efficient processing (large scale processing), very efficient marketing system and good storage facilities, high starch quality, large volumes, and low cost of transport. Cheap labor cost and low farm gate price are the two major advantages in cassava starch production in Vietnam.

At present some foreign companies have invested in cassava starch production in Vietnam with high production capacity, better technology, and better export facilities. These investment may generate an increased opportunity for cassava starch exports in the future.

VI. CASSAVA STARCH MARKET POTENTIAL.

Future Domestic Demand Growth by Each End Product.

It is clear that cassava starch consumption is currently quite important (about 20% of the total cassava production). It is essential to assess whether this status is changing or likely to change over time. Results of the study reveal that there is great potential for cassava starch in the future. The major demand in the future could come from the MSG industry, food processing and home consumption. The demand of MSG is expected to grow to 60,000 tons by the year 2000. Today, many companies open business in this

industry. They have invested or plan to invest in MSG production for domestic consumption. It is difficult to increase the production for exports since the surrounding countries also produce MSG for their own consumption and their production satisfies these markets. Therefore MSG production in Vietnam is mostly to satisfy domestic consumption.

At present, most of the companies initiate to produce MSG from imported glutamate azide. There is a great potential in the demand of cassava starch in this industry. Substituting raw material is byproducts from the sugar industry, however cassava starch could still be the major raw material in MSG production. With modern technology and good types of bacteria used in the MSG production process, the conversion rate from cassava starch to MSG will be much higher and inclusion rate of byproducts from the sugar industry will increase because of its cheap price. Even so there is still a very high potential of the demand of cassava starch. The expected demand of cassava starch is about 90,000 tons per year by the year 2000.

However there are some constraints in using cassava starch in this industry. When a company decides to use cassava starch as raw material, a great volume of cassava starch will be used daily. For example, if a company produces 10,000 tons MSG per year, about 29 tons of cassava starch with 90% purity will be used daily. If the company decides to produce starch by itself, about 116 tons of fresh root is required per day. It is difficult to have sufficient supply under current conditions. The collection of this large volume is also costly since in some areas cassava production is not

concentrated. Transport cost are acceptable to a distance of less than 120 km around the plant. The organization of the collection system is also a problem. Another problem is the seasonality of cassava production. Harvesting time is about 5 to 6 months per year and without good storage facilities, there will not enough starch for the production year-around. If the above mentioned constraints could be solved then there is a very high cassava starch demand for the MSG production.

Given the fact that cassava starch is an inferior good for home consumption, the demand of cassava starch will decline with the increase in consumer's income. However there will be an increase in the demand as the population increases. With an expected population growth of 2.1% and an expected GNP growth of 8% per year, the demand of cassava starch for home consumption is conservatively estimated to increase slightly from 60,000 tons to 65,000 tons per year by the year 2000.

In the food processing industry, since cassava starch can be used in different food products, there will be a high diversification of products in the future. Cassava starch will be used in producing food products with higher quality and to produce new products such as new kinds of cakes and snacks. Better starch quality will be required in this industry.

When looking at the trend in the textile industry, it is expected that the production in this industry will increase substantially. There will be a great demand of glue material for textile production. With the investment of modern technology eg. high weaving speed machinery, more high quality glue material

(chemical modified starch) will be used instead of using raw cassava starch. At present, some companies have imported this glue material, but in the future it could be produce in the country using cassava starch. Hence, the potential demand of cassava starch in the textile industry is expected to be about 2,000 tons per year. The expected demand of cassava starch as glue material for carton production and for other purposes is expected to increase to about 1,200 tons and 150 tons, respectively. These demand takes only a small portion of the total starch demand in the future.

In the plywood industry, plywood with higher quality will be required and the inclusion rate of cassava starch in glue material will decline in the future. The expected inclusion rate of cassava starch will decrease from 30% to 20-25% but with the increase in the plywood production, about 120 tons of cassava will be used annually.

The demand of cassava starch for maltose production and for pharmaceutical industry will not increase very much. The demand could be higher in the glucose production with about 3,000 tons per year. Table 2 gives a summary of the estimated future demand by industry use.

Export Potential.

