STARCH INDUSTRY DEVELOPMENT AS A STRATEGY FOR AGRO-FOOD BASED RURAL INDUSTRIALIZATION

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PREFACE

This study was carried out by the International Food Policy Research Institute (IFPRI), in collaboration with the Centro Internacional de Agricultural Tropical (CIAT), and the Postharvest Technology Research Institute (PHTRI) with partial funding from Small Grants Fund of the Global Collaborative Post-Production Research Network of International Development Research Center (IDRC). The report was prepared by a team consisting of Francesco Goletti and Karl Rich of IFPRI, Christopher Wheately of CIAT, and Dr. Nguyen Kim Vu of PHTRI.

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LIST OF ABBREVIATIONS

IFPRI	International Food Policy Research Institute
CIAT	Centro Internacional de Agricultura Tropical
PHTRI	Postharvest Technology Research Institute
IDRC	International Development Research Center
MARD	Ministry of Agriculture and Rural Development
NMM	North Mountains and Midlands
RRD	Red River Delta
NCC	North Central Coast
SCC	South Central Coast
CH	Central Highlands
NES	North East South
MRD	Mekong River Delta

EXECUTIVE SUMMARY

BACKGROUND

The current study of the starch industry in Viet Nam is related to agro-food based rural industrialization as a strategy for rural development in Viet Nam. The major challenge for rural development in Viet Nam is to create productive employment in rural areas. The declining GDP share of agriculture implies diminished incentives for the rural population to stay in rural areas unless productive employment is available. Enterprises related to the transformation of food and agricultural commodities have the potential of providing such productive employment. Agro-food processing is labor intensive, generates higher value added than agriculture, and is usually located in rural areas where most of the poor live.

Growth of agriculture in Viet Nam has mainly relied upon rice in the past. Rice will continue to be important in the future because of its role as the main food staple, a major export commodity, and one main source of income for the rural population. Rice, however, will not have the capacity of accelerating growth particularly now that most of the benefits of liberalization of domestic and international trade have taken place. After rice, maybe only the livestock sector has the broad growth linkages that can sustain agricultural growth. Even in the livestock case, however, it is not sure that enough rural employment will be absorbed. That means that the acceleration of growth of rural economy will mostly depend on the development of a multitude of non-farm activities. Many of these non-farm activities will still be linked to agricultural production through

processing, storage, and transportation. Many of these activities will provide only a fraction of the total employment of large sectors such as rice and livestock, but the income will be much higher. In this respect, the study of starch processing is quite instructive, because it shares many insights that are common to other sub-sectors of the rural non-farm economy and shows where the rural economy of Viet Nam might evolve in the future.

OBJECTIVES

The study has five main objectives:

1. to characterize the production and consumption of starch in Viet Nam;
2. to describe the marketing channels for the starch distribution system;
3. to identify the key policy issues related to the promotin of the starch industry as a strategy for rural industrialization;
4. to analyze the effects of alternative policy options for accelerating growth of the starch industry;
5. to identify the priorities for further research.

The following four sections describe the main conclusions emerging from the analysis of processing, marketing, end uses, and policy options.

STARCH PROCESSING

A Dynamic Sector

Until ten years ago, starch processing was barely ten percent of total use of cassava. From 1988, an increasing number of participants have started to be involved in starch processing, including both rural households and large enterprises. The survey data point out at least 24 percent of total cassava to be

currently utilized for starch, and this is probably an under-estimate, given that the survey was under-sampling several regions such as the North East South, where starch production is quite big. Out of 339 processors, more than 62 percent have started operations after 1988. In the case of rural households, the micro and small enterprises have emerged from farming activities. In the case of the central parts of the country, starch processing is still a source of income not much more important than other agricultural activities, but in the Red River Delta and in the North East South is becoming a specialized activity. The opportunities of cassava and canna processing for the local food industry and other non-food uses has induced dramatic increase of investment by small and large enterprises, with an average annual rate of 78 percent over the period 1988 to 1997. Moreover, the new entrants have increased the size of their operations, as shown by an average processing capacity of new entry of less than 10 tons per day previously to 1994 to an average capacity of almost 60 and 80 tons per day in 1995 and 1997. An additional reason for this strong growth of investment and production is the linkage with world markets. Starch in Viet Nam is already an exportable commodity. During 1998, more than 21,000 tons have been exported to countries such as Singapore, Taiwan, Philippines, Indonesia, and Malaysia. The export prices of starch are much higher than domestic prices, partly reflecting the better quality of exported starch. On average, export prices were almost $300 per ton, to compare to less than $200 per ton for domestic starch.

Strong Linkages with Rural Development

In the 19 communes that we have surveyed, almost 4,800 households were reported to be involved in starch production. Moreover, several other households are involved in starch processing industry such as noodles, maltose, candy, paper, and food. Starch production and processing is becoming a viable entrepreneurial activity for many rural households, contributing overall to more than 55 percent of their income. In the North East South, there is an even higher specialization, with starch related activities providing about 79 percent of total average income. Moreover, the income of rural households engaged in starch processors is more than twice the income of the average rural household ($358 per capita versus $170 per capita).

As with other agrobusiness activities, the link between starch processing and agricultural production is very close, as pointed out by the induced demand for raw material. The greatest beneficiary is cassava production. In our survey, we found that about 24 percent of total cassava production is demanded by starch producers. The greatest share is for dry starch production (18.7 percent of the total). The total starch production (wet and dry) in the survey was found to be 131 thousand tons, corresponding to more than 477 thousand tons of cassava.

A Complex Structure of Production of Starch

Production of starch in Viet Nam is carried out by a variety of enterprises, including very small firms and some large ones. In our survey, the micro enterprises (less than one ton per day) comprise almost 50 percent of the sample, small enterprises (between 1 and 5 tons per day) about 26 percent, medium enterprises (between 5 and 10 tons per day) about 24 percent, and

large enterprises (more than 10 tons per day) only 10 percent of the sample. Among large enterprises, there is VEDAN with capacity of 800 tons per day. The contribution of small-medium enterprises to wet starch production is about 87 percent in our sample, while they contribute only 13 percent to dry starch production, indicating a specialization of small-medium enterprises in wet starch and a specialization of large enterprises in dry. The dry starch is in fact relatively more capital intensive than the production of wet starch.

Different enterprises have quite different capital equipment, as shown by a very small value of equipment for micro-small enterprises (about $50), while for large enterprises the average value is about $363,000. The small enterprises, however, have a much more efficient use of capital equipment, as shown by an output-capital ration of 9.3 tons per million Dong of capital equipment versus 0.6 tons of starch for large enterprises. The regional distribution of enterprises indicates a large predominance of small firms in the north and large firms in the south.

Income and Cost of Production

The different structure of production is reflected in different operation cost (excluding raw materials) structure for various firm size. Micro enterprises, for example, rent equipment and this is a large share of their cost (35 percent). Large enterprises spend more than 68 percent in electricity and labor, while medium enterprise allocate only 47 percent to these two items. Profits vary from Dong 7.5 million for micro enterprises to Dong 712 billion for large ones. The profit shares increase with the size of the enterprise, varying from 12 percent for medium enterprises to 23 percent for large enterprises.

Constraints

In spite of its dynamism, there are several constraints facing the starch industry that require solution for the sector to accelerate its growth. We focus here on four types of constraints. First, the low level of technology as indicated by just the barest equipment (graters and pumps) for the majority of small processors. Only large enterprises have access to sedimentation tanks, dryers, and complete starch system. The great majority of the industry is working with locally manufactured equipment, or equipment from Russia and China, of quite low value and inappropriate for producing high quality starch.

Second, the access to credit is quite limited for both small and large. Large firms have a better access to bank credit, but the large firms are also the ones that express bigger gap between obtained credit and credit requirements (the requirement-obtained credit ratio is almost 7).

Third, the high material cost, cassava particularly, contributes to lowering the competitiveness of the industry. Large enterprises pay the highest price for raw material procured by farmers (Dong 319 per kg) while micro enterprises pay the lowest one (Dong 285 per kg) in partly due to their proximity to farm production. Interestingly, however, the greatest part of procurement is done from traders, and in this case there is a surprisingly little variation between different firm sizes. Raw material costs represent over 94 percent of total cost of production for the micro enterprises and 86 percent for large enterprises. The high cost is related to the low productivity of cassava, that averages only 7.3 tons/ha in the country, even though there is a huge difference between the yield in the North Mountains and Midlands (6 tons/ha) where most of the production takes place and the yield in the North East South (10.2 tons/ha). Finally, the production of starch is

polluting the environment causing serious problem in water quality at the community level. In the absence of sewage systems and water purification systems, the starch processors have no other choice but to dump the residues and the polluted water into the village street and inadequate sewage system. This is indicated as one of the most serious problems by both households and community leaders.

MARKETING

A crucial link in the post-harvest chain for starch is the role of traders, given their importance as a major source of procurement and sales for processors and end-users. As part of the project on starch, a survey of 115 starch traders was conducted between March and April 1998 in six regions of Viet Nam. The goal was to obtain some characteristics about traders, such as their procurement and sales patterns, marketing network, and present profitability to understand the role they play in the starch system as the link between processors and end-users.

General Characteristics

Like processors, starch traders have only recently commenced operations, with over 70 percent of traders reporting that they began starch trading after 1988. Even in regions where trade in starch is more established, such as the RRD, NCC, and NES, the average trader has engaged in starch trading for only 10 years. Almost all traders are household operations that, with the exception of the NES, employ just 2 to 3 workers. Traders in the NES, while also considering themselves household enterprises, nevertheless employ an average of 13

workers. 80 percent of all traders are male, with the distribution of male traders relatively similar across Viet Nam.

Starch traders are extremely diversified. Only 39 percent of income in 1997 resulted from trade in starch, though this is up from 36 percent in 1996. 15 percent of income comes from other starch related activities, with an additional 15 percent from non-starch activities and 14 percent from crop production. Traders in the NMM, NCC, and NES are the most concentrated in trading starch, with over half of the income generated from this source. By contrast, traders in the RRD are the most diversified in Viet Nam, with only 27 percent of income coming from starch trading. The remainder derives from other starch activities (23 percent), non-starch activities (18 percent), crop production (13 percent), and livestock (11 percent).

Patterns of Procurement and Sales

The starch traders surveyed are active in the trade of both roots and starch. With respect to trade in roots, an average of 567 tons of cassava roots and 96 tons of canna roots were procured by traders. Over 96 tons of wet cassava starch and 40 tons of dry cassava starch (1st and 2nd class) were obtained by starch traders, while canna starch purchases were somewhat smaller on average (35 tons of wet canna starch, 8 tons of dry canna starch). The greatest average volumes of procurement in roots occur in the RRD (699 tons) and NES (429 tons), while large quantities of starch are bought in the NMM (800 tons of wet starch) and the NES (293 tons of wet starch and 74 tons of 1st class starch). The pattern of sales volumes in roots and starch is similar to procurement. Unlike processors, whose time in production, procurement, and sales occurred

mainly in peak periods, traders often spend significant time in what is considered "off-peak" periods, particularly in root procurement and dry starch sales.

Nationally, 71 percent of cassava roots are obtained by other traders, with the remainder coming directly from farmers. While other traders are the main source of roots in the RRD (78 percent), 68 percent of traders in the NCC and 57 percent of traders in the NES obtain cassava roots from farmers. 69 percent of traders purchase wet cassava starch from starch enterprises, though there are distinct regional differences. Starch enterprises are the exclusive source of wet starch in the NMM and RRD and represent over 75 percent of wet cassava purchases by traders in the NES. In the NCC, however, three-quarters of traders obtain wet cassava starch from other traders. Farmers are the exclusive supplier of wet cassava starch in the SCC and CH. 59 percent of dry cassava starch is obtained from starch enterprises, with 30 percent coming from traders and 10 percent from own production. Traders are the only supplier of dry starch in the NCC, while in the RRD and NES, enterprises are the main source of dry cassava starch.

Two-thirds of canna roots come from traders, while the remaining one-third comes from farmers. Most canna starch (wet and dry) comes from farmers, with starch enterprises as a secondary source only in the RRD. Other traders play a minor role as a source of procurement in canna starch.

Starch traders sell a sizable portion of wet and dry starch to other traders. In the case of wet starch, 40 percent is purchased by other traders. These averages hide important regional patterns, however. In the CH and NES, large volumes of starch are purchased by other traders. Yet elsewhere in the country, there are few sales to starch traders. In the RRD, two-thirds of wet cassava

sales go to food industries, with the remainder to other sources. In the NCC, noodle factories and households are the most important markets for wet starch. Maltose factories in the NMM purchases large volumes of wet starch. In 1st class cassava starch, sales to exporters and traders predominate nationally, though these figures are inflated by the large average volumes of starch sold in the NES. In the RRD, packaging paper and food industries each purchase about 37 percent of the starch sold in the RRD. In the central coasts, 1st class starch is sold to food sources; namely noodles (96 percent in the SCC, 31 percent in the NCC), food industries (24 percent in the NCC), households (4 percent in the SCC), and other sources (40 percent in the NCC). All 2nd class cassava starch is sold in the RRD, with over 75 percent destined for food industries. Smaller amounts are sold to maltose factories and households.

Wet canna starch is mainly purchased by traders (20 tons) and noodle producers (16 tons). Sales to traders are important in the RRD, with 36 tons of wet canna starch sold, with sales to noodle producers slightly smaller at 29 tons. In the NCC and CH, wet canna starch is sold exclusively to noodle factories. Dry canna starch is sold to similar markets as wet canna starch, but in different proportions — 4.6 tons is sold to noodle producers versus 3.2 tons to traders. As with wet canna starch, traders are important only in the RRD. Nonetheless, sales to noodle producers represent the largest market for dry canna starch in all regions.

The volume of trade for the majority of traders is under 100 tons (table 4.11.1). Fewer than 2 percent of traders deal with more than 500 tons of either wet or dry cassava starch per year. Larger volumes of roots are more common among traders, yet only 30 percent of traders trade more than 100 tons of cassava roots.

Marketing Network

79 percent of the traders in the survey reported the use of some means of transportation. 58 percent of traders use trucks, followed by 16 percent of traders who use carts. Other forms of transport include bicycles, cyclos, and boats. There is a noticeable regional dimension to the mode of transport employed. In the RRD, CH, NES, over 70 percent of traders use trucks in their operations. In the SCC, however, only 16 percent of traders use trucks, while over 83 percent use carts. In the NCC, trucks are not used at all; instead, most traders conduct their operations with bicycles (54 percent) or cyclos (31 percent). This might suggest that traders in these regions rely on longer distance trade, while those in the NCC and SCC conduct business in the local market.

Most trade in roots and starch is conducted on a local basis (i.e. within the same province), with the RRD being a major exception. With the exception of the RRD, the distance traveled for purchases and sales of both types of commodities is usually under 35 km. Nationally, traders traveled the farthest to procure and sell roots (79 km), followed by dry starch (45 km). Traders travel the smallest distance for wet starch purchases (23 km). Sales of roots follow the same pattern in terms of distances, while traders typically venture an average of over 60 km for sales of starch.

The RRD presents the most interesting variations in the trade in roots and starch and contains almost all instances of non-local trade. In the RRD, traders travel over 120 km for root purchases, as they typically obtain their roots from the NMM, particularly Son La and Vinh Phu. Typical distances traveled by these traders ranges from 40 to 300 km. Sales distances are similar at 105 km, though

most sales of roots occur in within the RRD. For wet starch, there appears to be two types of traders in the RRD. Those centered around Ha Tay and Hai Hung purchase both wet cassava and canna starch locally, traveling no more than 10 km. Those in Ha Noi, however, travel between 70 and 250 km for wet canna starch obtained in the NMM. Most traders in the RRD sell wet starch locally, though there are several traders who travel great distances to sell canna starch; this includes one trader who sells both wet and dry canna starch from the RRD to the NES! In addition, a trader in the CH travels some 700 km to sell starch in the NES. Most trade in dry starch in the RRD is local, though there are two traders in Ha Noi who travel to the NMM for dry canna starch.

Profitability and Constraints to Trade

Traders have been rather profitable recently. Over 95 percent of traders reported conditions as either normal or good in 1997, an improvement over 1996. Conditions improved everywhere with the exception of the RRD. The most important reason for the optimism expressed by traders is from increases in the volume of trade. In the RRD, fewer traders reported conditions as good as in 1996, but only a handful considered 1997 a bad year for profits. Traders in the RRD appeared to be negatively affected by changes in sale prices, while those in the CH and NES saw profits rise as a result of changes in sale prices.

Overall, traders receive 38 million Dong (almost $3000) from trading activities (table 4.11.2). These figures include income from trade in roots, which is sizable in the RRD. Income in the RRD is over 10 times that in the NES, primarily due to the large margins received by traders in the RRD from trade in cassava and canna roots.

Traders face a number of constraints related to their operations. The most significant of these related to credit access and bank dealings. Only 46 percent of all traders receive credit and of those traders, 60 percent consider the amount borrowed to be adequate. Slightly less than half (48 percent) of traders providing suggestions mentioned problems with either obtaining credit, banks in general, or the length of loans being offered. A secondary problem reported by traders were regulatory impediments. These include high road fees, problems with police regulations, and the number of inspection stations.

END USERS

The survey of 235 end users of starch collected information on the main characteristics of each enterprise, on the types of starch used, range and volumes of products made, prices, and on trends in volumes of starch purchased. Qualitative information on the major problems facing these end users, especially in the area of starch quality, was also obtained.

About 83% of enterprises are micro- or small scale, household level activities. Of these, 93% were in the unregistered, informal sector. The larger scale organizations comprised private, state and cooperative enterprises, a well as a few foreign and joint venture companies. All of these were legally registered. 58% of enterprises had been in operation for 10 years or less, demonstrating quite dynamic growth in recent years. Household level enterprises used 3-4 workers on average, while the formal sector enterprises were highly variable in employment of labor, ranging from very few to 28,000 in the textile sector.

The smaller, household level enterprises produce traditional products, principally noodles, maltose (for the candy industry) and a type of pancake. The larger

enterprises manufacture a range of food and non-food products, including glucose, MSG, paper, plywood, pharmaceuticals and textiles. In general, the larger enterprises were under represented in the survey, as was the south of Vietnam. The total volume of starch procured by the end users that were surveyed (73,600 tons dry starch equivalent) was less than the starch production recorded in the starch processors survey.

Noodle enterprises comprised over half those surveyed (55%), with maltose (12%) and other, traditional foods (17%) also important: this represents the small, household level scale of enterprises. The non-food sector (pharmaceutical, textiles, paper etc) totaled 15%, while the glucose and MSG sectors between them totaled only 1.3% of the enterprises. The MSG factory is foreign owned (VEDAN), the glucose plants are operated as joint ventures or private Vietnamese-owned enterprises, while paper, textile and pharmaceutical firm are either state or private Vietnamese owned firms. Regionally, the Red River Delta is home to the major concentration of small, household enterprises. The north mountain region has five firms, all state owned. The south (NES) has proportionately more large scale firms than other areas of the country. The central region has the fewest starch end users in general, and most of these are small producers of noodles and other traditional foods.

Two type of cassava starch were distinguish by the end users: 1st and 2nd class. The highest quality, 1st class starch is used by the pharmaceutical, paper, glucose and MSG industries and is the major type of dry starch used, 2nd class starch is used by sectors where quality is less important (adhesives, plywood). Wet starch is used by traditional small scale processors (noodles and maltose) and by the MSG factory. Very little modified starch was reported in the survey

(180 tons total): this was used by the textile and pharmaceutical sectors. Canna starch, both wet and dry, was only used for production of noodles.

Although the noodles sector comprised over 55% of the enterprises surveyed, these only accounted for 1.3% of the cassava starch procured. The single MSG enterprise (VEDAN) accounted for 60.5% of total cassava starch procured, and thus dominates the starch sector of Vietnam. VEDAN purchases both wet and dry starch, influencing both markets. The two glucose producing enterprises procure 7% of cassava starch. Maltose, with 13% of enterprises, procures 14% of starch.

End users were asked for the volumes of starch they procured in 1996, 1997 and for projection for the year 2000. The glucose sector reported the largest expected increase (185%) in starch procured between 1996 and 2000, followed by the pharmaceutical sector (52%) and maltose (35%). The noodles sector (canna starch) was projected to increase by only 21%, and the textiles sector by 9%. It was not possible to obtain a projection for 2000 from the MSG sector.

The prices paid for cassava starch varied according to the end user and by region. The pharmaceutical sector paid the highest prices for 1st class cassava starch (4,000 dong/kg), followed by paper and textiles, with noodles, glucose and maltose paying the lowest price (around 2000 dong/kg). The difference in price strongly suggests that there is no standardization of quality for "1st class" cassava starch. The pharmaceutical sector has the most stringent quality requirements, and by paying a higher price can obtain starch that meets its needs. The maltose and pharmaceutical industries paid more for starch in the north, than the south of the country in 1997, while textiles and paper paid less in the north than the south.

The relative prices of cassava and canna starches changed between 1996 and 1997. Taking wet cassava price as a standard (price index of 100 in each year), dry cassava was quite consistent over the two years at 199-194, while wet canna starch ranged from 271 in 1996 to only 180 in 1997, and dry canna starch from 392 in 1996 to only 295 in 1997. Modified starch was 10 times the price of wet cassava starch.

Starch users procure their starch from traders and urban wholesalers: direct market links between starch processors and end users are not so common. Most of the starch is sourced locally, although some inter-regional trade was found. Cassava starch from the red river delta region is trucked to south Vietnam.

Color was rated the most important quality characteristic by 87% of enterprises, with only 8% mentioning purity. Quality is rated visually or "by experience" by 94% of enterprises: very few use any laboratory quality control. 67% of enterprises purify starch after purchase, incurring losses of between 0.7 and 3.5% in the process. The fact that firms are accustomed to purification of starch themselves, perhaps explains why purity was not ranked higher as a major quality characteristic.

The problems mentioned by starch using enterprises were concerned with price (of starch and products), supply and quality. The noodles sector was especially concerned about volatility of prices, reflecting the importance of canna starch as a raw material. Noodles and textile firms were also concerned about starch quality, while the MSG, maltose and noodle sectors demonstrated concern over problems with raw material supply availability. The MSG factory specifically referred to seasonality of supply as a constraint.

In conclusion, the expansion of both large and small scale starch using enterprises over the last ten years is clear. The emergence of industries such as MSG and glucose has transformed the way starch is used in Vietnam, as well as increasing the proportion of cassava that is processed into starch. Based on the results of this survey, continued expansion of most of the larger scale sectors is envisaged (although no information could be obtained for the MSG industry), while at the smaller scale noodle enterprises do not expect to expand at the rate of the past, but maltose would appear to have a more positive outlook. One clear area for future research and policy development is in the quality standardization of starch.

ANALYSIS OF POLICY OPTIONS

Starch industry is a good example of rural industrialization where low-value agricultural commodities such as cassava and canna are processed into high-value commodities such as starch to be used in a variety of industries including the food industry (noodles, MSG, maltose) and the non-food industry (paper, pharmaceutical, textile, glucose, adhesive, etc.). Even though the sector is small relatively to rice, livestock, and coffee, it has a high potential in terms of demand growth, poverty reduction, and income diversification of rural areas, particularly the less favored ones.

Identification of Key Policy Issues

Issue #1: Low productivity of cassava.

The average of cassava yield in Viet Nam is low (7.3 tons/ha) even though there is large regional variation from 6 tons/ha in the North Mountains and Midlands to over 10 tons/ha in the North East South. The low productivity at the farm level

results in high cost of raw materials for the starch industry. Moreover, demand for starch could be constrained by supply bottlenecks during the procurement season. New varieties of cassava already exist that promise a dramatic increase in productivity and in starch content.

Issue#2: Low quality of starch.

Currently, the starch produced in Viet Nam is not of a quality appropriate to meet the specifications required by international markets. Even though about 20 percent of starch produced in Viet Nam is exported, the total quantity is still small. The starch appropriate for exports fetches much higher prices than domestic prices. The increase in quality could benefit the sector, mainly the processing industry but also farmers who will face higher prices for their product.

Issue #3: Lack of access to credit for capital equipment investment

Both large and small enterprises face difficulty in obtaining credit to finance their procurement activities as well as capital investment. The distribution of capital equipment is highly skewed, with small and medium size enterprises having only few hundred dollars value of equipment, and large enterprises several hundred thousand dollars. Yet, the output capital ratio for small enterprises is much higher than for large enterprises. The allocation of investment will have different effects depending on the destination of investment.

The three policy issues, namely low productivity of cassava, low quality of starch, and limited access to credit, point to alternative policy options. In the case of low productivity of cassava, a strategy for action could be to promote investment in research and extension that leads to the adoption of higher yield cultivars with higher starch content and improved agronomic techniques that preserve soil fertility and ensure a more sustainable production. In the case of

low quality of starch, alternative strategies might involve the upgrading of processing equipment, a better market information system that allows identifying opportunities in international markets, quality inspection mechanisms that ensure the production of starch with precise specifications, and access to export credit. In the case of limited access to credit, a possible strategy might be to change the current practice of the banking system biased toward large enterprises.

Results of Starch Industry Model of Viet Nam (SIMV)

The results obtained from the model depend on the elasticities assumed for various demand and supply parameters reported in the appendix. Of course, a more complete study should evaluate these parameters more closely and conduct a rigorous sensitive analysis. The conclusions presented here are only suggestive of the likely direction of the effects of various policy options. As such, they should be taken with caution and be tested by further research.

Effects of Increasing Cassava Productivity

In this case, we are interested in studying the effect of 10 percent increase in cassava yields. The overall income effect of this policy is modest amounting to 1.8 percent of total income. The distribution of gains and losses is, however, interesting. Farmers' income slightly declines by 1.3 percent as the higher production of cassava induces a downward price movement of 7 percent. Cheaper cassava prices are benefitting feed processors that now expand their exports considerably (by 17%) and increase their income by 7 percent. The major gain is for dry starch processors who gain almost 12 percent, mainly due to lower input prices that allow the expansion of production and the exports of

starch at export prices. In other words, the link between international and domestic prices in the case of dry starch helps processors to benefit from lower cassava prices. Exports shoot up by almost 47 percent and reach 32.5 thousand tons. The negative effect on farm income has to be qualified, by saying that in so far as farmers are also involved in other postharvest activities such as feed and starch processing, they will benefit from the increase in productivity.

Effects of Increasing Starch Quality

In this case, the margin between export prices and domestic prices is narrowed from an initial value of about 1000 Dong/kg to 900 Dong/kg as the result of higher quality of starch produced in Viet Nam. Overall income of the sector increases by 3.4 percent. This time both farmers and processors gain, the former through higher prices for cassava and the latter through higher prices of starch and increased exports. Dry starch processors income increases by more than 13 percent and exports by almost 41 percent. The only sub-sector that loses is the feed processing sector given the higher cost of raw materials.

Effects of Increasing Capital Equipment

In this case we consider an increase of 10 percent in the availability of credit for capital investment. The analysis considers alternative strategies for investment. One strategy consists in increasing the capital only of large enterprises and another strategy consists in increasing the capital only of small enterprises. When capital is increased only for large enterprises, there are sectoral income benefits but these are not big (only 1.5 percent for the sector as a whole, 1.2

percent increase for farm income, and 4.4 percent increase for the dry processors). When capital is increased only for small enterprises, the benefits are much higher. This is the consequence of a more productive use of capital by the small enterprises (their output-capital ration is more than 10 times than for large enterprises). In fact, the overall sector income rises by almost 11 percent. Farmers benefit greatly from this strategy as well the small processing enterprises.

OVERALL CONCLUSIONS

Conclusion #1:

The starch industry is a dynamic sector that has exhibited a strong growth over the past 10 years.

Until ten years ago, starch processing was barely ten percent of total use of cassava. From 1988, an increasing number of participants have started to be involved in starch processing, including both rural households and large enterprises. Field data point to about 24 percent of cassava production currently processed into starch. In the case of rural households, micro and small enterprises have emerged from farming activities. In the case of the central parts of the country, starch processing is still a source of income not much more important than other agricultural activities, but in the Red River Delta and in the North East South is becoming a specialized activity. The opportunities of cassava and canna processing for the local food industry and other non-food uses has induced dramatic increase of investment by small and large enterprises, with an average annual rate of 78 percent over the period 1988 to 1997. Moreover, the new entrants have increased the size of their operations, as shown by an average processing capacity of new entries of less than 10 tons per day before 1994 to an average capacity of almost 60 and 80 tons per day in

1995 and 1997. An additional reason for this strong growth of investment and production is the linkage with world markets. Starch in Viet Nam is already an exportable commodity. During 1998, more than 21,000 tons have been exported to countries such as Singapore, Taiwan, Philippines, Indonesia, and Malaysia. The export prices of starch are much higher than domestic prices, partly reflecting the better quality of exported starch. On average, export prices were almost $300 per ton, to compare to less than $200 per ton for domestic starch.

Conclusion #2:

The starch industry has strong linkages with rural development.

We have found entire communities involved in starch production. Moreover, several other households are involved in starch processing industry such as noodles, maltose, candy, paper, and food. Starch production and processing is becoming a viable entrepreneurial activity for many rural households, contributing overall to more than 55 percent of their income. In the North East South, there is an even higher specialization, with starch related activities providing about 79 percent of total average income. Such employment provides higher income than the average rural activity. The income of rural households engaged in starch processors is more than twice the income of the average rural household ($358 per capita versus $170 per capita).

As with other agrobusiness activities, the link between starch processing and agricultural production is very close, as pointed out by the induced demand for raw material. The greatest beneficiary is cassava production. In our survey, we found that about 24 percent of total cassava production is demanded by starch producers. The greatest share is for dry starch production (18.7 percent of the total). The total starch production (wet and dry) in the survey was found to be 131 thousand tons, corresponding to more than 477 thousand tons of cassava.

Conclusion #3

Future prospects for the sector appear strong as there is a growing domestic demand for starch and increasing opportunities for exports.

The smaller, household level end user enterprises produce traditional products, principally noodles, maltose (for the candy industry) and a type of pancake. The larger enterprises manufacture a range of food and non-food products, including glucose, MSG, paper, plywood, pharmaceuticals and textiles. The most important use of starch in Viet Nam is for fermentation products (including MSG) a sector that is rapidly growing.

End users were asked for the volumes of starch they procured in 1996, 1997 and for projection for the year 2000. The glucose sector reported the largest expected increase (185%) in starch procured between 1996 and 2000, followed by the pharmaceutical sector (52%) and maltose (35%). The noodles sector (canna starch) was projected to increase by only 21%, and the textiles sector by 9%. It was not possible to obtain a specific projection for 2000 from the MSG sector, but the prospect for MSG and in general fermentation products is positive. Not only are domestic demand prospects good, but prospects for exports also appear positive as industrial uses of starch are multiplying rapidly. The rapid growth of cassava starch exports of neighboring Thailand during the last 5 years offers an indication of a growing market in Asia.

This seems to be supported by other changes that are taking place such as the introduction of better varieties of cassava to lower the cost of production, the improvement of the quality of starch produced in the country through investment in new equipment, and the introduction of quality standards and mechanisms for quality inspection.

Conclusion #4

The growth potential of the sector depends on the resolution of key constrains in raw material productivity, quality and standardization, access to capital for investment, and environmental pollution.

In spite of its dynamism, there are several constraints facing the starch industry that require solution for the sector to accelerate its growth. We focus here on four types of constraints.

First, the high cost of raw material cost contributes to lowering the competitiveness of the industry. Raw material costs represent over 94 percent of total cost of production for the micro enterprises and 86 percent for large enterprises. The high cost is related to the low productivity of cassava, that averages only 7.3 tons/ha in the country, even though there is a huge difference between the yield in the North Mountains and Midlands (6 tons/ha) where most of the production takes place and the yield in the North East South (10.2 tons/ha).

Second, most of the starch produced in Viet Nam is not of a quality appropriate to meet the specifications required by international markets. The higher quality for exports fetches higher prices than in domestic markets. There is however, a problem also with the absence of grades and standards in domestic markets. What is commonly referred to as "1st class cassava dry starch" includes prices ranges from Dong 1750/kg to Dong 5,200/kg, implying different products. The industry is virtually not producing any modified starch and the assessment of quality is made on the basis of visual inspection rather than laboratory methods.

Third, the low level of technology is reflected in just the barest equipment (graters and pumps) for the majority of small processors. Only large enterprises

have access to sedimentation tanks, dryers, and complete starch system. The great majority of the industry is working with locally manufactured equipment, or equipment from Russia and China, of quite low value and inappropriate for producing high quality starch. The access to credit is quite limited for both small and large firms. Large firms have a better access to bank credit, but the large firms are also the ones that express bigger gap between obtained credit and credit requirements (the requirement-obtained credit ratio is almost 7).

Finally, the production of starch is polluting the environment and causing serious problem in water quality at the community level. In the absence of sewage systems and water purification systems, the starch processors have no other choice but to dump the residues and the polluted water into the village street and inadequate sewage system. This is indicated as one of the most serious problems by both households and community leaders. For larger enterprises, the pollution problems are less serious as they are more easily regulated and have invested in water treatment devices.

IMPLICATIONS FOR POLICY

Implication #1

There is a need of an integrated strategy involving farm production and postharvest technology. Unless farm productivity increases, there could be supply bottlenecks to the expansion of the starch industry. That implies investment in research and extension activities for increasing yield and starch content of cassava roots at the farm level.

Implication #2

There are important benefits to be reaped from improving quality of starch, mostly deriving from higher prices in international markets. That implies institutional building that promotes the standardization of starch in Viet Nam, quality control, easier access to international markets, and market information systems.

Implication #3

The best way to stimulate growth of the sector is to increase the access of credit for capital equipment investment of small and medium scale starch enterprises. That implies a more liberalized financial and banking system, whereby credit is not directed to large enterprises only, but on the basis of market potential.

Implication #4

Starch processing of small and medium enterprises is currently characterized by severe pollution that is harming the environment and the health of entire communities and risks to make future production unsustainable. The current situation will require a combination of approaches including regulation, tax policy, local government initiative, and technological innovation.

Implications for research

The study has reached some conclusions but it has left many unresolved issues that need to be further researched for improving the design and implementation of policy. Five main areas for further research are briefly indicated here.

Development and adoption of new cassava varieties

The proposed research activity should look at the following areas:

- availability and suitability of cassava new varieties (yield, starch content, fertility input requirements, extended period of production)
- soil fertility management (as cassava is uprooted, there are considerable soil nutrient losses that need to be replenished to preserve soil fertility)
- contract arrangements between farmers and processors (in order to smooth procurement operations of starch factories over the production period)

Quality control, standardization, and technology

The proposed research activity should look at the following areas:

- creation and use of starch standards
- technology requirements for the production of different standards
- institutional mechanisms to control quality of starch

Environmentally friendly processing

The proposed research activity should look at the following areas:

- environmental assessment of pollution generated by different industry scales
- alternative responses of communities to the problem and mechanisms to enhance community action on this front
- analysis of costs and benefits of alternative options (regulations, tax policy, community action, technology development)

Growth of small and medium enterprises

The proposed research activity should look at the following areas:

- dynamics of enterprise growth (transition from micro to small, medium, large)

- linkages between small and larger scale enterprises (e.g. sale of wet starch for purification) and mechanisms to enhance these linkages
- constraints to growth (credit, technology, land access, etc.)
- evaluation of constraints (which constraint is more important?)

World markets and export opportunities

The proposed research activity should look at the following areas:

- major importers, exporters, trade flows
- qualities and prices
- barriers to trade
- trends
- new emerging uses of starch (fermentation industry, biotechnology, food and non-food industry)

1. INTRODUCTION

BACKGROUND

In the context of rural development, there is an increasing need to promote activities and policies which generate and diversify income in rural areas. Policies that are designed to benefit rural producers often focus on high potential areas and miss those rural households who may not cultivate the crops most suited to intensive agriculture. This is certainly the case in Viet Nam, where farmers in the North Mountains and Central Coast have not directly benefitted from policies that have targeted rice production. The hypothesis of this research activity is that the starch industry, based on cassava, canna and, potentially sweet potato is one potential avenue for generating income for the segment of the rural poor in Viet Nam who cannot benefit from intensive rice cultivation or cash crops such as coffee. This is predicated on the strength of linkages between the production of root crops, especially cassava, in poor areas and the local processing of starch for industry to meet an increasing domestic demand for starch-related products. These include both food (e.g. maltose, glucose, MSG, and noodles), animal feed (e.g. lysine) and industrial (e.g. textiles, pharmaceutical, and paper) products.

Even though the starch industry is a small sub-sector of the rural economy of Viet Nam, its study can offer important insights into the non-farm rural sector that may be of more general interest. While in the past most rural development was based on rice production, in the future, other activities, both agricultural and non-agricultural, will increasingly contribute to the growth of the rural economy.

Rice, livestock, and coffee will continue to be important in the future of Vietnamese agriculture, but they will not be enough to absorb the increasing labor force in rural areas. That will require the generation of a diverse range of non-farm activities, both small and large scale, many of which will still be linked to agro-food production, but will have a more substantial share of postharvest added-value such as processing, storage, transportation, and marketing. In this context, the starch industry is a small but not unimportant case of how the rural economy of Viet Nam can evolve in the future.

The present research activity is conducted within the framework of the Small Grants Fund of the Global Collaborative Post-Production Research Network funded by IDRC and is a joint collaboration between IFPRI, CIAT, and the Postharvest Technology Research Institute (PHTRI) in Viet Nam. The project started in February 1998 with an initial workshop in Hanoi where the objectives, methodology, and research issues were discussed with representatives of various departments of the Ministry of Agriculture and Rural Development and community leaders involved in the starch industry. The workshop was followed by a training workshop with a team from the PHTRI and the organization of a field survey of the processing industry, the marketing system, the end users, and the rural communities involved in starch production.

OBJECTIVES OF THE STUDY

The study has five main objectives:

1. to characterize the production and consumption of starch in Viet Nam;

2. to describe the marketing channels for the starch distribution system;

3. to identify the key policy issues related to the promotin of the starch industry as a strategy for rural industrialization;

4. to analyze the effects of alternative policy options for accelerating growth of the starch industry;

5. to identify the priorities for further research.

METHODOLOGY AND RESEARCH QUESTIONS

The methodology used in this study is a combination of methods including descriptive analysis of marketing channels and processing technology, time series analysis of production of raw material, review of available literature, and modeling of the structure of the starch industry in order to conduct policy evaluation. The various methods are intended to provide answers to specific research questions that translate the objectives of the study into research activities. The first step is then to present the key questions that we intend to explore.

Research Question Related to the Production and Consumption of Starch

Our aim is to reach a broad understanding of the dynamics of the starch sector in Viet Nam. Specifically, we intend to explore four set of issues.

(a) How is the production of starch organized in Viet Nam? Who are the main producers of starch? Where are the major producers of starch located? What are the main types of production processes and technologies used in Viet Nam?

(b) How is the demand for starch characterized in Viet Nam. What is the breakdown of the uses of starch? How much is used for food and how much for industrial purposes? How much is domestically produced? How much is imported and exported?

(c) What role does industry scale play in the development of the starch industry in Viet Nam? Given the increased domestic and foreign investment into large-scale starch enterprises, what are the implications of these developments on (i) the demand for raw material? and (ii) the role of small-scale processing in Viet Nam? What are the production advantages of small-scale processing versus large-scale processing? Are some locations more amenable to small-scale production, and if so, can policies be designed to encourage investment in these industries? For example, is small-scale processing more beneficial to the rural poor? What are the economic benefits of small-scale versus large-scale processing?

(d) What are the major constraints to starch production in Viet Nam? What is the scope for increasing cassava yields for the starch industry? What are the main technological constraints to production? What are the costs of production in producing starch? What are the environmental implications of expanding cassava and sweet potato yields for starch production?

The methodology used to answer these questions involves collecting and analyzing secondary data studies of the starch industry in Viet Nam. A survey of small-scale and large-scale starch producers has been designed and used to retrieve recent data on current production trends and technologies, as well as information on current and future investment plans.

Research Issues on the Distribution System

Our goal here is to get a more complete picture of the channels involved in the processing of starch. We wish to ascertain (i) the linkages between cassava and canna cultivation and local production of starch; (ii) the main markets and industries for domestic and imported starch in Viet Nam; and (iii) the links between starch processors and markets/end-users industries, with an emphasis on the differences in these links between small-scale and large-scale processors.

The methodology used involved the design of a survey of starch processors, end users, and traders to analyze starch marketing patterns.

Research Issues Related to Policies For The Promotion of The Starch Industry

The thrust of research here is to examine the sectoral effects of improving yields of cassava (or canna and sweet potato) and facilitating the development of the starch industry by way of technological investment. We wish to focus our attention on three areas.

(a) What are the effects of improving productivity of raw material used in the production of starch? How much income will be generated and who are the groups who win and lose?

(b) What are the effects of improving quality of starch? How will trade be affected? What is the distribution of gains among farmers and processors?

(c) What are the effects of alternative investments to upgrade the capital equipment of small and large enterprises?

The methodology used in this part involved modeling the starch industry including farmers, processors, end-users, and trade. We have developed a Starch Industry Model for Viet Nam (SIMV) that allows the study of linkages among different participants in the sector and the simulation of policy options.

ORGANIZATION

The study is organized into seven chapters, including the introduction. Chapter 2 gives the context of the starch industry in Viet Nam, looking at the role of starch in world markets, the sources of starch, trends in raw materials used in

starch production in Viet Nam, uses of starch, and environmental issues. Chapter 3 presents in-depth analysis of the starch processing industry in Viet Nam based on field survey data. Chapter 4 and 5 repeat a similar analysis for the marketing system and end users. Chapter 6 identifies some key policy issues and analyzes the effects of alternative policy options to promote the development of the starch industry in Viet Nam. Chapter 7 presents the overall conclusions of the study and the implications for policy and research.

2. CONTEXT OF STARCH PRODUCTION IN VIET NAM

INTRODUCTION

This chapter introduces the context of starch production in Viet Nam. First, it presents the different uses of starch and then it gives a brief overview of world markets for starch. The chapter then describes some trends on the production of raw materials needed to produce starch in Viet Nam. The chapter concludes with some observations obtained from a survey of communities involved in starch processing in Viet Nam and the associated environmental concerns.

STARCH USES

Starch uses are varied, and are diversifying further with continued global economic development. Traditional food uses have been supplemented by widespread use of starch as a raw material in a variety of non-food industrial products. Increasingly, industry is viewing starch as a renewable raw material that can replace non-renewable fossil fuel derived feedstock for a wide range of carbon-based products, including plastics. Another trend is the development of specialty starch products for niche markets/uses, either through modification of the native starch, or through identification/breeding of crop varieties containing starch with specific native functional characteristics.

In Vietnam, root crops, especially cassava, have been the traditional sources of starch for use in food products. Cassava starch is processed into a range of foods, including noodles, crackers and cakes. Canna starch is used in the

production of transparent (glass) noodles (see Prain et al. 1997 for a discussion of traditional starch processing in Viet Nam). This started as a cheaper substitute for high quality mung-bean starch, but is now generally accepted by consumers. Sweetpotato starch can also be used for noodle production, as in China, but with less consumer acceptability. Cassava starch is the main raw material for maltose production in northern Vietnam (maltose is, in turn, used by the confectionery industry). All of these traditional uses are found mainly as household enterprises: Vietnam may be a unique example of the development of small scale maltose production from cassava starch, for example.

Non-food industrial uses of cassava are also found in Vietnam, associated with larger scale (often state run) enterprises, for example the textile industry uses cassava starch for sizing, and the paper industry for coating high quality types of paper. As these industrial sectors develop, demand for starch is likely to increase: computer and glossy, high quality paper use most starch, for example. Cassava starch has excellent agglutinant properties, and is widely used in the adhesive, plywood and cardboard industries on this account.

Starch can be broken down into its saccharide components, which are useful in themselves (as glucose and fructose syrup sweeteners for the food and soft drinks industries) and as substrates for the production of a wide range of fermentation products (for example, monosodium glutamate -MSG-, lysine for the animal feed industry, and citric acid). In North America, the production of these sugar syrups represents the major use of starch (maize starch), especially for the soft drinks industry. As this sector develops in Asia, demand for such syrups will also expand.

Starch can also be modified for a wide variety of food and non-food uses. The modifications (chemical or physical) result in a starch product with different functional properties from the native starch (as extracted from the plant). Considerable research and development effort has gone into developing a wide range of modified starches for specific end uses (e.g. for the paper industry). Modified starches have a higher value than the native starch, and offer starch producers the prospect of marketing unique, branded goods for specific niche markets, rather than a generic product.

In Vietnam, the recent arrival of a few large scale starch-producing firms interested in added value products has resulted in a much more diverse product offering than was found only a few years ago. The production of fermentation products (MSG and lysine) has started, for example. The Thai starch industry, which is more developed, has placed substantial effort and resources on a shift towards production of higher valued modified starches from cassava. Cassava starch is seen as the logical raw material for modified starch and for production of sweeteners in SE Asia, comparable to maize in North America and potato in Europe. As the starch using industries develop in SE Asia, the range of starch-derived intermediate and end products manufactured from cassava will also expand.

A further driver for the expansion in starch uses, at a global level, is the shift from use of non-renewable (petroleum-derived) to renewable (plant-derived) resources. Starch can be used as a feedstock in the same way as oil, for the production of the vast array of carbon-based products on which modern society depends. Intense research and development is making the use of starch as an industrial feedstock increasingly competitive with oil-based raw materials. Market and regulatory forces (in the developed world at least) that favor more

environmentally friendly, sustainable manufacturing processes also contribute to this trend. The increasing use of starch in the manufacture of biodegradable plastics is one example where consumer/regulatory pressure and cost-reduction through R and D, have combined to create a new and expanding use for starch. Starch is thus positioned well to take advantage of consumer and industry trends that will be increasingly important during the 21st century.

STARCH IN WORLD MARKETS

In 1992 world starch production was estimated by Ostertag (1996) at 33 million tons/year, with a value of US$ 14 billion. 45% of starch production is located in the USA, where maize starch converted into fructose and glucose syrups for food industry use is of major importance: it represents 75% of all starch used in the USA. The EU follows with 21% of the total, including a large volume of potato starch. SE Asia is a major producer of cassava starch, with Thailand as a major player in world markets. China produces a range of starches, including cassava and maize. China is also the major producer of sweetpotato starch in the world, although most of this occurs at a small scale. Japan also produces sweetpotato starch, and imports maize from USA.

The volumes of starch traded internationally are small in proportion to the total production volume. This is due to a number of factors, including the diverse raw material sources available for starch in different regions of the world, and the presence of tariff barriers to trade in this commodity.

Starch is used in its native state, but is often subjected to a range of chemical or physical modifications to alter the functional properties for specific end uses. Modified starch has been increasingly used in food and non-food industries in

recent years. Starch is also used to produce the sweeteners used in the food industry (e.g. HFCS).

Thailand has been particularly active in developing a starch industry based on cassava over the last two decades. By 1994, when total fresh root cassava production in Thailand was over 19 million tons, 50% of this was converted into starch. The remainder was processed in chips or pellets for export to the feed industry. In the same year, starch exports totaled 1.15 million tons, with a further 900,000 tons used by domestic industries. The Thai modified starch industry started in 1984, and by1989 there were about 7 modified starch factories, most of which were joint ventures with developed countries. By 1998, there were 49 cassava starch factories of which about 11 factories produced modified starch, or were equipped with modified starch facilities within the factory (Titapiwatanakun, 1998).

Within Thailand, 31% of cassava starch is modified, either chemically or physically before use. A further 12% is used for sweeteners, 12% for MSG production and 12% for other food industry purposes (Figure 1). The only major non-food use is by the paper industry (12%), with the textile, plywood and adhesive sectors all accounting for 2% or less of domestic usage.

Exports of Thai cassava starch have grown rapidly from 1975, when they were approximately 150,000 tons, until 1994, when exports reached over 900,000 tons (Figure 2). Exports peaked in 1994, and stayed constant until 1997. Volumes for 1998 are expected to be much less, due to the effects of drought on cassava production in general in Thailand, which has reduced raw material availability. However, the shortage has increased prices for cassava starch over 1997.

Thai cassava starch exports are mostly targeted at other Asian markets (Figure 3), with 8% going to Taiwan and 22% to Japan. Other Asian countries account for the bulk of the rest, with only 3% going to each of the USA and EU markets. If Vietnam is to develop an export sector, competition from Thai starch in these regional markets will be strong.

Thailand is turning attention from increasing volumes to adding value: an increasing % of starch is now exported as modified starch, at much higher prices than native starch. While total starch export from Thailand hav not grown since 1994, the rate of growth of modified starches has been high (8% annually), reflecting the drive towards greater added value in the Thai industry (Titapiwatanakun, 1998). Another feature of the Thai experience with starch has been the leading role take by industry associations (Thai Tapioca Trade Association, Thai Tapioca Flour Industries Association) and industry sponsorship of research and development activities, in key areas of cassava production, processing and marketing (for example, the diffusion of new, high starch cassava varieties and market information).

Some general trends which are acting on the industry are the increased use of modified starches, and the diversification of starch use in both food and non-food sectors (e.g. in bio-degradable plastics). A counteracting trend may be apparent in the West, however: consumer resistance to use of chemically modified starch in food products. This may drive industry to give more attention of native starches with unusual characteristics: the diversity of starch functional properties in the germplasm of many species is both wide and under exploited.

For Vietnam, issues such as the standardization and improvement of product quality and reduction in raw material costs are critical if export markets are to be targeted in the future.

AGRICULTURAL PRODUCTION TRENDS FOR RAW MATERIALS

Starch in Viet Nam is produced from three main sources: cassava, sweet potatoes, and canna. Since in starch processing, raw material is the main component of costs, it is important to look at the current production situation for these products as well as to their trends over time.

In 1997, Viet Nam produced almost 2 million tons of cassava and 1.6 million tons of sweet potatoes (see table 2.4.1). Differently from rice, production is mostly concentrated in mountainous regions, with the two main delta contributing only marginally to total production. The Northern Mountains and Midland region contributes 35 percent of total production, even though 43 percent of total cassava cultivated area is in this region, a reflection of low yield. In general, yields are relatively low, with an average value of only 7.3 tons per hectare. The distribution of yields is very unequal ranging from as low as 6 tons per hectare in the North Mountains and Midlands to over 10 tons per hectare in the North East South.

In the case of sweet potatoes, the distribution of production is concentrated in the northern part of the country, that contributes about 77 percent of the total. The average yield of 6.1 tons per hectare hides a considerable regional variation, from a minimum of 5.5 tons per hectare in the Northern Mountains and Midlands regions to 12.8 tons per hectare in the Mekong River Delta.