By the year 2000 the export of cassava starch will have increased significantly. At present there are foreign companies investing in the cassava processing sector and export of their products. In the future, when these large scale processing plants with better technology (eg. good drying facilities, higher

conversion ratio, better starch quality, lower production cost) are in full capacity and when new high yielding and high starch level varieties have been introduced in Vietnam, there is a good prospect for increased exports of cassava starch. It is expected that by the year 2000 the export volume could be around 10,000 tons per year. But when the comparative advantage of cheap labor declines, more starch will be used for domestic industrial consumption.

In general there is a great potential of cassava starch market in the monosodium glutamate industry and export. High starch consumption is still expected to come from the food producing industry and home consumption. The consumption of cassava starch in the textile industry, carton production, plywood industry, maltose and glucose production, and in pharmaceutical industry will not change very much. By the year 2000, the total demand of cassava starch could be almost two times higher than the current consumption.

Assessment of other starches competition.

Compared to rice starch and wheat flour, cassava starch has a relatively lower price (table 6). This price relationship will not change much in the future. The price of rice starch, as compared to that of cassava starch, will not decline because of the technology and because the government will not encourage the use of rice starch in the industry. Wheat flour is less competitive with cassava starch in industrial usage. Because it is imported using scarce currency, wheat flour has high price and if it is used in the industry, the production cost will be very high. Other starches

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such as cannel starch, corn starch, etc. are mostly used in the food processing sector. For industry use, they have either to high price or their supply are too low.

Assessment of Government Policies Influencing Market Potential.

The Vietnamese government has emphasized the substituting role of cassava and other roots and tubers in order to favor rice for domestic human consumption and export. Government policies also encourage the export of agriculture products including cassava based products such as dry chips and starch through a zero export tax. The government also uses tax policy to limit the import of goods that can be produced in Vietnam to protect domestic production. For example, the import tax on MSG and wheat flour is 20% of CIP price. The investment policy has also encouraged investment in the cassava sector. These policies can have a great effect on the cassava starch potential, especially in the MSG industry and cassava processing industry for export. As a result, several foreign companies have invested in these two industries.

V., CONCLUSION.

The analysis of current cassava starch utilization and starch shares by each end product reveals that the food processing industry, home consumption, textile industry and glucose production are currently major cassava starch consumers. It is expected that the demand is very high in the MSG industry. There will be a small change in the demand of cassava starch in the food processing and home consumption, however the demand is still very high in these

two sector. In the food processing industry, there is a high diversification of products using cassava starch. Better starch quality is required in this industry. Cassava starch export will also increased substantially. In the future, the demand of cassava starch by the year 2000 is expected to increase about two times with respect to the current demand.

The trend of cultivated area in Vietnam shows that there is a decreasing trend in cassava area and only a small upward trend in productivity. In the future the cassava area is likely to decrease further since other industrial crops with higher profits will substitute for cassava. With the expected increase in future demand of cassava starch, there will be a gap between supply and demand. The gap will increase further when we include the increasing demand of cassava flour for livestock and poultry. Therefore without improvement in cassava productivity, a large supply shortage can be expected in the future.

Since the supply can not be increased through the increase in cultivating area the supply of cassava could only obtained through intensification in cassava production. The introduction of high yielding and high starch level varieties can be a solution to this problem. Of course for introduction of high yielding varieties different research activities are needed such as research on adoption of new variety in different economic regions and technological transfer to farmers. It is also necessary to look into the adoptability of farmers to new technology. The high yielding varieties give higher output but it also requires much more chemical fertilizers, pesticides, and labor than local

varieties and not all farmers can afford it. Lack of knowledge about new technology and lack of credit are some of the constraints for farmer's adoption. Therefore increased extension activities are needed to help farmers understanding the technology better and agricultural credit availability need to be improved.

The development of the cassava sector should follow an harmonic development process i.e. harmonic development between production, processing and consumption. Only in this way, the possible losses of the society could be eliminated. Efforts to promote cassava production must be matched to the capacity of the market to absorb the increase supply of roots. For example in 1987 farmers were encouraged to produce more cassava while market demand was decreasing. There was an over supply situation and as a result, the price of cassava fresh roots went down significantly. The price of roots was so low that farmers decided not to harvest their crops because if they harvest it they will have more loss. For harmonic development of cassava sector as well as the agriculture in general, cassava production, processing, and marketing activities must be coordinated and favorable disposition toward cassava based products must be created. therefore an integrated research is needed. It requires cooperation among agronomists, plant breeders, processing technologist, economists...