Trends in production for both cassava and sweet potatoes have been negative for the period 1986 to 1995 with an annual percentage growth rate of -2.5 for cassava and -0.1 for sweet potato, respectively (see tables 2.4.2 and 2.4.3). The negative trend has accelerated during the latter part of the period, that is in 1991-1995, declining to rates of -2.9 percent for cassava and -7.5 percent for sweet potatoes. These trends are partly the result of shift of production towards other more profitable crops such as rice, maize, and sugar cane and partly the result of low productivity growth of both cassava and sweet potatoes. Yield growth has been negative and partly responsible for the decline in production. In the case of cassava, half of the negative production growth is explained by declining yields, and in the case of sweet potato the situation is even more dramatic, where declining yields at 0.7 percent over the period 1986-95 have more than outweighed the increase in cultivated area. The poor performance of yield might be partly the result of a poor soil management and shift toward marginal soils, and partly the result of non-adoption of higher yielding varieties.

COMMUNITIES AND STARCH PRODUCTION

19 communities where starch processing or use is important, were surveyed across the country. This included 7 communities in the red river delta, 3 in the north central coast, 4 in south central cost and 1 in NES region of the south. The commune chair or vice-chair were interviewed in most cases. The population of the communities ranged between 3,600 and 13,000, apart from two towns with populations in excess of 50,000.

In the red river delta, production of cassava is not important: processing is the major activity (table 2.5.1). Cassava represents 24% of crop area in the north central coast, and 64% in the central highlands. Canna was rarely mentioned:

only in the red river delta, where it comprises 6% of crop area, does it assume more than marginal importance in three communities. Both cassava and canna are produced.

In the red river delta, 28% of households are involved in starch processing (table 2.5.2). In other regions this is much lower (1-8%). This reflects the specialization of some communities around Hanoi in root crop starch processing. For example, 49% of the 2226 households in Tu Dan commune, Toan Thang village of Hai Hung province are involved in starch processing. In these communities, the starch, and related noodle and maltose enterprises, form a major component of the local economy.

The community leaders provided some indication of the trends in starch production that they have observed recently. These results do not correspond directly with those from the starch end users. The community survey found a decreasing trend for wet starch production, both canna and cassava (table 2.5.3). Cassava dry starch trends were evenly balanced, while growth in dry canna starch production was found in all communities where this starch is produced (the red river delta).

Perhaps the major issue confronting the community leader that were interviewed in this survey, is the issue of environmental pollution related to the management of wastes from starch processing. The community leaders reported that the wastes from cassava processing were, indeed a problem. 61% of them classed this as a major problem, affecting human and animal health and soil fertility. The waste water is generally discharged directly in rivers, lakes, canals etc with no treatment. Individual enterprises are responsible for disposal, and also for the supply of fresh water to their processes.

The community leaders proposed a number of potential solutions, including investment in infrastructure at the community level, dissemination of waste treatment methods to starch processors and encouragement of larger scale processing operations. Research may be needed, some considered. Many communities see a role of the government in solving this problem.

ENVIRONMENTAL ASPECTS OF STARCH PRODUCTION FROM ROOT CROPS

Starch production involves extraction of the starch component from the grated, fresh root raw material, using substantial volumes of added water. In addition to the principal starch end product, a by-product consisting of the other root components (principally fibre and residual starch) is also obtained. Moreover, waste water is produced at various steps in the starch extraction process. The by-product is often used for animal feed or, less-frequently, for further added-value processing (often involving fermentation steps). Waste water has no economic use, and represents a cost to the enterprise for treatment and disposal. The waste water contains organic matter (carbohydrate in suspension and/or solution) and (from cassava only) hydrogen cyanide, both of which act as pollutants if the waste water enters local water resources.

In Thailand, the expansion in size and scale of the starch industry has been associated with an increased awareness of, and willingness to invest in, measures to reduce the environmental burden associated with starch extraction from cassava. In part, this has made economic sense: improved efficiency of water use in the extraction processes, with emphasis on recycling of water, has been cost efficient as well as significantly reducing the volumes of waste water. The waste water that is produced undergoes aerobic oxidation in ponds alongside the factories, to reduce the organic matter load and so mitigate any effects on Biological Oxygen Demand (BOD) once released into the local rivers. The investment costs for waste water treatment are substantial. However, the increasing scale of the individual factories has made the pollution generated by them much more apparent, and has resulted in tougher regulation of discharges, and a more systematic enforcement of them (C. Oates, personal

communication). In this case, increasing enterprise scale has resulted in reduced pollution levels through a combination of regulatory measures and economic logic.

In Vietnam, the small scale traditional root crop processing enterprises have not invested in waste water treatment or disposal technologies. Most frequently, the waste water is discharged directly into the street next to the enterprise, and quickly enters and contaminates the local water resources. In rural situations, where starch processing enterprises are disbursed, this may not represent a major problem (the waste water may often be released directly onto fields as irrigation water, with little organic matter reaching rivers). However, in the case of villages where large numbers of starch processing households are concentrated in one area, the pollution problem can be severe. This study includes such areas, especially in the Red River Delta region of north Vietnam.

Here, wastes are commonly discharged directly into the street. The combined wastes from many enterprises create a health hazard, since fresh water sources are contaminated. In fact, this negatively affects the starch enterprises themselves, since the fresh water used in the extraction process is also contaminated, reducing the quality of the end product and rendering it unsuitable for uses where high quality starch is required (eg the pharmaceutical industry). In some villages, the pipes that supply water to individual enterprises are laid in the same trenches that carry away the waste water.

While clear regulatory and investment options are available for dealing with this issue for large scale starch factories, resolving the problem at a small scale is more complex. Regulations are more difficult to enforce among the many households involved in the starch processing business, and funds for investment

in this activity are scarce, and perhaps would not be given highest priority. Since the community is affected by the problem, there is an issue as to whether public funds could or should be used to assist a rapid resolution of the problem. From a technological perspective, the waste water problem could be attacked at the level of individual enterprises, e.g.

- improved water use efficiency through use of hydrocyclones, as in Tamil Nadu, India (NRI);
- improved starch extraction rate to reduce the BOD load in the waste stream
- small scale water water treatment at the enterprise level (CIRAD and Univalle in Colombia and Ecuador).

Technical solutions at a community level are also possible, e.g. oxidation ponds and bio-digesters, to which the discharges from a number of enterprises can be channeled. But these will require considerable investment, perhaps with funds from government or raised via taxes on polluters.

Another potential solution to the problem is to encourage starch enterprises to increase in scale: this will make investment in efficient starch production and water use, and in waste water management facilities, more feasible as well as facilitating regulation of the sector. However, the potentially adverse consequences for rural equity and poverty alleviation if this strategy is actively pursued need to be considered.

The issue of environmental pollution is, perhaps, the major issue confronting the communities where small scale starch processing is important. These communities benefit from the additional income provided by this sector. However, the cost borne by the entire community from the pollution externalities of starch processing need to be reduced. Solutions to the problem may be at

community or individual enterprise level, may involve public and/or private investment, may focus on technology and/or policy. These alternatives need to be assessed and a strategy for reducing the scale of this problem developed in the near future.

3. STARCH PROCESSING

CHARACTERISTICS OF PROCESSORS

Starch production occurs throughout Viet Nam. Every province, save the Mekong River Delta, has some element of a starch industry. According to Table 3.1.1, most of the surveyed processors were found in the Red River Delta (44.8 percent) and in the North East South (30.4 percent), around HCMC. A smaller degree of production can be found in the North Central Coast. The provinces of Ha Tay, Hai Hung, Tay Ninh, and Dong Nai contain the largest concentration of starch processing facilities (see Table 3.1.2).

Over 50 percent of starch processors have commenced operations within the past ten years (see figure 3.1.1 and table 3.1.3). Most of the new arrivals to the starch industry started between 1988 and 1994, which coincides with the period of *doi moi*. This suggests that liberalization may have had a significant impact in opening private sector involvement in the starch industry. Interestingly, only a few industries have started up in the past 3 years.

According to Table 3.1.4, about 50 percent of starch processors can be classified as *micro processors* (i.e. capacity of less than 1 ton of starch per day). Another 26 percent of processors have a design capacity between 1 and 5 tons per day; we will designate these processors as *small processors.* The third category of processors, to which we will refer as *medium processors*, have capacity between 5 and 10 tons per day. Medium processors, roughly 14 percent of the sample, generate between 5 to 10 tons per day. *Large*

processors make over 10 tons of starch per day and comprise about 10 percent of the survey population. The distribution of starch processors varies greatly across regions (see table 3.1.5 and 3.1.6). Most starch processors in the Red River Delta, North Central Coast, Central Highlands, and South Central Coast have a capacity of less than 5 tons of starch per day. By contrast, there is a greater concentration of medium and large processors (over 70 percent) in the North East South (see Table 3.1.5). In the NMM, the size of most processors is between 5 and 10 tons of starch per day. Nationally, design capacity for starch is 6.2 tons per day, though there is substantial regional variation (see Table 3.1.7). In the RRD, NCC, and SCC, the average capacity is 1 ton or less of starch per day. In the NES, the average size is 15.47 tons per day. The figure for the CH is inflated by a processor whose capacity is 200 tons per day in Gia Lai (see table 3.1.6).

The number of workers employed by starch processors is related to the average size of starch facilities (see Table 3.1.8). In the RRD, NCC, SCC, the average number of workers varies from 3.59 to 4.23. In the NES, where starch facilities are the largest, an average of over 9 workers are employed. In the CH, the average quantity of workers employed (almost 16) reflects the 110 workers employed by the previously mentioned processor with a capacity of 200 tons per day.

On average, starch processors receive a majority (54.7 percent) of their income from starch production (see Table 3.1.9). With the exception of large processors in the CH and NES starch processors are also active in both crop and livestock production -- these comprised 20.1 and 18.7 percent, respectively, of income in 1997. The degree to which starch production represents the main source of income varies greatly by region. In the NES, for example, processors

receive their income almost exclusively from starch (78%) and livestock (14%). Processors in the central regions of Viet Nam appear to engage in starch production as a means for income diversification, as the combined income from crops and livestock is greater than the income received from starch. In the RRD, starch comprises the majority of income for processors, but they receive a sizable portion from crops (20%) and livestock (23%). In the NMM, starch and other starch-related income sources, such as noodle production, represent the main means of income generation. Between 1996 and 1997, the income generated from starch production has increased in the south (NES, SCC, and CH) and decreased in the north (RRD and NCC). In the RRD and NCC, the reduction in income from starch has been made up from increased income from crops and livestock.

EQUIPMENT

We have considered different types of equipment, ranging from very unsophisticated graters to complete starch systems. Across the sample, graters and water purification pumps are the two pieces of equipment used by most of the people (see table 3.2.1). While micro and small enterprises use low technology such as graters, medium and large enterprises use more of washers, sievers, sedimentation equipment, dryers, water purification systems, and complete starch systems. Since most of the medium and large enterprises in our sample are located in the NES, then one could deduce that the most technologically improved starch equipment in also located in the south.

Ownership of equipment is very common (see table 3.2.2). The only exception is for micro and small enterprises in the north, where there is a tendency to rent

equipment such as graters (47 percent), milling and sifting equipment (33%), and stirring systems (7%).

Most of the equipment is made in Viet Nam (see table 3.2.3). Over 80 percent of the washers, graters, sievers, milling and sifting equipment are made in Viet Nam. Other equipment comes from China (12% of graters, 50% of packaging equipment, 27% of scales, 43% of water purification systems, 8% of stirring systems, 17% of complete starch systems, and 100% of motors). Equipment from Taiwan, Russia, Japan, USA, and Thailand is also used. For example, 50% of sedimentation equipment and 33% of dryers come from Taiwan; 40 percent of purification pumps come from Russia.

The equipment is relatively new, with average age between one and seven years (see table 3.2.4). This is a reflection of the young age of the starch industry in Viet Nam, as already shown in the general characteristics of the starting date of operation of most of the enterprises.

The current value of the equipment varies a lot as a function of the type of equipment (see table 3.2.5). The average current value ranges from as low as Dong 8000 for packaging equipment (a reflection of only 2 percent of the enterprises using this type of equipment) to as high as Dong 485 million for complete starch systems.

The investment in equipment has been growing quite fast since 1987, from a total of Dong 12 million in 1987 to Dong 3.68 billion in 1997 (in constant 1998 prices). The peak of the investment was in 1995 with Dong 157 billion (see table 3.2.6). This trend has been accompanied by the entry of larger mills (see table

3.2.7 and figure 3.2.1). In fact in 1995 the average capacity of the new entrant was almost 57 tons per day.

ASSETS

After considering equipment, we are going to examine other types of assets used in the processing of starch. These include transportation assets, building and storage facilities, tanks, sedimentation channels, and pipes and tubes.

Table 3.3.1 shows that most assets have been acquired after 1990. This general conclusion, however, hides great variation across different types of processors. For example, in the case of transportation assets, while micro, small, and medium enterprises have acquired these assets in 1990, for large enterprises the distribution over time is more even with investment occurring both before 1990 and after (see table 3.3.2). The same is true for other types of assets. That suggests a more gradual investment by large enterprises over time, whereas in the case of smaller enterprises there is an outburst of investment activity concentrating in some particular years.

For each type of assets, tables 3.3.3 to 3.3.6 give the distribution across regions and enterprise size. The tables show that less sophisticated assets are used by smaller enterprises and more expensive assets by larger enterprise. For example, micro and small enterprises use bicycles and cart rather than trucks and tractors, houses rather than warehouses for storage and processing activities.

Table 3.3.7 gives the total current value of different types of assets per processor. The distribution of assets values is very skewed across different

sizes of enterprises. While the average value of equipment is about Dong 1.3 million for small enterprises, large processors equipment is valued at Dong 4.7 billion. After equipment, the other asset where there is very unequal distribution is building and storage. The total value of equipment, however, is on average 2.8 times bigger than for building and storage.

Table 3.3.8 shows the evolution of total investment over time for different types of enterprises. The year 1994 saw an outburst of investment with Dong 15.8 billion, mostly due to investment by medium enterprises.

SEASONALITY OF PRODUCTION, PROCUREMENT, AND SALES

Peak Periods for Production, Procurement, and Sales

The peak season for the production of wet cassava starch occurs between October and February. The season lasts slightly longer in the North. Wet canna starch is produced between November and January on average. Both varieties of dry cassava starch (1st class and 2nd class) are produced year-round by some processors, but most processors generate dry starch between October and February (see figures 3.4.1.1-3.4.1.5).

Procurement of cassava roots for the peak season starts in October and lasts until February, similar to the season for cassava starch production. Canna root procurement displays the same pattern as canna starch production. Wet cassava starch is obtained between October and February, though in the South, purchases of wet starch are made between August and May. Purchases of wet canna starch occur between December and February (see figures 3.4.1.6-3.4.1.9).

Starch sales coincide with the production and procurement cycles discussed above. Peak sales of wet cassava starch are between October and February. Peak sales for dry cassava starch occur at this time, though there is a greater proportion of processors who sell during other months of the year. Canna starch is sold between December and January. Exports of cassava starch typically occur between January and July (see figures 3.4.1.10-3.4.1.14).

Peak and Off-peak Days in Production

The survey shows that the production of wet cassava starch keeps occupied micro and small processors more days than dry cassava starch (of 1st class), while the opposite is true for medium and large enterprises (see table 3.4.2.1). On average, micro processors spent slightly more time in cassava starch production as small processors (123 days versus 110 days) in peak periods. In offpeak periods, the opposite result is true, with small processors working 58 days on average and micro processors working 46 days. There is enormous regional variation in production intensity, however. Micro enterprises in the NCC and SCC work significantly more in wet starch production, averaging 131 days and 178 days, respectively, while in the NES, both types of small enterprises work much less than the sample average (43 days for micro and 60 days for small) . Small processors work more in wet starch production than micro processors in the South, while the opposite is true in the North.

In wet canna starch production, we observe that micro processors spent 53 days per year in peak production versus 42 days for small processors. Small processors actually spend more days in offpeak canna production at 52.5 days.

Medium processors, on average, spend 86 days per year in peak wet cassava starch production and 36 days in offpeak production. Wet canna starch production takes an average of 40 days of the year, but is only concentrated in one facility in the NES. Medium processors in the NCC spend much more time in both peak and offpeak wet cassava starch production than the national survey average. Large processors spend 88 days per year in peak wet cassava starch production and 30 days in offpeak production. Among large processors, only large processors in the NES spend time producing wet cassava starch. On average, 20 days are spent on wet canna starch production in peak periods. This result is attributed to one processor spending 20 days on wet canna starch production in the RRD.

Micro and small processors spend less time in dry cassava starch of 1st class production than in wet starch production. For first class cassava starch, micro processors spend 86 days per year in peak production, while small processors work slightly under 103 days per year during peak periods. Small processors spend almost 199 days in second class cassava starch production, while micro processors spend almost 122 days in peak periods In offpeak periods, micro processors work more days than small processors in both first and second class cassava starch production.

The regional trends among small and micro processors in dry cassava starch are opposite those in wet cassava starch production. In the NES, processors of first class cassava starch spend less time than the national average (60 days for small processors, 47 for micro processors). In the NMM, NCC, and CH, there is no production of dry cassava starch of either class. In the RRD, micro processors work less days (136 days) than small processors (145 days) in peak production of first class starch. Similarly, small processors

spend more time in second class starch production (199 days) than micro processors (122 days). In offpeak periods in the RRD, micro processors work almost 76 days in first class production and 77 days in second class production, while small processors work for 25 and 70 days for each type of dry starch, respectively.

As with wet canna starch, micro processors spend more time than small processors in the production of dry canna starch. The time allocated towards dry canna starch production is small relative to wet canna starch.

Medium processors allocate more time toward dry cassava starch (first class) than wet starch production. No time is spent working on second class cassava starch. In the NMM and NCC, where there was a sizable portion of time used in wet starch production, there is no production of dry cassava starch. Dry starch production occurs in the RRD, where no wet cassava starch is produced among medium processors. Interestingly, the time spent on offpeak production in the RRD (60 days) is greater than peak production (50 days). In the NES, medium processors spent about 109 days in dry starch production during peak period.

Large processors spend 147 days in peak first class cassava starch production. Large processors spend less time in second class starch production than both micro and small processors. Dry canna starch production is taking a negligible amount of days.

Peak and Off-peak Days in Procurement

Three main conclusions emerge from the consideration of peak days for procurement activities (see table 3.4.3.1). First, for the overall sample,

procurement of wet cassava starch occupies more days (114 days) than procurement of cassava roots (103), a consequence of the longer storability of wet starch relatively to fresh roots. Second, the overall period of procurement of fresh cassava roots is longer for medium and large enterprises than for micro and small. In the case of wet cassava starch, the large enterprises procure for almost 250 days of the year, while micro, small, and medium procure for an average of 113, 106, and 50 days per year. Finally, while in the RRD fresh cassava roots are procured for more days than in the NES (121 versus 99 days during peak), the opposite is true for cassava starch (111 versus 155 days). The latter might be a reflection of the more intensive production of dry starch in the NES than in the RRD.

Peak and Off-peak Days in Sales

Differently from production and procurement, sales of starch have a shorter period of activity. For wet cassava starch, on average 91 days of peak activities are obtained in the survey (see table 3.4.4.1) versus 113 and 103 days for production and procurement activities, respectively. Similarly, in the case of dry cassava of first class, there are 77 days of activities on average during peak period. In the case of wet starch, there are not big variations among small and large enterprises, but in the case of dry cassava of first class, the sales peak days vary between 48 for micro enterprises to 124 for large enterprises.

PRODUCTION

The survey shows that micro and small processors concentrate mainly in wet cassava starch production (see Table 3.5.1). They also produce a small amount of dry cassava starch as well. Average volumes are relatively low at roughly 17

tons of wet cassava starch for each group during the peak period. Small processors generate more dry cassava starch than micro processors (8.6 tons versus 6.1 tons). Small processors also produce the bulk of wet canna starch (6.5 tons) relative to micro processors (1.3 tons) as shown in table 3.5.2. Quantities of dry canna starch are quite small, at less than 1 ton in peak for each group. Micro and small processors produce a portion of their wet cassava starch in offpeak periods. Micro processors generate roughly 20 percent of their wet cassava starch in offpeak period, while small processors produce about 25 percent of wet cassava starch in offpeak periods. Regionally, micro processors produce at about the national average for wet starch, with the exception of the SCC, which produces 27 tons in peak periods. Small processors produce the highest volumes of wet cassava starch in the NCC (42 tons) and CH (55 tons). In offpeak periods, production is greatest in the RRD and NCC, while very small elsewhere in the country. For dry starch, most production is concentrated in the NES for both micro and small processors. Here, small processors produce over 66 tons of dry starch, while micro processors produce 36 tons. This likely reflects the larger importance of starch production for income in the NES relative to the rest of the country.

Medium sized processors produce slightly more wet starch (103 tons) than dry starch (86 tons), though if expressed in equivalent units (e.g. dry starch equivalent), medium processors produce more dry starch overall. Peak production volumes of wet starch are highest in the NMM and NCC, while dry starch is produced mainly in the NES and RRD. Offpeak production represents only a small proportion of total starch production, though there are regional exceptions. In the NMM, offpeak production of wet starch is roughly 22 percent of total wet starch production. In the RRD, offpeak production of dry starch is

over 40 percent of total dry starch production, but this only reflects one processor.

According to the survey, we observe that most large processors concentrate on the production of dry starch, generating an average of 1015 tons. While large processors make wet starch as well, it represents only about 10 percent of total starch volume on average (143 tons). Moreover, wet starch among large processors is only produced in the NES. The survey also points out that, on average, large processors produce only a marginal amount of dry starch in offpeak periods (65 tons).

PROCUREMENT

Micro processors procure more cassava roots during peak season than small processors (see Table 3.6.1), averaging almost 58 tons of cassava. Small processors procure roughly 56 tons of cassava roots. On the other hand, small processors purchase more cassava roots in offpeak periods (13.8 tons versus 11.6 tons) and procure substantially more wet starch than micro processors (16.1 tons of wet starch for small enterprises compared to 5.9 tons for micro processors).

The regional pattern of procurement is similar to that of production. In peak periods, the greatest procurement of cassava roots among micro processors is in the SCC and NES, while for small processors, purchased volumes are highest in the NCC, CH, and NES. In the case of the RRD, cassava root procurement for small enterprises is quite small at 4.7 tons, while wet cassava starch purchases, at 22 tons, are high. This suggests that small processors in the RRD rely on the reprocessing of wet starch for their starch production rather than the

conversion of roots to starch. In the NES, large quantities of roots are purchased by both micro (192 tons in peak periods) and small processors (318 tons in peak periods), but no wet starch is obtained. This suggests that, among micro and small processors, production of dry cassava starch in the NES arises exclusively from the processing of roots into dry roots rather than from the processing of wet starch.

Canna root procurement is similar to the patterns in canna starch production, in that most procurement takes place among small processors in the RRD (see table 3.6.2).

Medium processors procure significantly more cassava roots than micro or small processors, averaging 625 tons of cassava roots in peak season (see table 3.6.1). Canna procurement is negligible. Offseason purchases of cassava roots represent approximately 6 percent of total root procurement. Large processors procure a sizable portion of cassava roots. On average, they obtain 3960 tons of cassava in peak season and 266 tons in the offseason.

SALES

Most sales by micro and small processors are in wet starch (see table 3.7.1). Both small and micro processors average 16 tons of sales of wet cassava starch in peak periods, which is smaller than the survey average of 40 tons. Small processors sell more wet cassava starch (6.3 tons) than micro processors (3.9 tons) in offpeak periods. Among micro processors, there is little regional variation in the quantity of starch sold in the RRD, NCC, and NES. Micro processors in the SCC sell more starch on average while those in the CH sell

less than the average for micro processors. Small processors sell more wet cassava starch than the national average in the NCC and CH.

In wet canna starch, small processors sell five times as much wet canna starch as micro starch processors (5 tons versus 1 ton). Most wet canna starch sales among micro and small processors occur in the RRD (see table 3.7.2).

Both micro and small processors engage in dry starch sales as well. Most dry starch sales are in dry 1st class cassava starch. 1st class peak sales volumes are 8.7 tons for small processors and 6.9 tons for micro processors. Interestingly, micro processors produce twice as much 1st class cassava starch in offpeak periods as small processors. Dry canna starch sales average less than 1 ton for each group. 1.7 tons of 2nd class cassava starch are produced by small processors, while only 1.1 tons are generated by micro processors. Significant sales of 1st class dry cassava starch among both groups occur in the NES -- 36 tons are sold in the peak season by micro processors while small processors sell over 66 tons. Canna sales are found in the RRD. No export sales are reported from either group.

Medium sized processors sell an average of 87.5 tons of wet cassava starch and 80.2 tons of dry 1st class starch in peak periods. Offseason sales are not insignificant — 13.8 tons of wet cassava starch and 13.6 tons of dry 1st class starch. Sales of wet starch are greatest in the NMM and NCC, while dry starch sales are highest in the RRD and NES. Moreover, the factory in the RRD exports 10 tons of 1st class starch.

An average of 143 tons of wet starch is sold by large processors. Most of the starch sold by large processors is 1st class cassava starch. 743 tons is sold

domestically while 260 tons is exported. Exports come from the joint venture in the CH as well as processors in the NES. An average of 45 tons of exports occur in the offseason, all from the CH.

MARKETING CHANNELS

Procurement

Micro and small enterprises rely heavily on traders as their primary supplier of cassava roots (see table 3.8.1.1). Micro and small enterprises in the South (NES and SCC) obtain a portion of their roots from own production. In the CH, famers are the main source of cassava. Small and micro processors in the RRD rely solely on traders for roots. Small processors obtain about two-thirds of their wet starch supply from other enterprises and one-third from traders.

Micro enterprises obtain about two-thirds of their wet starch from other enterprises, but the remaining one-third is predominated by starch from own production than from traders. With respect to wet starch, micro processors in the NES are dependent on their own supply of wet starch, while both micro and small processors in other regions rely on other enterprises and traders.

Among small processors, the majority of canna roots are obtained from traders, though a sizable proportion (26 percent) are supplied through own production (see table 3.8.1.2).

On average, medium processors rely on traders for their supply of cassava, though in the NMM, medium enterprises obtain the majority of their cassava from farmers. Procurement quantities of roots are higher than the medium processor

average in the NMM and NES, though for different reasons. In the NMM, cassava roots are converted into wet starch, while in the NES, roots are being transformed into both wet and dry starch. All procurement of roots in the NCC goes towards wet cassava starch production. Wet cassava starch purchases are small on average (5.2 tons), but are large in the RRD (250 tons), as medium starch enterprises there produce only dry starch. These purchases come exclusively from other starch enterprises.

In the NES, most roots are obtained through traders, while in the CH, all roots are supplied by farmers. The joint venture in the CH exaggerates these figures somewhat, as that factory purchases 8750 tons in the peak season and 3750 in the offseason. In the NES, only 56 tons of cassava roots are procured in the offseason. The large canna processor in the RRD purchases just 8 tons of canna roots, all of which is from own production. The level of wet starch purchases (194 tons) is relatively low compared to the volume of roots purchased. About 74 percent of wet starch is supplied by other enterprises, with the remainder coming from traders. No starch is purchased in the offseason.

Sales

The majority of cassava starch sales go to traders (see table 3.8.2.1-3.8.2.3). Small processors sell more of their wet starch to traders and noodle factories than micro processors, while micro processors sell more wet starch to other enterprises and maltose factories. In the RRD, most wet starch sales by both groups goes to maltose factories. In the NES, small processors sell mostly to traders, while micro processors concentrate on noodle factories. Elsewhere, traders dominate the market for wet starch sales.

In wet canna starch, small processors sell five times as much wet canna starch as micro starch processors (5 tons versus 1 ton). Most wet canna starch sales among micro and small processors occur in the RRD. Over half of wet canna starch sales are directed towards noodle factories, with the remainder going to traders and other food industries (see tables 3.8.2.4-3.8.2.5).

Traders are the main buyers of starch (dry or wet) for medium and large enterprises.

Table 3.8.2.6 summarizes the quantity of exports of dry starch reported in the survey. All exports were of dry cassava starch. One-half of exports go to Singapore, with another 40 percent sold to Taiwan. Minor amounts are exported to the Philippines, Indonesia, and Malaysia.

PROCUREMENT AND SALES PRICES

Procurement and sales prices of roots and starch do not vary greatly among different types of starch processors. The average procurement price for cassava is 348 Dong/kg in peak periods and 378 Dong/kg in the offseason (see table 3.9.1). Regionally, cassava root prices are highest in the RRD and NES and lowest in the NMM. Offseason prices in the NES are lower than those in the peak season. Roots supplied by farmers, at 318 Dong/kg are the cheapest on average (see table 3.9.2), while those from other enterprises (450 Dong/kg) are the most expensive. Cassava roots obtained by traders, the main source for all types of processors, are slightly more expensive than the average at 377 Dong/kg. In some areas, such as the RRD, traders are the only source of roots.

In the NES, the difference between farmer and trader price is relative small (17 Dong/kg).

Peak season canna root prices are 444 Dong/kg in peak periods and 505 Dong/kg in offpeak period (see table 3.9.3). Canna prices are about 150-200 Dong/kg lower in the North than in the South. Roots from traders are significant more expensive (472 Dong/kg) than those from farmers (400 Dong/kg) as shown in table 3.9.4. In the RRD, the prices charged by traders are between 59 and 115 percent higher than those of farmers. Despite this, less than 10 percent of all canna purchased in the RRD is bought from farmers.

The procurement price for wet cassava starch is 1037 Dong/kg, while the sales price is 1105 Dong/kg in peak season (table 3.9.2). Offseason purchase and sales prices are approximately 150 Dong/kg higher. Procurement prices for wet starch tend to be lowest in the RRD and highest in the NES. Sales prices for wet starch are highest in the NES and NCC and lowest in the SCC. Interestingly, in the RRD, NCC, and NES, the sales price is higher as the processor scale increases.

In the NES, the procurement price for wet cassava starch is higher than the sales price. Wet starch from traders is about 10 Dong/kg more than starch purchased from other enterprises.

The price margins between purchase and sales price for wet canna starch are much higher than wet cassava starch. The peak purchase price for wet canna starch is 1300 Dong/kg whereas the sales price is 1949 Dong/kg (table 3.9.8). The offpeak procurement price is 200 Dong/kg lower than the peak price, while the offpeak sales price is 380 Dong/kg higher.

Sales prices for dry starch depend on the grade (table 3.9.5). In peak season, 1st class starch, at 1989 Dong/kg, is about 33 Dong/kg less than 2nd class starch. Offseason 2nd class starch commands a price of 2325 Dong/kg, almost 275 Dong/kg more than 1st class cassava starch. Dry canna starch is priced higher in peak season (3159 Dong/kg) than offseason (2850 Dong/kg). Sales prices for both grades of dry cassava starch are highest in the RRD and lowest in the NES. Export prices for 1st class starch are quite high in peak season at 3340 Dong/kg.

TRANSPORTATION AND COMMUNICATION

73 percent of the survey respondents use some sort of transport to either buy or sell starch. Surprisingly, micro and small processors use transportation much more frequently than medium processors (see table 3.10.1). While over 80 percent of micro and small enterprises contract transportation services, only 21 percent of medium processors utilize this service. Just over half of large processors require transportation for starch purchases or sales. Transportation services are more common in the North than in the South, though there is no pattern among processor classifications within each region.

Over 69 percent of those using transportation cited carts as the most important means of transportation, with bicycles denoted as having secondary importance at 18% (table 3.10.2). Truck transport is used predominately by medium and large processors, though each group uses some amount of cart transport. Micro and small processors in the RRD reported a wide range of response for means of transportation, but most (over 85%) use carts (see table 3.10.3). Bicycles are used exclusively by micro and small processors in the NCC, while carts are used exclusively in other regions by this group.

Most processors do not travel long distances to procure raw materials. The average distance to acquire roots was 3.97 km, while for wet starch, the figure is 1.32 km (see tables 3.10.4 and 3.10.5). There is great regional variation between purchase distances. In the NMM, processors travel over 20 km to obtain roots; in the NCC over 18 km. In the RRD and NES, processors travel less than 1 km on average. Wet starch sales also tend to be localized (see table 3.10.6). With the exception of the NMM, where on average sales travel 72 km to Vinh Phu and Ha Tay, the average sales distance is just over 2.5 km. By

contrast, dry starch sales travel a longer distance, averaging 3.3 km. In dry starch, sales from large processors travel over 13 km on average (see table 3.10.7).

The unit costs of transportation are reported in table 3.10.8. The average unit cost of Dong 2500 per ton-km hides considerable variation across regions and means of transportation. The lowest unit costs are in the NES and the highest in the NMM and NCC, a difference partly explained by the status of infrastructure and by the predominance of trucks used by enterprises in the south relatively to the north.

The survey respondents did not report any major restrictions on the movement of goods (see table 3.10.9). Only 7 percent of the sample noted trade bottlenecks. No problems with transporters were cited (3.10.10). Most restrictions on trade occurred in the NMM and RRD. Of those reporting problems, it is noteworthy to point out that all medium processors in the NMM cited business impediments. Problems with police were stated as the most important form of restriction. Among those reporting restrictions, all medium processors in the NMM and most small and micro processors in the RRD reported problems with police. Among large processors, the most common complaint was food company regulations in the NES.

Over 98 percent of the sample has the ability to choose among different transport services (see table 3.10.11). The vast majority of transport fees (95%) are negotiated. Fixed fees are more common among medium and large processors. All types of processors in the NCC and CH reported paying fixed fees for transportation.

49 percent of starch processors report traders are the most important source of market information, while 36 percent receive market information from other starch users (table 3.10.12). Traders are significantly more important among small and medium processors, while other starch users play an important information function among large and micro processors.

Regulatory information comes primarily from other sources (57 percent) followed by extension agents (38 percent). Extension agents are particularly important among medium and large processors — over 78 percent of medium processors and 87 percent of large processors utilize their services to obtain information about regulations. By contrast, over 93 percent of both small and micro processors get their regulatory information from other sources. There is a greater reliance on extension agents among all processor types in the south, while other sources predominate in the north.

Banks are the most important source for credit information, according to over 40 percent of the sample. Banks are especially important among large processors, with 79 percent receiving their credit information from this source. Small processors rely heavily (62 percent) on the media for credit information. Micro processors use banks and other sources for information. While 57 percent of medium processors note banks as their top source for credit information, 36 percent cite personal contacts. Media sources are used in the RRD, while banks are much more important in the South.

Most starch enterprises operate with a low level of communication technology. 87 percent of processors have no telephone and almost all do not own computer, fax machines, or computer (see table 3.10.13). 69 percent of

large processors own telephones. The frequency of owing a telephone increases as the scale of the processing unit increases.

STORAGE

About 36 percent of micro processors use storage facilities (see table 3.11.1). Most storage facilities consist of a concrete structure, a roof covered structure, or a yard (see table 3.11.2). In the case of micro and small processors, the most common facilities are the concrete structure and the yard (see table 3.11.3) with capacity of 9.8 tons and 14.7 tons, respectively (see table 3.11.4). Micro processors store less than a ton of roots and dry starch and about 3 tons of wet starch, over half of which is stored in the offseason (see tables 3.11.5-3.11.7)). Storage among micro starch enterprises is found mainly in the RRD. They also hold wet starch longer in offpeak periods — on average, they store wet starch for 20.5 days, almost 8 days longer than in peak periods. Roots are typically stored for only about 2 days in peak periods, 1 day in offpeak times. Dry starch is kept for over 32 days in peak periods, while in offpeak periods, dry starch is held for just 5 days. Losses among micro starch enterprises are minimal (less than 1 percent) in peak periods for roots and dry starch. Wet starch losses range from 1.4 percent in peak periods to 2.1 percent in offpeak periods.

Only 24 percent of small processors use storage facilities. Among small enterprises, yards and concrete structure are the most popular means of storage (see table 3.11.3). The capacity of storage units is greater for small processors. Yards average 44.9 tons of storage space, while concrete structures have a mean of 20 tons. Small starch processors store an average of about 1 ton of roots and dry starch (see tables 3.11.5 and 3.11.6). A greater amount of wet

starch is kept by small processors — 12.8 tons in peak periods and 5.4 tons in offpeak periods. As with micro starch enterprises, the processors who store reside in the RRD. In general, small processors store roots and starch for longer periods of time, but also suffer greater losses. Small processors store roots for 3.4 days on average in peak periods and 4 days in offpeak periods. Information on root losses was not reported. Wet starch is kept for 36 days in peak season and 41 days in the offseason. Losses in wet starch range between 2.7 percent in the offseason and 3.2 percent in peak season. Dry starch is stored for 18.5 days on average in peak periods, while offseason totals are only a third of that figure. Losses in dry starch are negligible.

48 percent of medium processors use storage facilities. 60 percent of these processors use roof covered storage units which have an average capacity of 25.4 tons. Medium processors do not store roots. Most storage is in wet and dry starch and is geared toward offpeak periods. 14.6 tons of wet starch is stored in the offseason for an average of 56 days while in peak periods, 22 tons is kept for just 22 days. Dry starch is kept even longer in the offseason — 5.7 tons is stored for 74 days. Peak period dry starch remains stored for 16 days.

75 percent of large processors use storage facilities. 68 percent of these are roof covered, with the remainder being concrete structures. While roof covered structures have a capacity of 32.9 tons, the concrete structures utilized by large processors have an average capacity of 1127.5 tons. Large processors hold 8.5 tons of roots for 1.5 days during the peak season and slightly less than 7.7 tons for 2 days in the offseason. Only small quantities of wet starch are stored by large processors — on average, they keep 3.5 tons in the peak season for 11.8 days. Offpeak wet starch storage is minimal. 52.3 tons of dry starch are held for 19 days in the peak period. Offseason storage of dry starch is roughly one-fifth

the quantity of peak season storage, though volumes are kept an average of two days longer.

CREDIT

Slightly under 45 percent of the sample reported borrowing money in the past year. As one would expect, there is a higher incidence of borrowing among medium and large processors (68 and 76 percent, respectively) than micro and small processors (44 and 22 percent, respectively, as shown in table 3.12.1). Over half of all types of processors in the South borrowed money.

Commercial banks represent the largest source of credit among the surveyed households, with an average of 13.2 million Dong borrowed (see table 3.12.2 and 3.12.3-3.12.7 for regional details). This is followed by agricultural banks with an average of 8.7 million Dong. Most credit from commercial banks, however, is obtained by medium and large processors. Less than 21,000 Dong was borrowed among micro processors from commercial banks, while no money was obtained by small processors. Micro and small processors tend to rely more on agricultural banks for credit, averaging 4.0 million Dong and 11.65 million Dong borrowed, respectively. Interest rates in both commercial banks and agricultural banks run at about 1.2 percent per month. Family sources are a small source of credit, averaging 1.36 million Dong, though interest rates are slightly lower at 1 percent per month.

57 percent of the sampled households report that the credit received was generally sufficient to meet expenses. Over half of the surveyed micro, small, and medium processors in the South noted that they did not receive enough credit, while over half of small and micro processors in the RRD did receive

ample credit (see table 3.12.8). Lack of collateral was cited by over half the sample as being the main reason for having credit denied and bank difficulties were reported more frequently in the RRD (see table 3.12.9).

When asked about the gap between average credit obtained and credit requirements (see table 3.2.10), processors indicate huge credit constraints. On average, processors get Dong 27.2 million credit, but they indicate a requirement five times bigger at Dong 135 million. Particularly constrained are the large enterprises in the NES.

82 percent of the processors surveyed sell on consignment. Consignment tends to be more popular among micro and small processors, with over 87 percent reporting the use of this practice. As expected (see table 3.12.11), micro and small processors make more of their sales on consignment than larger processors (58 and 54 percent, respectively versus 44 percent for large processors). Advance payment is used by only 16 percent of the sample, generally among larger processors in the NES (see table 3.12.12). On average, only 11 percent of all sample have an advance payment received, though 22 percent of medium processors and 26 percent of large processors report receiving payments in advance.

COST OF PRODUCTION, INCOME, AND CHANGE IN PROFITABILITY

An average of 4.5 own workers are used in peak season among starch processors, while 1.8 are used in off-peak periods (see table 3.13.1). Only 1.8 male workers and 0.63 female workers are hired in the peak season; offseason employment is negligible. The number of workers hired increases as the scale of the starch facility increases. As expected, large processors hire the most

workers, averaging almost 12. Average wage rates for men among large processors, at 18653 Dong/day, are almost 2000 Dong/day higher than medium processors and 4000 Dong/day higher than micro or small processors. Female wages are about 2000 Dong/day less than male wages on average (16667 vs 14084). Interestingly, female wages in medium and large facilities are 2000 Dong/day higher than male wages.

Details on costs of production are given in table 3.13.2. Table 3.13.3 shows the cost shares. Electricity and fuel costs represent 38 percent of total costs for starch processors, followed by hired labor at 27 percent. Equipment rent represents a sizable cost for micro and small processors (35 and 25 percent, respectively). Processors in the North spend more on transportation and rent than those in the South, while fuel costs represent a higher proportion of total costs in the South

Putting together the figures for cost of raw materials and sales, we obtain income for different processors (see table 3.13.4). The income ranges from Dong 7.5 million for micro enterprises to Dong 712 million for large enterprises. The income is clearly correlated with size of the enterprise. In terms of profit share of total sales, it is 21 percent on average, varying between as low as 12 percent for medium enterprises to 23 percent for large enterprises.

1997 was not as good a year as 1996 for starch production. While only 4.4 percent of the sample considered 1996 to be a bad year, in 1997, that figure rose to 25.5 percent (see table 3.13.5). Moreover, those who considered 1996 to be good declined from 19.3 percent in 1996 to 14.8 percent in 1997 (see table 3.13.6 and 3.13.7). Micro and small processors fared much worse between 1996 and 1997. The proportion of those considering profitability to be bad rose

from just 0.7 percent of micro processors in 1996 to 16.7 percent in 1997. Among small processors, the figures are even worse — just 2.8 percent considered 1996 to be unprofitable, while 60.8 percent considered 1997 to be a bad year. Medium and large processors fared better than smaller processors, with a larger proportion reporting 1997 to be average than in 1996. Southern processors typically viewed 1997 more favorably than processors in the North.

63 percent of those surveyed cited the sale price for starch as the main reason for the change in profitability (see table 3.13.8). The data suggest that canna prices, particularly in the RRD, fell dramatically between 1996 and 1997. Wet cassava starch prices also fell somewhat in the NCC, while rose in the NMM, RRD, and NES. 22 percent of the sampled noted that raw material prices were the most important reason for changes in profits. Information from the survey reveals than cassava root prices fell everywhere except the NES.

PROBLEMS AND SUGGESTIONS

The most acute problem that processors want solved is pollution, with 22 percent of the responses (see table 3.14.1). Various policies aimed at improving credit access and loans were also important. 31 percent of micro processors cite that the pollution issue is important , particularly among those in the RRD (40%) as shown in table 3.14.2. Issues of loan length and improving the domestic market were also suggested. Small processors gave a variety of suggestions, including increasing credit and solving pollution. Medium and larger processors did not concentrate on pollution issues, focusing instead on the desire to promote the domestic market for starch and improving processing technology.

SUMMARY AND CONCLUSIONS

The preceding sections have highlighted the details of the structure and dynamics of the starch processing industry in Viet Nam. The analysis could be summarized into five major sets of conclusions related to: i) the dynamism of the sector, ii) the strong linkages with rural development, iii) a complex industrial structure where both very small and large enterprises coexist, iv) a capacity to provide productive employment and to use capital efficiently, and v) a set of constraints that limit the potential for growth. Each of these conclusions will be examined in the following paragraphs.

A Dynamic Sector

Until ten years ago, starch processing was barely ten percent of total use of cassava. From 1988, an increasing number of participants have started to be involved in starch processing, including both rural households and large enterprises. The survey data point out at least 24 percent of total cassava to be currently utilized for starch, and this is probably an under-estimate, given that the survey was under-sampling several regions such as the North East South, where starch production is quite big. Out of 339 processors, more than 62 percent have started operations after 1988. In the case of rural households, the micro and small enterprises have emerged from farming activities. In the case of the central parts of the country, starch processing is still a source of income not much more important than other agricultural activities, but in the Red River Delta and in the North East South is becoming a specialized activity. The opportunities of cassava and canna processing for the local food industry and other non-food uses has induced dramatic increase of investment by small and large enterprises, with an average annual rate of 78 percent over the period

1988 to 1997. Moreover, the new entrants have increased the size of their operations, as shown by an average processing capacity of new entry of less than 10 tons per day previously to 1994 to an average capacity of almost 60 and 80 tons per day in 1995 and 1997. An additional reason for this strong growth of investment and production is the linkage with world markets. Starch in Viet Nam is already an exportable commodity. During 1998, more than 21,000 tons have been exported to countries such as Singapore, Taiwan, Philippines, Indonesia, and Malaysia. The export prices of starch are much higher than domestic prices, partly reflecting the better quality of exported starch. On average, export prices were almost $300 per ton, to compare to less than $200 per ton for domestic starch.

Strong Linkages with Rural Development

In the 19 communes that we have surveyed, almost 4,800 households were reported to be involved in starch production. Moreover, several other households are involved in starch processing industry such as noodles, maltose, candy, paper, and food. Starch production and processing is becoming a viable entrepreneurial activity for many rural households, contributing overall to more than 55 percent of their income. In the North East South, there is an even higher specialization, with starch related activities providing about 79 percent of total average income. Moreover, the income of rural households engaged in starch

processors is more than twice the income of the average rural household[1] ($358 per capita versus $170 per capita).

As with other agrobusiness activities, the link between starch processing and agricultural production is very close, as pointed out by the induced demand for raw material. The greatest beneficiary is cassava production. In our survey, we found that about 24 percent of total cassava production is demanded by starch producers. The greatest share is for dry starch production (18.7 percent of the total). The total starch production (wet and dry) in the survey was found to be 131 thousand tons, corresponding to more than 477 thousand tons of cassava (see table 3.15.1).

A Complex Structure of Production of Starch

Production of starch in Viet Nam is carried out by a variety of enterprises, including very small firms and some large ones. In our survey, the micro enterprises (less than one ton per day) comprise almost 50 percent of the sample, small enterprises (between 1 and 5 tons per day) about 26 percent, medium enterprises (between 5 and 10 tons per day) about 24 percent, and large enterprises (more than 10 tons per day) only 10 percent of the sample. Among large enterprises, there is VEDAN with capacity of 800 tons per day.

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[1] From table 3.13.4, the weighted average of micro and small starch processors is $987, when using an exchange rate of Dong 13,500/US$ and weights of .67 and .23 for micro and small enterprises. From table 3.1.9, we get that starch income is 55 percent of total income for household enterprises (micro and small). Therefore, on average, the total household income of starch enterprises is $1,794 (obtained from $987/.55). Moreover, the average household size is 5, from which we get an income per capita of $358.

The contribution of small-medium enterprises to wet starch production is about 87 percent in our sample, while they contribute only 13 percent to dry starch production, indicating a specialization of small-medium enterprises in wet starch and a specialization of large enterprises in dry (table 3.15.2). The dry starch is in fact relatively more capital intensive than the production of wet starch.

Different enterprises have quite different capital equipment, as shown by a very small value of equipment for micro-small enterprises (about $50), while for large enterprises the average value is about $363,000 (table 3.15.3). The small enterprises, however, have a much more efficient use of capital equipment, as shown by an output-capital ration of 9.3 tons per million Dong of capital equipment versus 0.6 tons of starch for large enterprises (table 3.15.4). The regional distribution of enterprises indicates a large predominance of small firms in the north and large firms in the south.

Income and Cost of Production

The different structure of production is reflected in different operation cost (excluding raw materials) structure for various firm size (table 3.15.5). Micro enterprises, for example, rent equipment and this is a large share of their cost (35 percent). Large enterprises spend more than 68 percent in electricity and labor, while medium enterprise allocate only 47 percent to these two items. Profits vary from Dong 7.5 million for micro enterprises to Dong 712 billion for large ones. The profit shares increase with the size of the enterprise, varying from 12 percent for medium enterprises to 23 percent for large enterprises (table 3.15.6).

Constraints

In spite of its dynamism, there are several constraints facing the starch industry that require solution for the sector to accelerate its growth. We focus here on four types of constraints. First, the low level of technology as indicated by just the barest equipment (graters and pumps) for the majority of small processors. Only large enterprises have access to sedimentation tanks, dryers, and complete starch system. The great majority of the industry is working with locally manufactured equipment, or equipment from Russia and China, of quite low value and inappropriate for producing high quality starch.

Second, the access to credit is quite limited for both small and large. Large firms have a better access to bank credit, but the large firms are also the ones that express bigger gap between obtained credit and credit requirements (the requirement-obtained credit ratio is almost 7) (table 3.15.7).

Third, the high material cost, cassava particularly, contributes to lowering the competitiveness of the industry. Large enterprises pay the highest price for raw material procured by farmers (Dong 319 per kg) while micro enterprises pay the lowest one (Dong 285 per kg) in partly due to their proximity to farm production (table 3.15.8). Interestingly, however, the greatest part of procurement is done from traders, and in this case there is a surprisingly little variation between different firm sizes. Raw material costs represent over 94 percent of total cost of production for the micro enterprises and 86 percent for large enterprises. The high cost is related to the low productivity of cassava, that averages only 7.3 tons/ha in the country, even though there is a huge difference between the yield in the North Mountains and Midlands (6 tons/ha) where most of the production takes place and the yield in the North East South (10.2 tons/ha). Finally, the

production of starch is polluting the environment causing serious problem in water quality at the community level. In the absence of sewage systems and water purification systems, the starch processors have no other choice but to dump the residues and the polluted water into the village street and inadequate sewage system. This is indicated as one of the most serious problems by both households and community leaders.

4. STARCH MARKETING

CHARACTERISTICS OF TRADERS

The distribution of starch traders in the sample is similar to that of processors, though proportionally more traders in the sample operate in the RRD (table 4.1.1). Almost 54 percent of the surveyed traders operate in the RRD, compared with 23 percent in the NES. The majority of those in the RRD are found in Ha Tay, with sizable numbers in both Hai Hung and Ha Noi (table 4.1.2). In the NES, two-thirds of traders reside in Dong Nai. Virtually all traders are household operations (table 4.1.3). 80 percent of traders are male (table 4.1.4). The highest proportion of women traders is found in the NCC at 40 percent. The proportion of female traders is higher than the average in the RRD, while slightly lower than the average in the NES. 44 percent of traders are legally registered (table 4.1.5).

An average of five workers are employed by traders, though with the exception of the NES where over 13 workers are employed on average, most traders use less than three (table 4.1.6). In the NMM, NCC, and SCC, traders use less than two workers in their operations.

Most traders commenced operations after 1988; less than 30 percent started before this time (tables 4.1.6 and 4.1.7). The RRD, NCC, and NES have the most established traders, with the average trader starting in 1988. 1990 was an important year for all traders — 18 percent of all traders in the sample began trading in this year. 1990 was important across regions, with between 13 and 50 percent of traders establishing business at this time. In other years, entry into trading was consistent, with a slight lull between 1991 and 1994 (see figure 4.1.1).