For the development of cassava sector, the government should provide a good statistical system and provide adequate information on prices, demand and other market information to help farmers, processors and other producers in making good decisions in their production. The government should also provide clear signals on its

own pricing policy and make market information widely available.

The technical requirements on starch quantity and quality of different end products using cassava starch could be used as criteria for cassava production and starch processing. To satisfy future demand on cassava starch quantity and quality, many improvements in the production, processing and marketing should be done. In the processing, beside the investment of modern processing plants, traditional processing units need to be improved to increase processing efficiency, i.e. higher conversion ratio and better starch quality.

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Table 1. Cassava Utilization in Vietnam, 1992.

UTILIZATION	QUANTITY OF PERCENTAGE	
	FRESH ROOTS	
	(tens)	(%)
Fresh root for human consumption	301376.60	12.20
Animal feed (by farmers and industry)	1503845.90	60.88
Dry chip for export	120000.00	4.86
Starch production	395077.50	15.99
* Dry starch (80%)	316062.00	
* Wet starch (20%)	79015.50	
Home processing		
(dry chip and starch not included)	150000.00	6.07
Total	2470300.00	100.00

Table 2. Current Utilization and Starch Shares by End Products
and Potential Demand of Cassava by Year 2000.

END PRODUCTS	STARCH CONSUMPTION		POTENTIAL DEMAND	
	IN 1992 (tons)	PERCENTAGE (%)	IN 2000 (tons)	PERCENTAGE (%)
DRY STARCH	70236	100	181720	100
-Food processing	25000	35.59	30000	16.51
-Home consumption	40000	56.95	45000	24.76
-Textile	1550	2.21	2000	1.10
-Monosodium Glutamate	0	0	90000	49.53
-Carton	600	0.85	1200	0.66
-Glue for other purposes	50	0.07	150	0.08
-Plywood	96	0.14	120	0.07
-Maltose	40	0.06	100	0.06
-Glucose	1800	2.56	3000	1.65
-Pharmaceutical Products	100	0.14	150	0.08
-Export	1000	1.42	10000	5.50
WET STARCH				
(Cakes, noodles...)	17559		18000	
TOTAL STARCH CONSUMPTION	87795		199720	
FRESH ROOT CONSUMPTION	395077.5		898740	

Table 3. Total Cultivated Area and Production of Cassava
in Vietnam, 1976-1992.

YEAR	CULTIVATED AREA ('000 has)	PRODUCTION ('000 tons)
1976	243.5	1843.1
1980	442.9	3323.0
1985	335.0	2939.6
1986	314.7	2882.3
1987	298.9	2738.4
1988	317.7	2838.3
1989	284.6	2585.4
1990	256.8	2275.8
1991	273.2	2454.9
1992	277.2	2470.3

Source : Statistical Year Book of Vietnam, 1993.

~~TABLE 4. POTENTIAL GROWTH OF CASSAVA STARCH BY INDUSTRY IN VIETNAM, 1992-2000.~~

PRODUCT	1992 CURRENT DEMAND (tons.)	2000 ESTIMATED DEMAND (tons.)	GROWTH RATE (%)
DRY STARCH	70236	181720	159
Food Processing	25000	30000	20
Home Consumption	40000	45000	13
Textile	1550	2000	29
MSG	0	90000	very large
Carton	600	1200	100
Glue for other purposes	50	150	200
Plywood	96	120	25
Maltose	40	100	150
Glucose	1800	3000	67
Pharmaceutical products	100	150	50
Export	1000	10000	900
WET STARCH	17559	18000	3
TOTAL STARCH CONSUMPTION	87795	199720	127
TOTAL FRESH ROOT CONSUMPTION	395077	898740	127

Table 5. Prices of some products in Ho Chi Minh City in November 1993.
 (1US\$ = 1080 VND)

PRODUCTS	WHOLE SALE PRICE (VND/KG)	RETAIL PRICE (VND/KG)
Cassava starch:		
Quality I	2200	2300
Quality II	2000	2200
Quality III	1800	2000
Rice starch	2900	3000
Wheat flour	3000	3200
Cassava flour	950	1300
Cassava noodle	3200	3300
MSG	15500	16000