Starch trading comprised 39 percent of traders income in 1997, up from 36 percent in 1996 (table 4.1.8). Between 1996 and 1997, the proportion of income from starch trading increased in all regions. In the NMM, NCC, and NES, starch trading represents over 50 percent of total income. Traders tend to be well diversified in other activities. Nationally, 15 percent of income comes from other starch related activities, 15 percent from other non-starch activities, and 14 percent from crop production. Starch production makes up just 5 percent of income, though this represents an income from the 4 percent reported in 1996. Traders in the RRD are the most diversified in Viet Nam, according to the survey. Only 27 percent of income comes from starch trading. The remainder derives from other starch related activities (23 percent), other activities (18 percent), crop production (13 percent), and livestock (11 percent). In the SCC and CH, traders are active in crop production, with over 30 percent of income

accumulating from this source. In the NES, almost 11 percent of income is from starch production.

PROCUREMENT

Traders are actively engaged in both starch trading and the movement of roots. Almost 99 days are spent in the procurement of cassava roots (table 4.2.1). More time is spent in wet cassava starch procurement in peak periods, with 110 days allocated to this commodity. Roughly 86 days are spent in obtaining dry cassava starch of both types in peak periods. Interestingly, the time spent in offpeak procurement of cassava roots is significant (47 days), suggesting that offpeak trade in cassava may be a form of income diversification. The time allotted toward offpeak trade in wet cassava starch is small at just 13 days. More time is utilized in the purchase of dry starch.

An average of 73 days is spent in obtaining canna roots in peak periods, while just 17 is spent in offpeak periods. Traders spend less time in procuring wet canna starch (36 days) and dry canna starch (28 days).

On average, 483 tons of cassava roots are procured in peak periods (table 4.2.2), with an additional 84 tons procured in offpeak periods. The largest volumes of trade in roots belong to the RRD (699 tons) and the NES (429 tons). Elsewhere, trade volumes of roots are under 50 tons. Offpeak trade in roots is important in the RRD and NCC — offpeak volume is 17 percent and 40 percent, respectively, of total trade.

Average procurement volumes of wet cassava starch are 92 tons in peak season and just over 4 tons in offpeak periods. Large volumes of wet cassava

starch trade are reported in the NMM (800 tons) and the NES (293 tons). Interestingly, wet starch procurement in the RRD is small at just over 8 tons in peak periods. Offpeak procurement is important in the NMM and CH, but insignificant in the NES.

28 tons of dry 1st class starch are procured by traders in peak periods. The NES obtains almost 74 tons of 1st class starch, while the RRD, NCC, and SCC purchase between 8 to 15 tons less than the national average. Offpeak procurement is relatively small at 2.8 tons. 2nd class cassava starch procurement volumes are fairly low at over 7 tons in peak periods. Only the RRD, with its purchases of 13 tons of 2nd class cassava starch, trades in this commodity. Offpeak procurement of 2nd class starch is slightly lower than that of 1st class starch at 2.3 tons.

An average of 91 tons of canna roots are obtained by traders in peak periods (table 4.2.3). Root procurement occurs only in the RRD, with average purchased volumes of 169 tons. Almost 32 tons of wet canna starch is obtained on average. Wet canna starch is mainly procured in the RRD (57 tons) and CH (20 tons), though a small amount is purchased in the SCC. Only 4.8 tons of dry canna starch are obtained by traders, all in the RRD, SCC, and CH.

SALES

Sales patterns for traders closely follow procurement schedules (see table 4.3.1). Roughly the same amount of time is spent in cassava and wet cassava starch sales as in procurement in both peak and offpeak periods. Significantly more time is spent in selling dry cassava starch. In 1st class starch, over 117 days are allocated towards sales in peak periods, with another 63 days used in

offpeak periods. For 2nd class starch, the time allocation is the reverse of 1st class starch — 61 days in peak season and 123 days in the offseason.

Similar patterns emerge in canna starch as well. For sales of canna roots and wet canna starch, time allocations are similar to procurement. In the case of dry canna starch, more than twice as much time is used in sales than in procurement in both peak and offpeak periods.

Sales patterns for traders are also similar to procurement trends. 41 tons of wet cassava starch are sold in peak periods, with the largest volumes coming from the NMM and NES (table 4.3.2). Over 72 tons of dry 1st class cassava starch is sold in peak periods, the majority (262 tons) sold in the NES. Interestingly, average sales of dry 1st class starch in the NES are higher than procurement, while average sales of wet cassava starch are lower than procurement. The reason behind this apparent discrepancy is the existence of a trader in the NES who is both a processor and trader; indeed, 60 percent of their income comes from processing versus 40 percent from trading. This trader procures wet cassava starch and processes it into dry cassava starch. It is also noteworthy to mention that while the number of days spent in sales of dry cassava starch is significant, the volume of sales is still relatively small on average — 4.4 tons for 1st class starch and 2.8 tons for 2nd class starch. While this represents almost one-third of the total sales volume for 2nd class starch, it is just 12 percent of 1st class sales.

A similar story emerges from canna starch. About 32 tons of canna starch are sold in peak periods, with another 4.3 tons dispersed in the offseason. About 7.5 tons of dry canna starch are sold in the peak season, but just 0.5 tons

are sold in the offseason, despite the fact that almost 29 days are spent in offpeak sales.

MARKETING CHANNELS

Procurement Sources

Traders and farmers are the only sources of cassava roots for traders (table 4.4.1.1). On average, 402 tons (71 percent) of cassava roots are obtained from traders against 165 tons (29 percent) from farmers. Traders are especially important in the RRD — there, they provide over three times the amount of roots as farmers. In the NCC and NES, farmers dispense more roots than traders. Figure 4.4.1.1 summarizes the procurement breakdown for cassava roots by region.

Starch enterprises are the most important source of both wet and dry starch for traders (tables 4.4.1.2 and 4.4.1.3). Starch enterprises provide 66 tons (69 percent) of wet cassava starch to traders, while other traders sell 23 tons. While starch enterprises are significant sources of wet starch in the NMM, RRD, and NES, in the central part of country, their role in providing wet starch is minimal (see Figure 4.4.1.2 for a breakdown by percentage within each region). In the NCC, for example, 48 tons of wet starch comes from traders and an another 15 tons comes from farmers. Only 1.3 tons is from starch enterprises. In the CH and SCC, all wet starch is purchased from farmers.

A similar story occurs in dry cassava starch as well. Nationally, 24 tons of dry starch is bought from enterprises and 12 tons is purchased from traders. In the NCC, however, almost all dry starch is from traders, while in the SCC, all dry

starch is from farmers (see Figure 4.4.1.3 for the proportion procured in each region). In the RRD, 20.5 tons of dry starch is obtained from enterprises, while an additional 14 tons generated from own production (7.3 tons) and traders (6.8 tons).

Slightly less than two-thirds of canna roots (63 tons) are obtained from traders, with the remainder (33 tons) purchased from farmers (table 4.4.1.4). The majority of wet canna starch, by contrast, is acquired from farmers — nationally, an average of 22 tons comes from farmers, while 13 tons is purchased from other enterprises. (table 4.4.1.5). Farmers are the exclusive source of wet canna starch in the CH and SCC. In the RRD, other enterprises are an important source of starch, though the quantity procurement from enterprises (24 tons) is still less than starch obtained from farmers (39 tons). Dry canna starch is mostly acquired from farmers (table 4.4.1.6). In the RRD, small portions of dry canna starch are also purchased from traders and other enterprises, with an additional small quantity coming from own production.

Sales Destinations

Wet cassava starch sales are relatively diversified, according to the trader survey. Nationally, the largest quantity of sales of wet cassava starch goes to traders, with an average sales volume of almost 19 tons (table 4.4.2.1). Other significant recipients of wet cassava starch include maltose producers (9 tons), noodle factories (6.6 tons), food industry (5.1 tons), other sources (3.4 tons), and households (2.5 tons). Despite having the largest average sales volumes, traders are only important as a source of sales in the CH (105 tons) and the NES (65 tons). Elsewhere, their influence is minimal (see Figure 4.4.2.1 for the top three sales destinations by region). In the NMM, average sales to maltose

factories were reported at 1000 tons. Sales to food industries in the RRD, while small at 5.7 tons, represented the largest client for wet starch. In the NCC, noodle factories (22 tons) and households (19 tons) bought the majority of starch. Noodles sales are important in the CH (37 tons) as well, though they are not as large as sales to traders.

Interestingly, the destination with the largest average sales volume of 1st class cassava starch was exporters, who bought an average of 41 tons of 1st class starch (table 4.4.2.2 and figure 4.4.2.2). This figure is inflated by a trader in the NES who sells 4800 tons of 1st class starch. Sales to traders, at 13 tons, represent the second most important source of sales. As with wet starch, traders are mostly important in the south, with average sales of 56 tons. Sales to starch enterprises (21 tons) are also important in the NES. The largest volumes of sales in the RRD go to the paper industry (6.5 tons) and food industries (6.3 tons), with smaller volumes purchased by traders, enterprises, adhesives, and households. In the NCC, sales are split between noodle factories and food industries, while in the SCC, most sales go to noodle factories. All 2nd class cassava starch (table 4.4.2.3) is sold in the RRD, destined for food industries (13 tons), maltose factories (3 tons), and households (1.1 tons).

Wet canna starch is mainly purchased by traders (20 tons) and noodle producers (16 tons) (table 4.4.2.4). Sales to traders are important in the RRD, with 36 tons of wet canna starch sold, with sales to noodle producers slightly smaller at 29 tons. In the NCC and CH, wet canna starch is sold exclusively to noodle factories. Dry canna starch is sold to similar markets as wet canna starch, but in different proportions — 4.6 tons is sold to noodle producers versus 3.2 tons to traders (table 4.4.2.5). As with wet canna starch, traders are important only in the RRD, with almost 6 tons sold to this group. Nonetheless,

sales to noodle producers represent the largest market for dry canna starch in all regions.

PROCUREMENT AND SALES PRICES

Peak procurement prices for cassava roots, wet cassava starch, and 1st class cassava starch are about 50 Dong/kg lower than offpeak prices (table 4.5.1). Average procurement prices for cassava in peak periods was 305 Dong/kg. Wet cassava starch was bought at 1125 Dong/kg, while dry cassava starch was purchased for 1773 Dong/kg. The average purchase price for 2nd class cassava starch in peak periods was 1637 Dong/kg, while offpeak prices are 110 Dong/kg higher. Root prices tend to be lowest in the RRD and CH and highest in the NES. Wet cassava starch prices tend to be lower in the North than in the South, though prices in the NCC are the highest in the country. Dry cassava starch, by contrast, is significant cheaper in the South (SCC and NES) than in the North.

Roots purchased from farmers are almost 65 Dong/kg cheaper than roots procured from traders (table 4.5.2). The price difference between sources is more pronounced in the RRD and NCC, where roots from farmers are nearly 100 Dong/kg less than roots from traders. Wet starch obtained from other enterprises, at 1085 Dong/kg, is close to 150 Dong/kg less than wet cassava starch from either farmers or traders (table 4.5.3). A similar pattern exists in dry cassava starch prices, where dry starch from other enterprises (1543 Dong/kg) is over 450 Dong/kg less than dry starch from traders (table 4.5.4).

Canna roots and dry canna starch is more expensive in peak periods than offpeak periods (table 4.5.5). Peak canna starch is purchased at 376 Dong/kg in peak periods, while in the offseason, can be procured at 367 Dong/kg. Dry

canna starch is over 700 Dong/kg less in the offseason than in peak periods. Peak wet canna starch prices are 200 Dong/kg lower than offpeak price. Prices for all canna products (roots and starch) are much lower in the RRD than in the rest of the country. Unlike cassava starch, wet canna starch from enterprises is more expensive than from other sources, such as farmers (table 4.5.6). The same is true with dry canna starch, where procurement prices from farmers and traders (at around 2900 Dong/kg) are 700 Dong/kg lower than those from enterprises (table 4.5.7).

Sales prices for cassava products provide traders with a significant profit margin (table 4.5.8). Peak prices for cassava roots, for instance, average 479 Dong/kg, which represents a margin of 174 Dong/kg. Offpeak prices for cassava roots are lower on average than peak prices. While procurement prices for cassava are lowest in the North, sales prices in the North are the highest. In the RRD, for example, the peak sales price for cassava is 526 Dong/kg. The average price for wet starch in peak periods for wet starch was 1306 Dong/kg, implying a margin of almost 170 Dong/kg. Sales price patterns in wet cassava starch are similar to the procurement price, except that the margin in the CH is quite small at 50 Dong/kg. Dry starch sales prices follow a similar pattern as procurement prices and average 2178 Dong/kg. This represents a margin of almost 400 Dong/kg.

The highest prices for wet cassava starch are paid by households, which pay an average of 2160 Dong/kg for wet cassava starch (table 4.5.9). Maltose factories only pay 1150 Dong/kg for wet cassava starch. Other endusers purchase wet starch at prices between 1340 to 1600 Dong/kg. Higher prices are paid by endusers that process starch into final goods, such as food industries and pharmaceuticals.

A wide range of sales prices exists for 1st class cassava starch (table 4.5.10). Specialized users of starch pay a premium for 1st class cassava starch. Adhesives industries, for example, purchase 1st class starch at 4000 Dong/kg. Other industries, such as pharmaceuticals, paper, and textile factories buy starch at prices between 3000 and 3500 Dong/kg. Endusers that require less refined varieties of starch pay much less for 1st class starch. Noodle factories buy 1st class starch at 1736 Dong/kg, while maltose producers purchase starch at 1725 Dong/kg. Other endusers, such as food industries, enterprises, and household pay slightly more than noodle or maltose producers, but less than pharmaceuticals or textiles. Households purchase 2nd class cassava at 1800 Dong/kg, while maltose and food industries obtain it at about 2000 Dong/kg (table 4.5.11).

The average sales price for canna roots in peak periods is 493 Dong/kg, representing a margin of 120 Dong/kg (table 4.5.12). Offpeak prices for canna roots are only slightly higher than peak prices. The average sales price for wet canna starch is 2070 Dong/kg, while dry canna sells for 3926 Dong/kg. Offpeak sales prices for wet and dry starch are much higher than peak prices — offpeak wet canna starch sells for 2337 Dong/kg, while dry canna starch sells for 4029 Dong/kg. In addition, the margins for wet and dry canna starch are much higher. As with procurement prices, sales prices are lower in the North than in the South.

All wet canna starch is sold by traders (table 4.5.13). Sales prices for dry canna starch varied widely by destination. While other trader buy dry canna starch at 2920 Dong/kg, households spend almost twice that amount at 5875 Dong/kg (table 4.5.14). Noodle producers purchase dry canna starch as 3788 Dong/kg.

MARKETING NETWORK AND TRANSPORTATION

Almost 79 percent of the traders in the survey reported the use of some means of transportation (table 4.6.1). There were no instances of transportation use in the NMM. Elsewhere, rates of transportation use varied from a low of 74 percent in the NES to 100 percent in the SCC and CH. The most common form of transportation used were trucks, with just under 58 percent of traders utilizing this type of transport (table 4.6.2). Carts are also a significant means of transportation, used by 16 percent of the sample. Trucks are commonplace in all regions where transport is used, with the notable exceptions of the NCC and SCC (table 4.6.3). In the SCC, only 16 percent of traders use trucks, while over 83 percent use carts. In the NCC, trucks are not used at all. Instead, traders conduct their operations with either bicycles (54 percent) or cyclos (31 percent). Elsewhere (RRD, CH, NES), over 70 percent of traders use trucks in their operations. This might suggest that traders in these regions rely on longer distance trade, while those in the NCC and SCC conduct business in the local market.

Traders travel a relatively long distance for the procurement of roots, averaging over 79 km (table 4.6.4). The distance is especially pronounced in the RRD, where traders travel over 120 km for root purchases. As one would expect, average distances in the NCC are small, given the low level of truck utilization. Traders travel a much smaller distance for wet starch purchases, averaging about 23 km (table 4.6.5). The greatest distances traveled are by traders in the North (NMM and RRD), while traders in the Central Coasts conduct their operations locally. The average distance for dry starch purchases is 15 km (table 4.6.6). Interestingly, traders in the SCC travel the farthest for dry starch purchases, averaging 32 km.

Distances for root sales are similar to root purchases (table 4.6.7). Traders in the RRD travel over 105 km to sell roots, while traders in other parts of the country travel less than 25 km on average. Wet starch sales distance average 63 km (table 4.6.8). Traders in the CH venture 357 km to sell wet starch, while those in the RRD go 109 km. Traders in the NCC, by contrast, travel only 7 km to sell wet starch. Dry starch sales distance average 68 km (table 4.6.9). As with trade in roots and wet starch, traders in the RRD travel the greatest distance to sell dry starch, averaging 142 km. Sales in the NCC and SCC are mostly local, with distances under 5 km.

The average distance between purchase and sales point is 119 km (table 4.6.10). This reflects the large distances traveled by traders in the RRD (165 km) and the CH (245 km). Distances in the NCC, SCC, and NES average less than 50 km. As one would expect, the distances traveled by truck are large, average 172 km. Interestingly, traders using trucks in the NES travel less than 50 km between purchase point and sales point. Distances for carts and cyclos are small (less than 5 km), as one would expect. Trucks carry an average of 8.4 tons (84 quintals) per shipment, though traders in the NES using traders transport under 4 tons. Unit costs for trucks is 1.40 thousand Dong/Ton/km, with rates highest in the NES (1.95), and lowest in the CH (1.04) and SCC (0.47).

Roughly 38 percent of traders report restrictions on the movement of goods (table 4.6.11). Restrictions are most commonplace in the RRD, with almost 59 percent noting some sort of restrictions. 87 percent of those reported restrictions cited police restrictions as the most important impediment to trade (table 4.6.12). Less than 5 percent of traders report problems with transporters (table 4.6.13). Over 93 percent of traders can choose among different transportation services, while over 72 percent negotiate fees (table 4.6.13).

Traders receive information from a variety of sources (table 4.6.14). Information on prices and market comes from starch users (39 percent), traders (32 percent), and personal contacts (14 percent). Regulatory information is provided by extension agents (52 percent), the press (24 percent), and starch users (14 percent). Over 90 percent of traders obtain information on credit from banks.

Traders are more technologically advanced than processors with respect to means of communication (table 4.6.15). Almost half of traders own a telephone. Less than 2 percent own a fax machine, however, and less than 1 percent has a computer.

STORAGE

Slightly over half (51 percent) of traders use storage facilities (table 4.7.1). Storage is very common in the NCC, with 86 percent of traders reporting this practice. In the SCC and CH, by contrast, only 17 and 25 percent of traders, respectively, use storage facilities. Of those using storage, the most common form of storage was concrete structures (47 percent), followed by roof covered facilities (40 percent) (table 4.7.2). Concrete structures are favored by 59 percent of traders using storage in the RRD, while a majority of traders in the NCC (46 percent), CH (100 percent), and NES (60 percent) use roof covered facilities (table 4.7.3). Concrete structures, with an average capacity of 98 tons, have a larger average capacity than roof covered facilities, which store an average of just 33 tons (table 4.7.4).

Not surprisingly, given the perishability of roots, only 0.3 tons of roots are stored by traders; this is allocated evenly among peak and offpeak periods (table

4.7.5). Roots are held an average of 2 days with only minimal losses of 1 percent in peak season and 2.5 percent in the offseason.

Traders store a larger quantity of wet starch, averaging over 8 tons in peak periods and 1.3 tons in offpeak times (table 4.7.6). The bulk of wet starch is stored among traders in the RRD, NCC, and NES. Wet starch is kept an average of 19 days in peak periods, while in the offpeak, it is kept for 36 days. Losses of wet starch are relatively small, averaging 1.5 percent in the peak season and 1.9 percent in the offseason. Interestingly, traders in the RRD, who hold 10 tons of wet starch in peak periods, have relatively sizable losses of starch (2.4 percent), despite holding starch for only 6.5 days during this time.

A total of 13 tons of dry starch is stored, on average, by traders (table 4.7.7). Traders in the NES (21 tons) hold the most dry starch, followed by those in the RRD (13 tons). Dry starch is kept for 42 days in peak periods, but just 18 days in the offseason. Traders in the NCC hold dry starch for longer in the offseason (37 days) than the peak season (27 days). Losses of dry starch average about 1 percent.

CREDIT

60 percent of traders that borrow consider the quantity of funds received adequate for operations (table 4.8.1). Regionally, over two-thirds of traders in the RRD and 87 percent of traders NCC receive ample funds, while no traders in the SCC and only 25 percent in the CH are in this situation. The most important reason cited for not obtaining additional funds is a lack of collateral (47 percent), followed by bank difficulties (32 percent), and high interest rates (21 percent) (table 4.8.2).

Over 71 percent of traders sell goods on consignment (table 4.8.3). Consignment sales are especially important to traders in the NMM (100 percent), RRD (77 percent of sales) and NCC (87 percent of sales). By contrast, only 17 percent of traders sell on consignment in the SCC. 42 percent of total sales are made on consignment (table 4.8.4). The proportion of sales made on consignment falls as one travels further south in the country. All sales in the NMM and over half of all sales in the RRD are made on consignment, while in the CH and NES, just 32 percent and 28 percent of sales, respectively, utilize this method.

56 percent of traders receive advance payment for raw materials (table 4.8.5). Advance payments for goods are most common in the NES, with 70 percent of traders receiving goods in this fashion, followed by the NCC, at 67 percent. Only 17 percent of traders in the SCC obtain raw materials in advance. Nationally, 29 percent of sales involved the receipt of advance payment, with the highest proportions in the NCC (35 percent) and NES (31 percent) (table 4.8.6).

SEASONALITY OF PRICES

During peak periods (October-March), cassava root prices demonstrate an upward trend (table 4.9.1 and figure 4.9.1). Cassava prices are relatively constant between October and November between 382-383 Dong/kg, rise slightly by 5-10 Dong/kg between December and January, with a more significant increase in February and March. In the NES, prices fall between October and December, rise marginally in January and February, with a steeper rise in March. Elsewhere, the trend is similar to the national one. Prices for roots are quite low in the CH, ranging from 190-200 Dong/kg. Elsewhere, we observe that prices decrease as one moves further south in the country -- prices

in the RRD are, on average, about 20 Dong/kg more than those in NCC and 25-35 Dong/kg more than in the NES.

Canna root prices remain steady between October and December, with a steep decline in January (table 4.9.2 and figure 4.9.2). This is followed by a sharp rise in prices in February and March.

Wet cassava starch prices fall steadily between October and December, ranging from 1421 Dong/kg in October to 1348 Dong/kg in December (table 4.9.3 and figure 4.9.3). This follows the trend in cassava root prices, though the behavior in wet starch is more dramatic and is lagged by one month. January prices rise to 1401 Dong/kg and increase substantially in February and March. Prices in the NMM and SCC remain constant throughout this period and are the lowest in the country. Prices in the RRD and NES follow the national trend, though the rise in prices between January and March is not as dramatic as in the NES. Prices for wet cassava starch decline as one moves south, though the difference between prices narrows as the price reaches its nadir. For example, the December price in the RRD (1550 Dong/kg) is 90 Dong/kg more than the price in the NCC, 205 Dong/kg more than the CH, and 230 Dong/kg greater than the NES price. In October, however, the price spreads are much larger — the difference between the RRD and NES price is over 700 Dong/kg.

Wet canna starch prices are at their lowest in December, at 2027 Dong/kg (table 4.9.4 and figure 4.9.4). This is interesting, given that canna root prices are at their lowest in January. Nationally, wet canna starch prices decline markedly between October and December, falling 220 Dong/kg, while rising sharply (250 Dong/kg) between January and March. Prices in the SCC and CH are typically 400 to 700 Dong/kg higher than those in the RRD and are much

less variable. Prices in the RRD, by virtue of the dominance of canna in this region, tend to follow the national trend.

1st class cassava starch prices are not particularly variable, relative to wet cassava starch (table 4.9.5 and figure 4.9.5). The difference between the maximum price (in March) and minimum price (in December) is only 133 Dong/kg. Prices fall steadily between October and December and only rise sharply beginning in February. 1st class prices in the SCC are the lowest in the country, averaging over 500 Dong/kg less than those in the NES and 1500 Dong/kg lower than prices in the RRD. Prices for 1st class cassava starch in the SCC and NES rise between October and March, while those in the RRD and NCC follow trends similar to the national one.

2nd class cassava starch prices exhibit a strange trend, rising between October and December, falling sharply between December and January, with a further steep increase between January and March (table 4.9.6 and figure 4.9.6). Dry canna starch prices behave in an equally perverse manner, falling between October and November, rising, then falling between December and January, with a sudden drop in price in February (table 4.9.7).

PROFITABILITY

Unlike processors, who fared relatively poorly between 1996-1997, most traders have had profitable operations during that time period (table 4.10.1). While the proportion of those reporting "Good" conditions increased just 0.4 percent between 1996 and 1997, the percentage of those reporting normal conditions rose from 58 to 67 percent. Moreover, the proportion of traders who noted "bad" conditions fell from 12 percent in 1996 to 3.5 percent in 1997. For

traders in the NMM, SCC, and NES, 1997 represented a substantial improvement over 1996 (see tables 4.10.2 and 4.10.3). In particular, the proportion of traders reporting "Bad" conditions fell from 50 percent in 1996 to under 8 percent in 1997. In the RRD, while the quantity of traders reporting normal conditions rose from 61 percent in 1996 to 74 percent in 1997, the proportion who cited good conditions fell from 37 percent to 23 percent. In addition, the number of traders with lower profit levels doubled in the RRD between 1996 and 1997, though these percentages are only a small proportion of traders in the RRD.

Changes in the volume of trade was the most commonly cited reason for the change in profitability among traders (51 percent), followed by the sale price for starch and roots (32 percent) (table 4.10.4). Most traders noted an increase in profitability from the volume of trade, though traders in the RRD saw a reduction in the overall level of trade between 1996 and 1997 (table 4.10.5). Traders in the RRD were negatively affected by changes in sale prices, while those in the CH and NES saw profits rise as a result of changes in sale prices.

Of those traders providing policy recommendations, the most common was for increasing loan periods, suggested by 26 percent of traders (table 4.10.6). Another 13 percent want better relations with banks. 9 percent of traders sought to improve road conditions. 24 percent of traders recommended policies that lowered impediments and regulations to trade, including reducing road fees, the number of inspection stations, police regulation, and transport regulations. 4 percent cited the desire to improve cassava varieties.

SUMMARY AND CONCLUSIONS

A crucial link in the post-harvest chain for starch is the role of traders, given their importance as a major source of procurement and sales for processors and end-users. As part of the project on starch, a survey of 115 starch traders was conducted between March and April 1998 in six regions of Viet Nam. The goal was to obtain some characteristics about traders, such as their procurement and sales patterns, marketing network, and present profitability to understand the role they play in the starch system as the link between processors and end-users.

General Characteristics

Like processors, starch traders have only recently commenced operations, with over 70 percent of traders reporting that they began starch trading after 1988. Even in regions where trade in starch is more established, such as the RRD, NCC, and NES, the average trader has engaged in starch trading for only 10 years. Almost all traders are household operations that, with the exception of the NES, employ just 2 to 3 workers. Traders in the NES, while also considering themselves household enterprises, nevertheless employ an average of 13 workers. 80 percent of all traders are male, with the distribution of male traders relatively similar across Viet Nam.

Starch traders are extremely diversified. Only 39 percent of income in 1997 resulted from trade in starch, though this is up from 36 percent in 1996. 15 percent of income comes from other starch related activities, with an additional 15 percent from non-starch activities and 14 percent from crop production. Traders in the NMM, NCC, and NES are the most concentrated in trading starch,

with over half of the income generated from this source. By contrast, traders in the RRD are the most diversified in Viet Nam, with only 27 percent of income coming from starch trading. The remainder derives from other starch activities (23 percent), non-starch activities (18 percent), crop production (13 percent), and livestock (11 percent).

Patterns of Procurement and Sales

The starch traders surveyed are active in the trade of both roots and starch. With respect to trade in roots, an average of 567 tons of cassava roots and 96 tons of canna roots were procured by traders. Over 96 tons of wet cassava starch and 40 tons of dry cassava starch (1st and 2nd class) were obtained by starch traders, while canna starch purchases were somewhat smaller on average (35 tons of wet canna starch, 8 tons of dry canna starch). The greatest average volumes of procurement in roots occur in the RRD (699 tons) and NES (429 tons), while large quantities of starch are bought in the NMM (800 tons of wet starch) and the NES (293 tons of wet starch and 74 tons of 1st class starch). The pattern of sales volumes in roots and starch is similar to procurement. Unlike processors, whose time in production, procurement, and sales occurred mainly in peak periods, traders often spend significant time in what is considered "off-peak" periods, particularly in root procurement and dry starch sales.

Nationally, 71 percent of cassava roots are obtained by other traders, with the remainder coming directly from farmers. While other traders are the main source of roots in the RRD (78 percent), 68 percent of traders in the NCC and 57 percent of traders in the NES obtain cassava roots from farmers. 69 percent of traders purchase wet cassava starch from starch enterprises, though there are distinct regional differences. Starch enterprises are the exclusive source of wet

starch in the NMM and RRD and represent over 75 percent of wet cassava purchases by traders in the NES. In the NCC, however, three-quarters of traders obtain wet cassava starch from other traders. Farmers are the exclusive supplier of wet cassava starch in the SCC and CH. 59 percent of dry cassava starch is obtained from starch enterprises, with 30 percent coming from traders and 10 percent from own production. Traders are the only supplier of dry starch in the NCC, while in the RRD and NES, enterprises are the main source of dry cassava starch.

Two-thirds of canna roots come from traders, while the remaining one-third comes from farmers. Most canna starch (wet and dry) comes from farmers, with starch enterprises as a secondary source only in the RRD. Other traders play a minor role as a source of procurement in canna starch.

Starch traders sell a sizable portion of wet and dry starch to other traders. In the case of wet starch, 40 percent is purchased by other traders. These averages hide important regional patterns, however. In the CH and NES, large volumes of starch are purchased by other traders. Yet elsewhere in the country, there are few sales to starch traders. In the RRD, two-thirds of wet cassava sales go to food industries, with the remainder to other sources. In the NCC, noodle factories and households are the most important markets for wet starch. Maltose factories in the NMM purchases large volumes of wet starch. In 1st class cassava starch, sales to exporters and traders predominate nationally, though these figures are inflated by the large average volumes of starch sold in the NES. In the RRD, packaging paper and food industries each purchase about 37 percent of the starch sold in the RRD. In the central coasts, 1st class starch is sold to food sources; namely noodles (96 percent in the SCC, 31 percent in the NCC), food industries (24 percent in the NCC), households (4 percent in the

SCC), and other sources (40 percent in the NCC). All 2nd class cassava starch is sold in the RRD, with over 75 percent destined for food industries. Smaller amounts are sold to maltose factories and households.

Wet canna starch is mainly purchased by traders (20 tons) and noodle producers (16 tons). Sales to traders are important in the RRD, with 36 tons of wet canna starch sold, with sales to noodle producers slightly smaller at 29 tons. In the NCC and CH, wet canna starch is sold exclusively to noodle factories. Dry canna starch is sold to similar markets as wet canna starch, but in different proportions — 4.6 tons is sold to noodle producers versus 3.2 tons to traders. As with wet canna starch, traders are important only in the RRD. Nonetheless, sales to noodle producers represent the largest market for dry canna starch in all regions.

The volume of trade for the majority of traders is under 100 tons (table 4.11.1). Fewer than 2 percent of traders deal with more than 500 tons of either wet or dry cassava starch per year. Larger volumes of roots are more common among traders, yet only 30 percent of traders trade more than 100 tons of cassava roots.

Marketing Network

79 percent of the traders in the survey reported the use of some means of transportation. 58 percent of traders use trucks, followed by 16 percent of traders who use carts. Other forms of transport include bicycles, cyclos, and boats. There is a noticeable regional dimension to the mode of transport employed. In the RRD, CH, NES, over 70 percent of traders use trucks in their operations. In the SCC, however, only 16 percent of traders use trucks, while

over 83 percent use carts. In the NCC, trucks are not used at all; instead, most traders conduct their operations with bicycles (54 percent) or cyclos (31 percent). This might suggest that traders in these regions rely on longer distance trade, while those in the NCC and SCC conduct business in the local market.

Most trade in roots and starch is conducted on a local basis (i.e. within the same province), with the RRD being a major exception. With the exception of the RRD, the distance traveled for purchases and sales of both types of commodities is usually under 35 km. Nationally, traders traveled the farthest to procure and sell roots (79 km), followed by dry starch (45 km). Traders travel the smallest distance for wet starch purchases (23 km). Sales of roots follow the same pattern in terms of distances, while traders typically venture an average of over 60 km for sales of starch.

The RRD presents the most interesting variations in the trade in roots and starch and contains almost all instances of non-local trade. In the RRD, traders travel over 120 km for root purchases, as they typically obtain their roots from the NMM, particularly Son La and Vinh Phu. Typical distances traveled by these traders ranges from 40 to 300 km. Sales distances are similar at 105 km, though most sales of roots occur in within the RRD. For wet starch, there appears to be two types of traders in the RRD. Those centered around Ha Tay and Hai Hung purchase both wet cassava and canna starch locally, traveling no more than 10 km. Those in Ha Noi, however, travel between 70 and 250 km for wet canna starch obtained in the NMM. Most traders in the RRD sell wet starch locally, though there are several traders who travel great distances to sell canna starch; this includes one trader who sells both wet and dry canna starch from the RRD to the NES! In addition, a trader in the CH travels some 700 km to sell starch in

the NES. Most trade in dry starch in the RRD is local, though there are two traders in Ha Noi who travel to the NMM for dry canna starch.

Profitability and Constraints to Trade

Traders have been rather profitable recently. Over 95 percent of traders reported conditions as either normal or good in 1997, an improvement over 1996. Conditions improved everywhere with the exception of the RRD. The most important reason for the optimism expressed by traders is from increases in the volume of trade. In the RRD, fewer traders reported conditions as good as in 1996, but only a handful considered 1997 a bad year for profits. Traders in the RRD appeared to be negatively affected by changes in sale prices, while those in the CH and NES saw profits rise as a result of changes in sale prices.

Overall, traders receive 38 million Dong (almost $3000) from trading activities (table 4.11.2). These figures include income from trade in roots, which is sizable in the RRD. Income in the RRD is over 10 times that in the NES, primarily due to the large margins received by traders in the RRD from trade in cassava and canna roots.

Traders face a number of constraints related to their operations. The most significant of these related to credit access and bank dealings. Only 46 percent of all traders receive credit and of those traders, 60 percent consider the amount borrowed to be adequate. Slightly less than half (48 percent) of traders providing suggestions mentioned problems with either obtaining credit, banks in general, or the length of loans being offered. A secondary problem reported by traders were regulatory impediments. These include high road fees, problems with police regulations, and the number of inspection stations.

5. STARCH END USES

GENERAL CHARACTERISTICS

Two hundred and thirty five enterprises that use root crop starch were surveyed across Vietnam, distributed geographically as shown in Table 5.1.1. Of these, 60% were located in the Red River Delta region, which contains several clusters of smaller-scale starch and starch-using enterprises, as well as some larger scale starch users. The North Central Coast (Thanh Hoa) and the NES region were also well sampled, while few enterprises were located in the other regions surveyed.

Most (83%) of the starch-using enterprises surveyed were household enterprises (Table 5.1.2). As might be expected only a few of these (7%) were legally registered. All the other enterprise types were legally registered, the most common type being Vietnamese owned private enterprises, of which 20 were surveyed (8.5% of sample), and state owned enterprises (5.5%). Foreign owned enterprises, cooperatives, and joint-ventures comprised under 3 percent of the end-users surveyed. Only 2 cooperatives and one foreign-owned enterprise were found. The absence of cooperatives in this type of business is worth noting.

Starch is used for a wide variety of food and non-food products throughout Vietnam. Over 55 percent of all the end-users surveyed produce starch noodles (see table 5.1.3). Another 16 percent produce of an assortment of food items, often traditional, while 12 percent are involved in the maltose industry. Other

industries that use starch, such as pharmaceuticals, textiles, fermentation products (including MSG), and paper, are small in number, but use large volumes of starch (see section 5.2). Starch end-users in the RRD, NCC, SCC, and CH specialize primarily (or exclusively, as in the case of the SCC and CH) in food production, namely noodles and other food products (see table 5.1.4). Most maltose factories are in the RRD as well. In the NMM, end-users concentrate on industrial uses of starch, such as paper, textiles, pharmaceuticals, and also maltose. In the NES, there is considerable diversification among end-users: 34 percent produce noodles and other food products, 23 percent are involved in paper production, while the remainder are active in a variety of other sectors, such as maltose, pharmaceuticals, fermentation products, textiles, and adhesives.

Household enterprises dominate the production of maltose, noodles and other processed foods, especially traditional food products (table 5.1.5). Private, Vietnamese-owned industries constitute the majority of enterprises in the glucose, pharmaceutical, plywood, and textile sectors. State-owned enterprises are also important in the pharmaceutical and textile sectors. Household enterprises are predominant in the RRD, NCC, SCC, and CH, not surprising given the concentration of noodle and other food production in these regions (table 5.1.6). All of the end-users in the NMM are state-owned. The NES has the highest proportion (34.5 percent) of privately owned industries, though household enterprises (55 percent) are still in the majority.

According to the survey results, the first earliest starch using enterprises in Vietnam were household enterprises: one founded in 1945 is still in operation in the North Central Coast region. They are also still being founded: between 1995 and 1997 all regions reported new household enterprises (Table 3, CW). State

owned enterprises showed a wide range of start-up dates a well, from 1960 to 1991 in the RRD region, for example.

On average, enterprises have been operating for over 12 years (table 5.1.7). Fermentation products (including MSG), adhesives, and plywood are relatively new entrants to the market. By contrast, pharmaceuticals and textiles industries have been operating an average of 30 and 25 years, respectively. As with processors, there has been significant entrance into this market after doi moi, with 58 percent of the surveyed end-users commencing production after 1988 (table 5.1.8). 1990 and 1992 saw 11 percent and 12 percent, respectively, of end-user starting operations. A more detailed look at the start-up dates for the 122 household enterprises in the Red River Delta region, reveals that 71% started operations in the decade between 1985 and 1994. The peak year was 1988, when 16 new enterprises were started (13% of the total). However, in the last three years (1995-7) only 7 new such enterprises were started (6% of the total): this may be indicative of a reduced dynamism of the economy.

Regardless of enterprise type or region, the average length of operation under the current managers/owners ranged between 6.5 and 10 years (Table 5.1.9). The Household enterprises in the north central coast region were most stable, close to 10 years. Some household enterprises also reported periods of great stability (25-30 years), revealing perhaps an absence of generational change (children undertaking other economic activities, rather than continuing the business). Obviously relatively new enterprises (joint ventures etc) reported short periods under current management.

The average number of years that enterprises have operated at current capacity is less than the average years since start-up in all cases, and less than the

average years under current management for most major regions and enterprise types, suggesting that expansion of capacity has been occurring in recent years. In general, household enterprises reported 4-5 years at current capacity (Table 5.1.10), suggesting some expansion in recent times. The state owned enterprises in the south, and the RRD reported more stability (average of 9 years at current capacity), while state enterprises in the northern mountains reported current capacity for only two years. The small number of enterprises sampled in these regions precludes any more general conclusions being made, however.

Household enterprises generally work with small amount of household labor (table 5.1.11). Hired labor among these enterprises is negligible except in the adhesive industry, which hires 4 workers. On average, households utilize 3.5 workers in their enterprise, with noodles and paper requiring almost 4 workers. Use of household or hired child labor (under 16 years of age) is reported as low, and appears totally absent in the south of the country. Other food and maltose require less household labor than the average. Among non-household industries, substantial numbers of workers are employed. The textile industry uses an average of 27,758 workers. The paper industry uses over 3,600 workers, while glucose averages 1,215 workers. VEDAN, the MSG factory in the NES, did not report employment figures. Other industries, such as pharmaceuticals, paper, and other food use under 300 workers, on average.

PROCUREMENT OF STARCH BY END-USERS

The VEDAN factory dominates starch procurement by industries in Vietnam. VEDAN is also a starch processor itself. The starch produced by VEDAN is processed into several fermentation products, including MSG and lysine, as is

additional wet and dry cassava starch that is procured from traders. The total volumes procured from starch traders by this one enterprise in 1997 were 8,000 tons of 1st class dry cassava starch and 61,000 tons of wet cassava starch. The wet starch was converted by VEDAN into 36,000 tons of dry starch before entering the process of MSG manufacture. In addition, 4,000 tons of dry starch were produced at VEDAN directly from fresh cassava roots. Thus in 1997, the MSG production process itself used a total of 48,000 tons of dry cassava starch, comprising 8,000 tons procured directly, plus 36,000 tons derived from wet cassava and 4,000 tons processed from fresh roots by VEDAN itself.

On a dry starch equivalent basis, VEDAN in 1997 was responsible for 60% of all the cassava starch procured by enterprises in this survey. Thus, the average volumes procured are greatly affected by the activities of this one company.

The average procurement of 1st class cassava starch among end-users in 1997 was 105 tons, while wet cassava starch procurement averaged 335 tons (Table 5.2.1.). As explained above, the wet starch average in 1997 was greatly affected by the procurement at VEDAN, as was average procurement of 1st class dry starch, but to a lesser extent. Excluding this one enterprise, average annual 1st class dry and wet cassava starch procurement falls to only 71 and 75 tons per enterprise, respectively.

Glucose and pharmaceutical sectors both procure significant quantities of dry cassava starch. The maltose industry dominates wet starch procurement, obtaining an average of 435 tons of wet cassava starch per enterprise. Food uses, such as noodles and other food industries, procure small amounts of both wet and dry cassava starch. Noodle factories purchased an average of just 3.2 tons of 1st class starch and 7 tons of wet cassava starch. Other food industries

acquired about twice as much dry and wet cassava starch as noodle factories. Average procurement of dry and wet starch for noodles was highest in the NES.

Average procurement of dry canna starch was 3.3 tons in 1997. Wet canna starch purchases were much higher at 14.6 tons. Noodle factories utilize all canna starch.

Trends in production show that the volume of starch purchased by end-users have been increasing and are expected to increase more in the future (tables 5.2.2 to 5.2.6). Maltose and packaging paper are expected to have a substantial demand for 1st class starch in the year 2000 - expected starch usage is over 3.5 times their current levels (table 5.2.2). Glucose demand for starch is predicted to be more than double present demand. In pharmaceuticals, average expected requirements for 1st class cassava starch in 2000 are estimated at about 900 tons, 23 percent higher than present demand. Other industries, such as textiles and noodles see very slow growth. Textile industries foresee a 4 percent increase in demand for 1st class starch between 1997 and 2000, while noodle demand for 1st class is expected to rise just 3 percent. Overall 1st class starch demand is expected to rise to 147 tons, or 40 percent higher than current levels.
2nd class production is expected to rise to 0.62 tons (from 0.48), an increase of 27 percent (table 5.2.3). This is mostly on the strength of starch demand in adhesives and packaging paper. Modified starch demand is expected to rise slowly between 1997 and 2000, from 0.77 tons to 0.80 tons, a modest gain of 4 percent (table 5.2.4).

Wet cassava starch (excluding the VEDAN company) is anticipated to grow 20 percent between 1997 and 2000 (table 5.2.5). The biggest expected jump in

starch demand is from the glucose industry, which predicts 41 percent rise in wet starch demand to 2550 tons. Maltose producers predict a 16 percent increase in wet cassava starch demand, while noodle factories foresee a 13 percent increase. Textile producers do not anticipate an increase in wet starch demand. No projection was obtained for MSG.

In canna starch, demand from noodle makers is expected to rise for both dry and wet starch. Dry starch demand is anticipated to be larger than wet starch demand (tables 5.2.6). It is expected that dry canna starch demand will increase 25 percent, from 3.3 tons to 4.2 tons. Wet starch demand, in contrast, is predicted to grow only 8 percent.

Total procurement of 1st class cassava starch was 24,800 tons (table 5.2.8). MSG acquired the most 1st class starch, at 8000 tons, followed by pharmaceuticals (5850 tons) and glucose (3000 tons). Noodles and other food industries combined to obtain just 601 tons of 1st class starch. Most 2nd class starch was purchased by the packaging paper industry. Of the 78,686 tons of wet starch procured by end-users, the MSG factory dominated consumption with 61,000 tons used. The 29 maltose enterprises were the next mot important users of wet cassava starch, with a total procurement volume of 12,694 tons. Glucose was also a significant user of wet starch, using 3600 tons. Food industries and noodles purchased less than 10 percent of total wet starch.

Over 77 percent of the wet starch procured by end-users was used in the NES, almost entirely by VEDAN (table 5.2.9): 786 tons was used by other end-users (food and noodle sectors) in this region of Vietnam. A further 20 percent was used in the RRD, mainly by the maltose industry. The RRD also uses the majority of the 1st class starch as well (14,640 tons or 59 percent). This is due

to the predominance of large, state-owned enterprises in pharmaceuticals, textiles, paper, and glucose that reside in the RRD. Despite the diversity of end-users in the NES, only 303 tons of dry starch are procured, if VEDAN is excluded: this suggests that most end-users in the NES are of a relatively small-scale.

Total wet canna starch volumes were 3,438 tons in 1997, while dry canna starch volumes were 779 tons (table 5.2.10). All wet and dry canna starch is used in the noodle sector. Most wet canna starch is used by noodle factories in the RRD (table 5.2.11). Dry canna starch is used predominately in the RRD, but small quantities are procured by noodle factories in the SCC and CH.

1st class starch is obtained primarily from traders (table 5.2.12). A major exception is VEDAN, which acquires fresh roots from traders and processes them on-site into dried starch (in addition to the dry starch that it procures directly). In addition, almost all of the 1st class starch obtained by textile factories comes from urban wholesalers, as does two-thirds of the 1st class starch for noodle producers. The paper industry relies primarily on other starch enterprises for their 1st class starch, while other food industries rely on a basket of starch enterprises, traders, and urban wholesalers for their supply. All other industries rely on traders for 1st class starch. Most 2nd class starch is obtained from starch enterprises directly. Wet cassava starch is procured by VEDAN from traders. Other wet starch users obtain this starch mostly (73 percent, excluding VEDAN) directly from starch enterprises, with the remainder coming from traders. Only glucose producers rely solely on traders for wet starch, apart from VEDAN.

Dry canna starch is obtained from a variety of sources (Table 15.2.12). 393 tons (or 49 percent) of dry canna starch comes from traders, while 208 tons (27 percent) comes from urban wholesalers and 174 tons (22 percent) comes from starch enterprises. In the CH, more dry starch comes from starch enterprises. 45 percent of wet canna starch comes from urban wholesalers, with another 34 percent arriving from starch enterprises. The remaining wet canna starch comes from traders. While most starch is procured from within the region where an enterprise is located, some inter-regional trade was found. This was mainly between the NMM and RRD regions (Table 5.2.13). In addition, 8 enterprises in NES reported procuring starch from the RRD region, but this volume of this trade was not specified.

PROCUREMENT PRICES OF STARCH

Procurement prices vary greatly depending on the type of end-use the starch is used for. On average, dry cassava starch costs 2442 Dong/kg, while wet cassava starch costs 1130 Dong/kg (table 5.3.1). Specialty cassava starches (2nd class, modified) fetch much higher prices: 2nd class costs 2960; modified starch costs 11783 Dong/kg. Canna starch prices have a larger difference between wet and dry price - wet prices in 1997 were 2363 Dong/kg and dry prices were 3837 Dong/kg (table 5.3.2).

Prices within a given type of starch are variable. 1st class dry cassava starch prices for noodles and maltose are over 700 Dong/kg less than the average price for 1st class cassava starch. By contrast, 1st class starch for pharmaceuticals is 1800 Dong/kg higher that the average price, at over 4000 Dong/kg in both 1996 and 1997. Dry cassava starch for other food uses and glucose is typically less expensive than the average, while industrial uses

(textiles, paper) is slightly more expensive than the average. The same pattern holds in wet cassava starch prices for noodles and maltose, though the difference between those prices and the average is much less extreme. In addition, wet cassava starch for other food, industrial, and glucose tends to be more expensive than that average wet starch price. All dry and wet canna starch is used for noodle production only (Table 5.3.2.).

A comparison of the relative prices of cassava and canna starch types, for both years (table 5.3.3) shows that dry cassava starch, 1st and 2nd class, was some 70-100% more expensive than wet starch. The small amount of modified starch used was considerably more expensive, reflecting the costs of importation as well as the added value of modification. The relative price of canna starch showed considerable variation between the two years: wet starch had an index value of 271 in 1996 but only 180 in 1997. The relative cost of dry canna starch was also lower in 1997 than in 1996. The large variability of canna starch prices is perhaps due to the dependence on a single market, noodles. Canna starch from China was used during 1996, when domestic canna prices were high: at this time imported dry canna starch prices averaged 4757 Dong/kg dry, 8% lower than average domestic dry canna starch.

1st class dry cassava starch is widely used in two regions: the red river delta and in the south, around HCMC. It is also used for a wide range of product types (end uses). Table 5.3.4 gives a breakdown of the price paid for this class of starch by each end use in each of the two regions. First, it can be seen that even within a region and product category, there is considerable variation in prices paid. For example, although the average price paid in the RRD for starch used in to make other foods is 3100 dong/kg, the range is from 1900-5200 dong/kg. In general, however, the price in the RRD is around 2000-3000 dong/kg. There are

no clear trends between the two regions either: for the 4 end uses that are found in both regions, two pay least for starch in the south, and two pay least in the north, although the differences are not wide. It appears that more than one type of "1st class cassava starch" exists: the lack of any formal standards or certification of quality may lead to confusion in nomenclature.

Wet cassava starch is used in all regions of the country for noodle production, except the northern mountains. The average prices paid vary between regions from 980-1733 dong/kg (Table 5.3.5). Within a region there is also considerable variation in price for this type of starch: in the north central coast the price ranges from 1566 dong/kg for noodles to 2300 for further starch processing. The lowest price of wet cassava starch was reported by VEDAN in the south.

Procurement prices for cassava starch have increased in nominal terms over 1996-1997 (Table 5.3.2. In 1st class cassava starch, prices increased almost 150 Dong/kg between 1996 and 1997. The greatest increase was reported in the NES with an almost 700 Dong/kg rise in prices. This was felt in all industries within the NES, with the noodle industry seeing the steepest rise - starch prices for noodle producers rose 95 percent. In the RRD, prices fell by 120 Dong/kg, on average. Pharmaceutical firms there saw starch prices fall 567 Dong/kg, while packaging paper industries reaped a 800 Dong/kg reduction in price. Interestingly, paper factories in the RRD saw a 100 Dong/kg rise in price. Unlike in the NES, noodle factories in the RRD faced a lower price for starch in 1997 than in 1996, though their starch prices are still higher than those in the NES.

FINAL USES OF STARCH AMONG END-USERS

End-users utilize a variety of starch for their products. 32 percent use dry canna starch, 29 percent use 1st class cassava starch, and 27 percent use wet cassava starch (table 5.4.1). Maltose industries use primarily wet starch (table 5.4.2). Starch usage by noodle factories varies greatly. Of those producing canna noodles, over 70 percent use dry canna starch. For those utilizing cassava starch, 55 percent use wet cassava starch and 45 percent use dry cassava starch. Most industrial uses of starch (textiles, pharmaceuticals, adhesives, paper, plywood) use 1st class cassava starch. VEDAN uses both dry and wet cassava starch in their fermentation processes. 64 percent of other food industries use 1st class starch, with the remainder using wet cassava starch.

Over 57 percent of sample reported that starch comprises more than 75 percent of their total costs (Table 5.4.4.) Starch represents less than 5 percent of total costs for 13 percent of end-users, including textiles, plywood, and paper industries. Starch costs are over half of total costs for all maltose producers and are over 75 percent of total costs for 69 percent of them. 83 percent of noodle factories report that starch makes up over 75 percent of total costs. The proportion of starch in total costs for other food industries varies greatly.

ISSUES OF QUALITY AMONG END-USERS

Over 87 percent of end-users cited color as the most important criteria for the quality of starch (table 5.5.2). Color is most important in food applications, such as maltose, noodles, and other food as well as in textiles and paper. Purity is most important in pharmaceuticals, plywood, and MSG. Moisture content is important to adhesive and packaging paper industries. 72 percent of end users

employ visual means of inspection to assess quality (table 5.5.3.). Another 22 percent cited "experience" as their main method. Other quality measures made up 5 percent of the responses, and were most important among pharmaceuticals and at VEDAN. Experience was most cited among other food industries, glucose, and adhesive factories.

Slightly over two-thirds of end-users purify starch after purchase (table 5.5.4). Purification is especially important to food applications such as noodles. Interestingly, over one-half of maltose factories and three-quarters of pharmaceutical companies do not purify starch after purchase. Since the pharmaceutical companies are buying the most expensive 1st class cassava starch, it is probable that they obtain satisfactory quality from the product they buy. Industrial applications of starch, such as plywood, paper, textiles, and adhesives tend not to purify starch. In the case of MSG, maltose, and other industries, purification may not be required either because their applications do not require it or they already purchased purified starch. Among those who purify starch, losses are minor -- only 3 percent of starch is lost in the purification process. Losses are predictably highest in noodles and other food, since these industries are more likely to purify starch. With the exception of paper, with losses of 3 percent, losses among other industries typically fall around 1 percent.

PROBLEMS IN THE STARCH USING INDUSTRY

General instability of the starch market, in terms of prices and raw material availability is the most commonly cited complaint among a range of end-users (table 5.6.1), from small, household enterprises to the VEDAN company. VEDAN specifically mentioned the problem of the restricted harvesting period of cassava

in reducing the length of the processing season. In total, 18 percent of end-users reporting problems mentioned that there were problems acquiring starch in the off-season. Other problems included lack of credit and high labor costs.

Although not many enterprises responded when offered the opportunity to detail the starch quality problems they faced, the fact that many enterprises are purifying starch after purchase, and 87% of enterprises rate color as the main quality issue, suggest that process improvement is required by starch producers. The wide range in starch prices found between industry sectors also suggests that there is a lack of standardization, quality control and certification of starch. Improving, standardizing and guaranteeing starch quality will become more urgent as the starch-using industries develop in the future, and as consumers become more demanding towards traditional products.

SUMMARY AND CONCLUSIONS

The survey of 235 end users of starch collected information on the main characteristics of each enterprise, on the types of starch used, range and volumes of products made, prices, and on trends in volumes of starch purchased. Qualitative information on the major problems facing these end users, especially in the area of starch quality, was also obtained.

About 83% of enterprises are micro- or small scale, household level activities. Of these, 93% were in the unregistered, informal sector. The larger scale organizations comprised private, state and cooperative enterprises, a well as a few foreign and joint venture companies. All of these were legally registered. 58% of enterprises had been in operation for 10 years or less, demonstrating

quite dynamic growth in recent years. Household level enterprises used 3-4 workers on average, while the formal sector enterprises were highly variable in employment of labor, ranging from very few to 28,000 in the textile sector.

The smaller, household level enterprises produce traditional products, principally noodles, maltose (for the candy industry) and a type of pancake. The larger enterprises manufacture a range of food and non-food products, including glucose, MSG, paper, plywood, pharmaceuticals and textiles. In general, the larger enterprises were under represented in the survey, as was the south of Vietnam. The total volume of starch procured by the end users that were surveyed (73,600 tons dry starch equivalent) was less than the starch production recorded in the starch processors survey.

Noodle enterprises comprised over half those surveyed (55%), with maltose (12%) and other, traditional foods (17%) also important: this represents the small, household level scale of enterprises. The non-food sector (pharmaceutical, textiles, paper etc) totaled 15%, while the glucose and MSG sectors between them totaled only 1.3% of the enterprises. The MSG factory is foreign owned (VEDAN), the glucose plants are operated as joint ventures or private Vietnamese-owned enterprises, while paper, textile and pharmaceutical firm are either state or private Vietnamese owned firms. Regionally, the Red River Delta is home to the major concentration of small, household enterprises. The north mountain region has five firms, all state owned. The south (NES) has proportionately more large scale firms than other areas of the country. The central region has the fewest starch end users in general, and most of these are small producers of noodles and other traditional foods.

Two type of cassava starch were distinguish by the end users: 1st and 2nd class. The highest quality, 1st class starch is used by the pharmaceutical, paper, glucose and MSG industries and is the major type of dry starch used, 2nd class starch is used by sectors where quality is less important (adhesives, plywood). Wet starch is used by traditional small scale processors (noodles and maltose) and by the MSG factory. Very little modified starch was reported in the survey (180 tons total): this was used by the textile and pharmaceutical sectors. Canna starch, both wet and dry, was only used for production of noodles.

Although the noodles sector comprised over 55% of the enterprises surveyed, these only accounted for 1.3% of the cassava starch procured. The single MSG enterprise (VEDAN) accounted for 60.5% of total cassava starch procured, and thus dominates the starch sector of Vietnam. VEDAN purchases both wet and dry starch, influencing both markets. The two glucose producing enterprises procure 7% of cassava starch. Maltose, with 13% of enterprises, procures 14% of starch.

End users were asked for the volumes of starch they procured in 1996, 1997 and for projection for the year 2000. The glucose sector reported the largest expected increase (185%) in starch procured between 1996 and 2000, followed by the pharmaceutical sector (52%) and maltose (35%). The noodles sector (canna starch) was projected to increase by only 21%, and the textiles sector by 9%. It was not possible to obtain a projection for 2000 from the MSG sector.

The prices paid for cassava starch varied according to the end user and by region. The pharmaceutical sector paid the highest prices for 1st class cassava starch (4,000 dong/kg), followed by paper and textiles, with noodles, glucose and maltose paying the lowest price (around 2000 dong/kg). The difference in

price strongly suggests that there is no standardization of quality for "1st class" cassava starch. The pharmaceutical sector has the most stringent quality requirements, and by paying a higher price can obtain starch that meets its needs. The maltose and pharmaceutical industries paid more for starch in the north, than the south of the country in 1997, while textiles and paper paid less in the north than the south.

The relative prices of cassava and canna starches changed between 1996 and 1997. Taking wet cassava price as a standard (price index of 100 in each year), dry cassava was quite consistent over the two years at 199-194, while wet canna starch ranged from 271 in 1996 to only 180 in 1997, and dry canna starch from 392 in 1996 to only 295 in 1997. Modified starch was 10 times the price of wet cassava starch.

Starch users procure their starch from traders and urban wholesalers: direct market links between starch processors and end users are not so common. Most of the starch is sourced locally, although some inter-regional trade was found. Cassava starch from the red river delta region is trucked to south Vietnam.

Color was rated the most important quality characteristic by 87% of enterprises, with only 8% mentioning purity. Quality is rated visually or "by experience" by 94% of enterprises: very few use any laboratory quality control. 67% of enterprises purify starch after purchase, incurring losses of between 0.7 and 3.5% in the process. The fact that firms are accustomed to purification of starch themselves, perhaps explains why purity was not ranked higher as a major quality characteristic.

The problems mentioned by starch using enterprises were concerned with price (of starch and products), supply and quality. The noodles sector was especially concerned about volatility of prices, reflecting the importance of canna starch as a raw material. Noodles and textile firms were also concerned about starch quality, while the MSG, maltose and noodle sectors demonstrated concern over problems with raw material supply availability. The MSG factory specifically referred to seasonality of supply as a constraint.

In conclusion, the expansion of both large and small scale starch using enterprises over the last ten years is clear. The emergence of industries such as MSG and glucose has transformed the way starch is used in Vietnam, as well as increasing the proportion of cassava that is processed into starch. Based on the results of this survey, continued expansion of most of the larger scale sectors is envisaged (although no information could be obtained for the MSG industry), while at the smaller scale noodle enterprises do not expect to expand at the rate of the past, but maltose would appear to have a more positive outlook. One clear area for future research and policy development is in the quality standardization of starch.

6. POLICY OPTIONS FOR STARCH INDUSTRY

INTRODUCTION

The previous chapters have looked at the field evidence concerning the starch subsectors, including processing, marketing, end-users and environmental problems at the community level. The analysis has shown a complex organization of the industry, whereby production of cassava is integrated with end-users through key postharvest activities involving starch processing, storage, marketing, and quality control for both domestic and external trade. All these postharvest activities are located in rural areas and are organized along a continuum of agents including both small, medium, and large enterprises. Starch industry appears to be a good example of rural industrialization whereby low-value agricultural commodities such as cassava and canna are transformed into high-value commodities such as starch thus contributing to income and employment generation in rural areas. Moreover, starch production is responsive to a rapidly growing demand for domestic end-uses and already exhibits potential for exports. Even though the sector is small in relation to rice, livestock, and coffee, it has a high potential in terms of demand growth and income diversification of rural areas, including the less favored ones. We have seen that the emergence of small processors in the rural economy, which started about 10 years ago, was a response to new market opportunities. This represented an income diversification strategy of farmers who are evolving into rural entrepreneurs.

This chapter addresses the policy issues related to the further promotion of the sector. So far, the sector has developed without involvement of the government. Yet, we have highlighted several constraints to the development of the starch

industry that might prevent it from realizing its full potential. The removal of constraints related to the procurement of raw materials, access to credit, product quality improvement, and environmental pollution have been mentioned by the private sector and community leaders as limiting already the growth of this promising sector. Our investigation is only a first attempt at considering policy options that might accelerate growth in a sustainable way.

The chapter is organized into five sections including the introduction. Section 2 discusses some of the key policy issues emerging from the field work. Section 3 presents the methodology used to analyze these policy issues. It consists of simulation of a Starch Industry Model for Viet Nam (SIMV). Section 4 presents the results of the simulation analysis. Section 5 gives the conclusions.

IDENTIFICATION OF KEY POLICY ISSUES

The following sections discuss some of the key policy issues that arise in the promotion of the starch industry in Viet Nam. We discuss three main issues related to low productivity of cassava, low starch quality, and low access to credit for capital investment in the sector. A fourth issue, environmental pollution associated to starch production, has not been considered in the current study because of time constraints to the authors. In spite of its importance, we will have to delay such analysis for the future.

Supply Bottlenecks Arising from Low Cassava Productivity

As in most agrofood processing, the procurement of raw materials is the main component of the cost of production. Cassava is the main source of starch in Viet Nam and cassava production is still characterized by a low level of productivity (at 7.3 tons/ha). The low productivity of cassava is a reflection of the cultivars used and also of poor soil fertility management. Soil fertility can suffer from continued cassava production; this contributes to negative growth of both production and yield. The issue for policy is then to consider investments in research and agricultural extension that contribute to raising the productivity of cassava, thus lowering the cost of raw materials for the starch industry. Whether or not this policy is appropriate depends on the evaluation of the income, production, and price effects of different sectors of the rural economy, including both farmers and processors. It is conceivable, for example, that an increase in yield of cassava that is not accompanied by a simultaneous increase in demand might hurt farmers (through declines in unit fresh root prices) even though it could be beneficial to starch processors and end-users.

The field work with end users of starch (see chapter 5) has shown a dynamic sector that is optimistic about the future potential. This optimism is reflected in the high demand growth expectations of most end users. In fact, if the trends of the past ten years continue, it would appear that, at least in the case of cassava, there is going to be a progressive reallocation of use of production, away from food and toward feed and starch. Increasing domestic demand for starch, however, might be constrained by supply bottlenecks. Increases in productivity could be the solution to the supply bottlenecks by making available larger quantities of raw materials at cheaper prices for processing over a longer time period during the production season.

For the starch sector, productivity is important in terms both of fresh root yield and the yield of starch (or dry matter, as a proxy for starch) per hectare. Increases in fresh root starch content can improve process efficiency, and hence justify a higher price per kilogram of fresh roots to the farmer. New varieties need to offer higher starch content as well as (or even instead of) higher fresh root yield.

Low Quality of Starch

Most starch in Viet Nam is produced for domestic use (about 86 percent). Some dry starch is however exported. The export price is at a large premium relative to domestic price. Starch required by international markets is characterized by demanding quality characteristics for end users. The production of this type of starch depends on a good understanding of international markets and on appropriate technology to purify starch. Information and technology are then the critical factors to improve starch quality. This implies a role for medium and large enterprises who have access to international customers and are able to satisfy their exact specifications. To a certain extent, this situation resembles the evolution of rice exports in Viet Nam. Whereas in the past the rice milling industry in Viet Nam was able to produce and export only low quality rice, over the years the country has improved its processing capacity and the ability to serve a more demanding international clientele. The process has been accompanied by a narrowing of the gap between rice export prices and international prices. A similar process may well take place in the case of the starch industry. The continuum of small, medium, and large enterprises in the starch sector of Viet Nam offers the opportunity of a specialization of different firm sizes for different markets. Small and medium enterprises might increasingly devote themselves to satisfy domestic demand and provide low

quality starch to large enterprises for further purification and quality enhancement in order to comply with international markets requirements. The development of linkages between small and large firms will help to ensure the relevance of starch processing to rural development in Viet Nam.

Limited Access to Credit

The field work reported in chapter 3 has shown a very skewed distribution of assets among different firm sizes. While micro, small and medium enterprises have limited capital, large enterprises are much better endowed. This is particularly true in the case of capital equipment. Moreover, the access of micro and small enterprises to credit in order to finance both capital investment and procurement of raw materials is quite limited. In spite of these constraints, these enterprises use the capital very efficiently. The output-capital ratio of micro and small enterprise, for example, is 9.3 tons of dry starch per million Dong of capital equipment, whereas it is 0.62 tons for large enterprises. One would expect that the same addition of capital results in higher ouput if directed toward small than large enterprises. At the same time, small enterprises are much more polluting than large enterprises so that one should weigh the increase in output against more damage to the environment.

THE MODEL USED FOR POLICY ANALYSIS

The three policy issues outlined in the previous section, namely low productivity of cassava, low quality of starch, and limited access to credit, point to alternative policy options. In the case of low productivity of cassava, a strategy for action could be to promote investment in research and extension that leads to the adoption of higher yield cultivars and improved agronomic techniques that

preserve soil fertility and ensure a more sustainable production. In the case of low quality of starch, alternative strategies might involve the upgrading of processing equipment, a better market information system that allows identifying opportunities in international markets, quality inspection mechanisms that ensure the production of starch with precise specifications, and access to export credit. In the case of limited access to credit, a possible strategy might be to give better incentives to the banking system in order to extend credit to small and medium enterprises.

Whatever the policy option that is chosen to deal with a specific policy issue, it is necessary to evaluate the effects of alternative actions. The evaluation of policy allows the understanding of costs and benefits that are associated to a certain intervention. The effects of policy are those related to income, production, trade, prices. Moreover, these effects have to be disaggregated as much as possible in terms of the groups -farmers, processors, and consumers- that gain or lose from a certain policy action.

In order to understand the various effects of a policy, it is then necessary to trace the links between the decisions of the agents involved in the marketing chain from producers of raw material to end users. The decisions are complex and have to take into account the linkages between domestic and international markets. In the case of cassava, for example, the produce has three main utilizations: food, feed, and starch. In turn, starch has several end uses ranging from the food industry (noodles, maltose, MSG) to pharmaceutical, paper, glucose, and textile industry. Most of the produce is consumed domestically, but in the case of feed and starch some amount is exported. Since the feed and starch trade is not constrained by policy restrictions (as for example is the case of rice export or sugar import), the link between domestic and international

prices is mediated only by transportation and marketing costs. That implies that, for example, an improvement in starch processing resulting in a better quality will be translated into increasing exports rather than in declining domestic starch prices (see later section).

Description of the Model

The model of the starch industry consists of six building blocs (for a more detailed description see Annex 1). Each bloc describes the behavior of agents and markets involved in the sector. The six building blocs are: farm production, food and feed uses of cassava, starch processing, trade, prices, and income. The model describes the behavior of various markets and agents involved in the starch industry only from a national point of view. The regional aspects are not present in this version of the model. As seen in the previous chapters, there are important regional dimensions and characteristics that differentiate the starch industry in the northern and southern parts of the country. Even though we are aware of these differences, we have focused only on the macro-sectoral dimension for two reasons. First, this model is the first attempt at looking at overall policy issues for the starch sector in Viet Nam and we are interested in obtaining some overall conclusions concerning the potential and the constraints needed to accelerate growth of the sector. The extension of the model to the regional dimension would be a theme for further research that will add more precision to the general conclusions derived here. Second, we think that some important characteristics of the starch processing industry such as the size of the enterprises are largely capturing some regional dimensions. In chapter 3, for example, we have seen that most large enterprises are concentrated in the North East South region, and the micro and small enterprises are concentrated

in the Red River Delta. By incorporating these differences in the structure of the processing industry we implicitly take into account of regional features.

Farm production of cassava is the first block of the model and captures the response of farmers to prices and to shift factors that reflect the improvement in yield or in agronomic technologies such as soil fertility management.

Once produced, cassava is then utilized for three main uses: food, feed, and starch. The second block of the model looks at the *food and feed uses*. Food demand is modeled as responsive to prices and to a demand shift which can be interpreted as income. As the demand for cassava has a negative income elasticity (see Goletti and Rich 1998), the demand shift allows studying the effect of growing income on demand of cassava as food. The feed component in this bloc is separated into the demand and the supply side. The demand for feed is responsive to the price of feed and to a shift factor interpreted as the induced demand for feed from growing consumption of pork meat. The supply of feed is responsive both to the input price of cassava and the output price of feed.

The third block of the model, the *starch processing*, is the most complex one, and it constitutes the focal point of the analysis. The starch industry demands cassava as raw material in the production of two main types of starch: wet and dry starch. Moreover, wet starch can be used either as an input to end uses such as noodles production, or as an intermediate input for the production of dry starch. Each type of starch, wet and dry, can be produced by small or large enterprises. The supply of starch by various enterprises is a function of input prices of cassava and wet starch (the latter only in the case of dry starch processors that utilized wet starch as input), output prices of starch, and the capital equipment available. The demand for starch originates from various

domestic end users and from exports. The demand is a function of starch prices, and a shift parameter specific to the end use. Eight end uses have been considered: noodles, maltose, glucose, other food, textile, paper and glue, pharmaceutical, and MSG. Some of these end uses utilize only one type of starch (for example the pharmaceutical industry utilizes only dry starch) or a combination of both dry and wet starch (for example the glucose industry).

The fourth block gives the *trade and balance* relations between supply and demand for cassava, feed, and starch. Trade is assumed to hold only in the case of feed and dry starch. Fresh cassava roots are not internationally traded due to their short shelf life; wet starch trade is marginal.

The fifth block of price relations *links the prices* at different marketing stages (for example farm and retail cassava price) and the domestic and international prices. These linkages take into account the marketing, transportation, and quality margins of the different products.

The last block of the model describes the *income* generated by farmers, feed processors, and starch processors. Income is here simply calculated as a share of the value of production. The starch processors shares are obtained from the field survey of cost of production, reported in chapter 3.

A *baseline solution* of the model is obtained by calibrating the aggregate data, the field data, and the parameters to reproduce the 1998 observations and is reported in table 6.3.1 (see Annex 1 for more details). From the baseline, we observe many interesting details about the cassava and starch subsectors that were obtained from the surveys and other aggregate data. Total income in both sectors is valued at $36.9 million. Of that income, roughly 70 percent ($25.8

million) is earned by cassava farmers. The value-added generated by starch processing represents 18.5 percent of the total income in these sectors, which is equivalent to $6.84 million. The remaining income goes to the feed industry.

SIMULATION OF POLICY OPTIONS

This section presents the results of the simulation of the Starch Industry Model for Viet Nam (SIMV). Each simulation studies the effects of policy options for addressing the policy issues identified in section 2, namely, low cassava productivity and supply bottlenecks, low quality of starch, and credit constraints for capital equipment investment.

Low Cassava Productivity and Supply Bottlenecks

As seen in chapter 2, the trends in cassava production, area, and yield have been negative for the past decade (see Goletti and Rich 1998). The average yield for the country is low at 7.3 tons per hectare. The declining productivity over the last decade is partly the result of poor soil fertility management but the low level of yield is mainly the reflection of low adoption of high yielding varieties. As the share of cassava utilized in starch is about 30 percent and growing, the competitiveness of the industry depends on a stable supply of cassava at low cost. Increase in productivity of cassava can be therefore conceived as a strategy of rural industrialization and not just a strategy to increase farm income and food security. The links between cassava production, processing and international markets introduce new dimensions that cannot be captured from a purely production focus. As markets respond to the increase in yield, prices, and therefore income may adjust in a manner that is not necessarily beneficial to all participants in the sector. To that purpose, we study

here the effects of an increase in cassava yield by 10 percent, from its 1997 values of 7.3 tons/ha to 8 tons per hectare. The various effects are reported in table 6.4.1.

The overall income effect is positive, but small. The sector income increases by 1.84 percent that is $0.68 million. The major gainers are starch processors followed by feed processors. Farmers, on the other hand lose relatively to other groups: their share of total income declines by 3.06 percentage points, while starch processors share of total income increases 8.5 percent to become 20.1 percent. Among starch processors, the big gainer is the dry starch industry with its share of total income raising by 9.7 percent. Wet starch processors share falls slightly to 1.84 percent of total income. Both small and large enterprise gain, since both are involved in dry starch production. Large enterprises gain 9.1 percent while small processors gain 3.1 percent.

Overall cassava production increase by 6.7 percent. Prices of cassava, however declines by a bigger percentage, 7.4 percent, contributing to increase demand for food, but also to a lower income of farmers, albeit the latter declines slightly by 1.28 percent.

As the result of lower cassava price, both feed and starch processors increase their production. In the case of feed, production rises by the a similar amount as cassava production. Prices and domestic consumption of feed do not change, however, as the increase in production of feed is almost completely exported at world related prices. Exports rise by a considerable 17 percent contributing almost an additional $2 million in export revenues. The income of feed processors rises by almost 7 percent.

The starch industry is the major beneficiary of lower cassava prices. The industry, however, is rewarding mostly dry starch processors, as these are the ones who can benefit from access to exports. In spite of lower input prices, wet starch producers loses from a drop of prices of 3.6 percent, partly offset by an increase in production. Total income of wet starch producers declines slightly by 1 percent.

The dry starch industry increases production considerably by 7.6 percent and their income goes up by 11.8 percent. The main reason, as mentioned above, is the boost in exports that increases by more than 47 percent and contributes an additional $3.13 million to export revenues.

In summary, the increase in cassava yield benefits the sector. Cheaper raw material prices stimulate higher production of feed and dry starch; almost the total additional production gets exported. Farmers and wet starch processors lose, even though slightly. Feed processors and dry starch processors are the main beneficiaries of the productivity increase. One should point out that the model separates the functional areas of farming, feed processing, and starch processing. In so far as farmers are also involved in cassava feed and starch processing, they will also greatly benefits from this change in productivity. A simple example would suffice to make this point a little more clear. If a rural household derives its income from cassava farming (20 percent), feed processing (10 percent), dry starch processing (10 percent) and other activities not related to cassava or starch (so that we can assume this other income does not change as a consequence of cassava yield increase), then the change in productivity described here will raise the household income by 1.6 percent (obtained from -.20*1.28+.10*6.94+.10*1.18). The higher is the household income derived from feed and starch activities, the higher is the income benefit.

This suggests that a purely production-focus on rural development will miss the point that the rural economy is a complex one where both agricultural, industrial, and, generally, postharvest activities take place.

Supply Bottlenecks and Higher Demand

The prospects of increasing demand for starch might appear to be a positive development for the industry. The expectation is that this demand might trickle down into higher demand for cassava and therefore a positive effect on farmers and processors. In fact, because of supply bottlenecks the increase in domestic demand for starch can have negative effect, unless a simultaneous increase in productivity at the farm level and at the processing level take place. To illustrate this point, we consider two simulations. First, we study the effect of an increase of demand by starch end users of 10 percent. Then, we consider the same increase in starch demand when also an increase in cassava yield productivity takes place.

The aggregate effect of increase in starch demand is negative, as shown in table 6.4.2. Total income of the sector declines slightly by 1.13 percent. The distribution of gains and losses among various participants shows a strong income gain by wet processor (over 13 percent) and a marginal gain by feed processors (0.38 percent). At the same time, dry starch processors lose considerably (-6.1 percent) and farmers slightly (-0.59 percent).

In order to understand these effects, we have to consider what happens in each market and the linkages between supply and demand by various market participants. Let us start from the wet starch market. The increase in demand will put an upward stimulus on prices, since wet starch is not internationally traded. This will increase production and the induced demand for cassava. In the dry starch market, however, the demand shift will not affect prices, as these are linked to world market. The main effect will be a crowding out of exports (from AD to BC in figure 6.1). But the other important effect is a backward shift

in the supply schedule of dry starch made necessary by higher wet starch prices. Even though this supply backward shift might be small in percentage terms, it is enough to lower the induced demand for cassava, since dry starch processing is the main user of cassava as we have seen in chapter 3. The negative effects on the induced demand for cassava by dry starch industry outweighs the positive effect induced by the wet starch industry. The result is a backward shift in cassava demand schedule that lowers the incentives of farmers to produce and therefore results in lower cassava prices and production. This benefits feed processors and starch producers. The second order positive effect on dry starch supply, however, is not enough to compensate for the first order effect of higher wet starch prices.

How could the potentially increasing demand for starch result in positive benefits for the sector? The answer lies in increasing productivity of cassava production or of starch processing. In the next two sections we will consider improvements in quality of starch and capital equipment. Here, we will consider the joint increase in demand and productivity of cassava.

When the starch demand is occurring simultaneously with increase in productivity of cassava then the resulting lower price of cassava will benefit both wet and dry starch producers. The latter in fact will definitely gain from much lower input price of cassava. Total income of the sector now increases, even though slightly (0.7 percent). Feed processors and starch processors income rises but farmers are penalized by a decline in prices higher than the increase in production induced by higher production of starch.

In summary, unless the increase in domestic demand for starch is accompanied by improvement in supply (of either farm production or processing technology) the potential benefits are going to be either negated or greatly reduced.

Low Starch Quality

Currently, only about 9 percent of dry starch produced in Viet Nam is exported. These exports are valued at about $300 per ton, a much higher price than the domestic price of about $200 per ton. The starch destined to export is of higher quality than the one destined to domestic market and has quality specifications responsive to foreign customers. The improvement of quality of starch produced in Viet Nam will translate in a narrower gap between the average price of domestic starch and the export prices. This margin could undoubtedly benefit the processing industry, but will have other effects as well on farmers and on feed processors. The improvement in quality could be achieved through investment in better processing technology and market information systems. To study the effects of such improvement we consider a model simulation where the export margin is reduced by 10 percent from Dong 1008./kg to Dong 800/kg.

The overall sector income increases by 3.4 percent corresponding to $1.25 million (see table 6.4.3). The income share of starch processors will rise 8.6 percent. Within starch processors, only the income shares of dry starch industry will benefit (9.7 percent) whereas the income share of wet starch industry, farmers, and feed processors will decline. Cassava use destined to dry starch industry increases while cassava destined to other uses declines.

Farmers benefit from the improvement in quality through an increase in production and prices of cassava. Their income rises by 1.78 percent. At the same time, the use of cassava as food falls because of higher price.

Feed processors lose from the increase in the price of cassava, since this is the key input to production. The decline in feed production is directly translated into a decline in exports and results in a loss of income of 1.1 percent for the feed sector.

Wet starch processors gain from this policy from an increase in production engendered by higher demand for wet starch by dry starch processors and higher prices resulting from the increase in demand. The big gainers, however, are dry starch processors. The smaller margin between domestic and export price results in higher domestic prices that stimulate higher production. The increase in production and the simultaneous decline in domestic consumption make more starch available for exports. Almost 31 thousand tons of starch get exported for a value of $9 million.

In summary, quality improvement makes domestic prices of dry starch closer to export prices, This benefits largely processors, but also farmers. The feed sector is penalized, due to higher input prices.

Limited Access to Credit

Both small and large processors have credit constraints that result in low investment in capital equipment required for starch processing. Small processors, in particular, have little recourse to formal credit and mostly rely upon their funds and on relative and friends. The little capital equipment they have, however, is used very efficiently, and has an output-capital ratio higher than large enterprises.

In this simulation we consider three ways to increase capital equipment in the industry. In the first case, we consider an expansion of credit to the sector that leads to a 10 percent increase in the value of the industry capital equipment. This expansion of credit should not be considered as a subsidy. As we will see, the income expansion will be more than sufficient to repay back the loan at market interest. In the second case, we consider the same increase in the industry capital equipment, but obtained through allocation of loans only to small enterprises. As the output-capital ratio is larger for the latter, then we would expect that the same injection of capital will have bigger effects. In the third case, we consider the same injection of capital as in the previous two cases, but the loans are now allocated only to large enterprises.

To give more intuition to our simulations, it is useful to keep in mind that the total capital equipment of the starch processing sector (excluding VEDAN) is valued at around $21 million (see chapter 3), so that a 10 percent increase implies an addition of $ 2.1 million to the total capital base. In the case of capital increase for small enterprises, this will translate partly in an increase in the average capital of each processing unit, and partly in an expansion of the number of small enterprises.

Let us start from the expansion of capital in the processing industry achieved through an equal distribution to small and large enterprises (see table 6.4.4). The overall income effect on the sector is of the order of 1.74 percent, equivalent to the aggregate effect of an increase in cassava productivity. Differently from the productivity case of section 6.4.1, however, farmers income increases because of higher cassava prices induced by demand for starch, even though the increase is a slight amount of 1.41 percent. The increase in cassava prices reduces the income of feed processors mildly. Wet starch processors income is marginally reduced because of lower prices not compensated by higher production. Dry starch processors, on the other hand, benefit because their expanded production, made possible by improved capital equipment, has an export outlet that prevents prices to go down. Over 4.5 thousand additional tons are exported while domestic consumption of dry starch changes only marginally, particularly in those end uses where both dry and wet starch is used simultaneously.

If the effects of increasing capital equipment in a non-biased way are positive on the sector, one has also to remark that they are not huge. Given the general difficulty of ensuring a good recovery rate for investment loans, one might even doubt that this policy is really making a huge difference. The picture, however, is substantially changed when the same total amount of capital increase is obtained by a reallocation to small processors.

In this case, the effects are large. Total income of the sector increases by 10.9 percent, corresponding to $4 million. That implies a repayment possibility of the loans in less than one year.

Even though farmers lose their income shares relatively to processors, their absolute income increases considerably (10.2 percent). This is the result of a boost in cassava production of 2.8 percent and an increase in prices of 7 percent.

The higher prices of cassava penalize feed processors income by 6 percent, whereas wet starch processors income is considerably reduced by 18.6 percent. Interestingly, the loss of industry income is also biased in favor of small processors. While large processors suffer from the higher input prices, small processors can now compensate with higher production made possible by more capital available. The gain of the small processors, however, is much smaller than the loss of the large processors.

In the dry starch industry everybody benefits, but the small ones more than the large ones. Exports now rise by 137 percent to a level of 52 thousand tons generating over $15.6 million.

When the same capital increase is biased toward large enterprises, the effects are similar to the unbiased case, given the dominance of large enterprises in the industry. The main result is that the sector income is not greatly affected (only 1.5 percent).

In summary, the increase in the capital equipment of small processors may achieve considerable improvements of sectoral income, benefitting farmers and boosting exports. The policy has also the effect of reallocating cassava away from food and feed uses to starch uses. More than 35 percent of all cassava is now destined to starch production.

CONCLUSIONS

Starch industry is a good example of rural industrialization where low-value agricultural commodities such as cassava and canna are processed into high-value commodities such as starch to be used in a variety of industries including the food industry (noodles, MSG, maltose) and the non-food industry (paper, pharmaceutical, textile, glucose, adhesive, etc.). Even though the sector is small relatively to rice, livestock, and coffee, it has a high potential in terms of demand growth, poverty reduction, and income diversification of rural areas, particularly the less favored ones.

This chapter addressed the policy issues related to the further promotion of the sector. The analysis of survey data at the enterprise, community, and end-user level has highlighted several constraints that need to be removed if the growth of the sector has to be accelerated. We have focused on some of the key policy issues and proposed a methodology to examine the effects of alternative policy options. The chapter was organized into four parts. First, we identified the key policy issues; second, we presented a methodology to examine the effect of alternative policy options; third, we reported the main findings of the analysis of the effects of alternative policy options analysis.

IDENTIFICATION OF KEY POLICY ISSUES

Issue #1: Low productivity of cassava.

The average of cassava yield in Viet Nam is low (7.3 tons/ha) even though there is large regional variation from 6 tons/ha in the North Mountains and Midlands to over 10 tons/ha in the North East South. The low productivity at the farm level results in high cost of raw materials for the starch industry. Moreover, demand

for starch could be constrained by supply bottlenecks during the procurement season. New varieties of cassava already exist that promise a dramatic increase in productivity and in starch content. These varieties are starting to make an impact in areas of southern Viet Nam associated with the large scale starch producing factories, but this is not yet reflected in agricultural statistics. For example, 25,000 ha of improved varieties was planted in 1996/97[2]. The importance of these varieties lies in their higher starch content as well as the increased fresh root yield that they offer.

Issue#2: Low quality of starch.

Currently, the starch produced in Viet Nam is not of a quality appropriate to meet the specifications required by international markets. Even though about 20 percent of starch produced in Viet Nam is exported, the total quantity is still small. The starch appropriate for exports fetches much higher prices than domestic prices. The increase in quality could benefit the sector, mainly the processing industry but also farmers who will face higher prices for their product.

Issue #3: Lack of access to credit for capital equipment investment

Both large and small enterprises face difficulty in obtaining credit to finance their procurement activities as well as capital investment. The distribution of capital equipment is highly skewed, with small and medium size enterprises having only few hundred dollars value of equipment, and large enterprises several hundred thousand dollars. Yet, the output capital ratio for small enterprises is much higher than for large enterprises. The allocation of investment will have different effects depending on the destination of investment.

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[2]Hoang Kim, personal communication.

The three policy issues, namely low productivity of cassava, low quality of starch, and limited access to credit, point to alternative policy options. In the case of low productivity of cassava, a strategy for action could be to promote investment in research and extension that leads to the adoption of higher yield cultivars with higher starch content and improved agronomic techniques that preserve soil fertility and ensure a more sustainable production. In the case of low quality of starch, alternative strategies might involve the upgrading of processing equipment, a better market information system that allows identifying opportunities in international markets, quality inspection mechanisms that ensure the production of starch with precise specifications, and access to export credit. In the case of limited access to credit, a possible strategy might be to change the current practice of the banking system biased toward large enterprises.

RESULTS OF STARCH INDUSTRY MODEL OF VIET NAM (SIMV)

The results obtained from the model depend on the elasticities assumed for various demand and supply parameters reported in the appendix. Of course, a more complete study should evaluate these parameters more closely and conduct a rigorous sensitive analysis. The conclusions presented here are only suggestive of the likely direction of the effects of various policy options. As such, they should be taken with caution and be tested by further research. The results are summarized in Table 6.5.1.

Effects of Increasing Cassava Productivity

In this case, we are interested in studying the effect of 10 percent increase in cassava yields. The overall income effect of this policy is modest amounting to 1.8 percent of total income. The distribution of gains and losses is, however, interesting. Farmers' income slightly declines by 1.3 percent as the higher production of cassava induces a downward price movement of 7 percent. Cheaper cassava prices are benefitting feed processors that now expand their exports considerably (by 17%) and increase their income by 7 percent. The major gain is for dry starch processors who gain almost 12 percent, mainly due to lower input prices that allow the expansion of production and the exports of starch at export prices. In other words, the link between international and domestic prices in the case of dry starch helps processors to benefit from lower cassava prices. Exports shoot up by almost 47 percent and reach 32.5 thousand tons. The negative effect on farm income has to be qualified, by saying that in so far as farmers are also involved in other postharvest activities such as feed and starch processing, they will benefit from the increase in productivity.

Effects of Increasing Starch Quality

In this case, the margin between export prices and domestic prices is narrowed from an initial value of about 1000 Dong/kg to 900 Dong/kg as the result of higher quality of starch produced in Viet Nam. Overall income of the sector increases by 3.4 percent. This time both farmers and processors gain, the former through higher prices for cassava and the latter through higher prices of starch and increased exports. Dry starch processors income increases by more than 13 percent and exports by almost 41 percent. The only sub-sector that loses is the feed processing sector given the higher cost of raw materials.

Effects of Increasing Capital Equipment

In this case we consider an increase of 10 percent in the availability of credit for capital investment. The analysis considers alternative strategies for investment. One strategy consists in increasing the capital only of large enterprises and another strategy consists in increasing the capital only of small enterprises. When capital is increased only for large enterprises, there are sectoral income benefits but these are not big (only 1.5 percent for the sector as a whole, 1.2 percent increase for farm income, and 4.4 percent increase for the dry processors). When capital is increased only for small enterprises, the benefits are much higher. This is the consequence of a more productive use of capital by the small enterprises (their output-capital ration is more than 10 times than for large enterprises). In fact, the overall sector income rises by almost 11 percent. Farmers benefit greatly from this strategy as well the small processing enterprises.

7. CONCLUSIONS AND IMPLICATIONS FOR POLICY AND RESEARCH

The current study has explored several issues related to the development of the starch sector as a strategy for rural industrialization in Viet Nam. The study has provided several insights and new information about the starch sector and useful lessons for rural development in Viet Nam. This concluding chapter presents the overall conclusions of the study and its implications for policy and research.

MAIN CONCLUSIONS

The previous chapters have described several details of the starch industry in Viet Nam and several conclusions were presented in each chapter. Before summarizing the main conclusions of the study, it would be useful to put the current study within the context of rural development in Viet Nam and similar countries. The major challenge for rural development is to create productive employment in rural areas. The declining GDP share of agriculture implies diminished incentives for the rural population to stay in rural areas unless productive employment is available. Enterprises related to the transformation of food and agricultural commodities have the potential of providing such productive employment. Agro-food processing is labor intensive, generates higher value added than agriculture, and is usually located in rural areas where most of the poor live.

Growth of agriculture in Viet Nam has mainly relied upon rice in the past. Rice will continue to be important in the future because of its role as the main food staple, a major export commodity, and one main source of income for the rural

population. Rice, however, will not have the capacity of accelerating growth particularly now that most of the benefits of liberalization of domestic and international trade have taken place. After rice, maybe only the livestock sector has the broad growth linkages that can sustain overall agricultural growth. But to do that, livestock production will have to become commercialized and therefore will not necessarily be able to absorb a large rural employment. That means that the growth of rural economy will mostly depend on the development of a multitude of non-farm activities. Many of these non-farm activities will still be linked to agricultural production through processing, storage, and transportation. Many of these activities will provide only a fraction of the total employment of large sectors such as rice and livestock, but the income will be much higher. In this respect, the study of starch processing is quite instructive, because it shares many insights that are common to other sub-sectors of the rural non-farm economy and shows where the rural economy of Viet Nam might evolve. The main insights of the analysis could be summarized into four conclusions:

Conclusion #1:

The starch industry is a dynamic sector that has exhibited a strong growth over the past 10 years largely.

Until ten years ago, starch processing was barely ten percent of total use of cassava. From 1988, an increasing number of participants have started to be involved in starch processing, including both rural households and large enterprises. Field data point to about 24 percent of cassava production currently processed into starch. In the case of rural households, micro and small enterprises have emerged from farming activities. In the case of the central parts of the country, starch processing is still a source of income not much more important than other agricultural activities, but in the Red River Delta and in the

North East South is becoming a specialized activity. The opportunities of cassava and canna processing for the local food industry and other non-food uses has induced dramatic increase of investment by small and large enterprises, with an average annual rate of 78 percent over the period 1988 to 1997. Moreover, the new entrants have increased the size of their operations, as shown by an average processing capacity of new entries of less than 10 tons per day before 1994 to an average capacity of almost 60 and 80 tons per day in 1995 and 1997. An additional reason for this strong growth of investment and production is the linkage with world markets. Starch in Viet Nam is already an exportable commodity. During 1998, more than 21,000 tons have been exported to countries such as Singapore, Taiwan, Philippines, Indonesia, and Malaysia. The export prices of starch are much higher than domestic prices, partly reflecting the better quality of exported starch. On average, export prices were almost $300 per ton, to compare to less than $200 per ton for domestic starch.

Conclusion #2:

The starch industry has strong linkages with rural development.

We have found entire communities involved in starch production. Moreover, several other households are involved in starch processing industry such as noodles, maltose, candy, paper, and food. Starch production and processing is becoming a viable entrepreneurial activity for many rural households, contributing overall to more than 55 percent of their income. In the North East South, there is an even higher specialization, with starch related activities providing about 79 percent of total average income. Such employment provides higher income than the average rural activity. The income of rural households engaged in starch processors is more than twice the income of the average rural household ($358 per capita versus $170 per capita).

As with other agrobusiness activities, the link between starch processing and agricultural production is very close, as pointed out by the induced demand for raw material. The greatest beneficiary is cassava production. In our survey, we found that about 24 percent of total cassava production is demanded by starch producers. The greatest share is for dry starch production (18.7 percent of the total). The total starch production (wet and dry) in the survey was found to be 131 thousand tons, corresponding to more than 477 thousand tons of cassava.

Conclusion #3

Future prospects for the sector appear strong as there is a growing domestic demand for starch and increasing opportunities for exports.

The smaller, household level end user enterprises produce traditional products, principally noodles, maltose (for the candy industry) and a type of pancake. The larger enterprises manufacture a range of food and non-food products, including glucose, MSG, paper, plywood, pharmaceuticals and textiles. The most important use of starch in Viet Nam is for fermentation products (including MSG) a sector that is rapidly growing.

End users were asked for the volumes of starch they procured in 1996, 1997 and for projection for the year 2000. The glucose sector reported the largest expected increase (185%) in starch procured between 1996 and 2000, followed by the pharmaceutical sector (52%) and maltose (35%). The noodles sector (canna starch) was projected to increase by only 21%, and the textiles sector by 9%. It was not possible to obtain a specific projection for 2000 from the MSG sector, but the prospect for MSG and in general fermentation products is positive. Not only are domestic demand prospects good, but prospects for exports also appear positive as industrial uses of starch are multiplying rapidly.

The rapid growth of cassava starch exports of neighboring Thailand during the last 5 years offers an indication of a growing market in Asia.

This seems to be supported by other changes that are taking place such as the introduction of better varieties of cassava to lower the cost of production, the improvement of the quality of starch produced in the country through investment in new equipment, and the introduction of quality standards and mechanisms for quality inspection.

Conclusion #4

The growth potential of the sector depends on the resolution of key constrains in raw material productivity, quality and standardization, access to capital for investment, and environmental pollution.

In spite of its dynamism, there are several constraints facing the starch industry that require solution for the sector to accelerate its growth. We focus here on four types of constraints.

First, the high cost of raw material cost contributes to lowering the competitiveness of the industry. Raw material costs represent over 94 percent of total cost of production for the micro enterprises and 86 percent for large enterprises. The high cost is related to the low productivity of cassava, that averages only 7.3 tons/ha in the country, even though there is a huge difference between the yield in the North Mountains and Midlands (6 tons/ha) where most of the production takes place and the yield in the North East South (10.2 tons/ha).

Second, most of the starch produced in Viet Nam is not of a quality appropriate to meet the specifications required by international markets. The higher quality

for exports fetches higher prices than in domestic markets. There is however, a problem also with the absence of grades and standards in domestic markets. What is commonly referred to as "1st class cassava dry starch" includes prices ranges from Dong 1750/kg to Dong 5,200/kg, implying different products. The industry is virtually not producing any modified starch and the assessment of quality is made on the basis of visual inspection rather than laboratory methods.

Third, the low level of technology is reflected in just the barest equipment (graters and pumps) for the majority of small processors. Only large enterprises have access to sedimentation tanks, dryers, and complete starch system. The great majority of the industry is working with locally manufactured equipment, or equipment from Russia and China, of quite low value and inappropriate for producing high quality starch. The access to credit is quite limited for both small and large firms. Large firms have a better access to bank credit, but the large firms are also the ones that express bigger gap between obtained credit and credit requirements (the requirement-obtained credit ratio is almost 7).

Finally, the production of starch is polluting the environment and causing serious problem in water quality at the community level. In the absence of sewage systems and water purification systems, the starch processors have no other choice but to dump the residues and the polluted water into the village street and inadequate sewage system. This is indicated as one of the most serious problems by both households and community leaders. For larger enterprises, the pollution problems are less serious as they are more easily regulated and have invested in water treatment devices.

IMPLICATIONS FOR POLICY

Even though the current study is still preliminary and requires further in-depth study of the key issues for policy, there appears already some tentative implications for policy. We want here highlight four main implications.

Implication #1

There is a need of an integrated strategy involving farm production and postharvest technology. Unless farm productivity increases, there could be supply bottlenecks to the expansion of the starch industry. That implies investment in research and extension activities for increasing yield and starch content of cassava root t the farm level.

Policy analysis conducted through the use of SIMV (starch industry model for Viet Nam) has shown that even modest increases in cassava yield can result in considerable benefits to the starch industry and increase of exports of both cassava feed and starch.

Implication #2

There are important benefits to be reaped from improving quality of starch, mostly deriving from higher prices in international markets. That implies institutional building that promotes the standardization of starch in Viet Nam, quality control, easier access to international markets, and market information systems.

SIMV shows that improvement in starch quality does not only benefit the starch industry through higher prices of starch, but also farmers through higher prices and production of cassava.

Implication #3

The best way to stimulate growth of the sector is to increase the access of credit for capital equipment investment of small and medium scale starch enterprises. That implies a more liberalized financial and banking system, whereby credit is not directed to large enterprises only, but on the basis of market potential.

The same amount of capital increase will have a much larger benefit to the sector and to farmers if the increase takes place through investment in the equipment capital of small and medium enterprises rather than large enterprises. This is mainly the result of a higher output-capital ration of small versus large enterprises. This is not to say that large enterprises are necessarily inefficient. It may be partly related to the fact that cassava harvesting and processing is seasonal, and thus large factories may have low capacity utilization for several months a year. In fact the industrial organization of the starch sector in Viet Nam is very complex and include both very small and very large enterprises, each performing different useful functions. The small enterprises have an advantage in the procurement of raw material and the supervision of labor. The large enterprises have an advantage in the better technology and information about world markets. As in the successful case of rice exports in Viet Nam, small, medium, and large enterprises might be required for the system to work well. The key point here is, therefore, not to advocate the growth of only small enterprises and to redirect credit to them by decree, but rather to allow small, medium, and large enterprises to compete and have access to a credit system that in the past has often been biased in favor of large enterprises.

Implication #4

Starch processing of small and medium enterprises is currently characterized by severe pollution that is harming the environment and the health of entire communities and risks to make future production unsustainable. The current situation will require a combination of approaches including regulation, tax policy, local government initiative, and technological innovation.

IMPLICATIONS FOR RESEARCH

The study has reached some conclusions but it has left many unresolved issues that need to be further researched for improving the design and implementation of policy. The study has also two main limitations. First, the farm production is not studied in detail, so that the decisions of farmers in relation to production and marketing of raw materials for starch processing are not well analyzed. In the design of the project, given the limitation of resources and time, we could not conduct a farmers survey that would have been key to the understanding of farmers decision. Second, the survey work has under-represented the North East South, where we have discovered that a lot of processing, marketing, and end users are located. Again, this limitation is mostly to be attributed to the exiguous resources available.

At the same time, the research has highlighted some key issues that clearly deserve more attention and require a bigger effort in understanding. Five main areas for further research are briefly indicated here.

Development and Adoption of New Cassava Varieties

In the current study, we have shown that increase in yield of cassava, the main raw material for starch production in Viet Nam, is key to the development of the

sector in so far as it lowers the cost of production of starch. At the same time, cassava is still important for food security of mountain people and is a key input to feed (particularly for pig production). The average yield of cassava and sweet potato (another potential raw material for starch) is low, particularly in those regions that contribute the most to total production (such as the North Mountains and Midlands). New high-yield and high starch content varieties of cassava are available from IAS (through collaboration with Thailand and CIAT) that promise high returns and in fact are starting already to be adopted in some parts of Viet Nam (for example in the North East South, there are now farmers that reach 20-25 tons/ha versus an average of 7.3 tons/ha for the country as a whole). The extension of new varieties presents problems related to the adoption of new technology that depends on comparative advantage, on the links with marketing and processing, and impinges upon soil fertility management. The large scale starch industry is, in fact, involved in financing the diffusion of new varieties, as also occurred in Thailand. The complexity of the adoption of new technology results not only from the technical aspects related to the development of appropriate high yielding varieties but also to the economic, institutional, and infrastructure environment in which farmers have to operate. The proposed research activity should look at the following areas:

- availability and suitability of cassava new varieties (yield, starch content, fertility input requirements, extended period of production)
- soil fertility management (as cassava is uprooted, there are considerable soil nutrient losses that need to be replenished to preserve soil fertility)
- contract arrangements between farmers and processors (in order to smooth procurement operations of starch factories over the production period)

Quality Control, Standardization, and Technology

The improvement of starch quality is needed both to meet the requirements of domestic end-users and the requirements of world markets. As of now, there is no standardization of the product. What is called "dry starch of 1st class, for example, hides a huge variation of price and quality. Standardization is key to the quality improvement and has implications for price behavior and technology. Both small and large enterprises can benefit from such standardization, because market niches could be developed and also result in a better industrial organization of the sector. The proposed research activity should look at the following areas:

- creation and use of starch standards
- technology requirements for the production of different standards
- institutional mechanisms to control quality of starch

Environmentally Friendly Processing

We have seen that small scale starch processing is polluting the environment mostly through waste water discharge. Some technological innovations could be introduced to deal with this problem. Even more important the issue of community action at the local level, infrastructure development, and regulations and price policies could be alternative options to deal with processing activities that are sustainable. The proposed research activity should look at the following areas:

- environmental assessment of pollution generated by different industry scales
- alternative responses of communities to the problem and mechanisms to enhance community action on this front

- analysis of costs and benefits of alternative options (regulations, tax policy, community action, technology development)

Growth of Small and Medium Enterprises

The current study has shown the industrial organization of starch industry in Viet Nam and the role played by various enterprise scales. The analysis of policy options has shown that capital investment in small scale industry has strong effects on growth of the sector. The study should be qualified with new information that will come from a better understanding of small scale industry in the North East South; it should also try to understand the constraints to the development of micro and small enterprises into medium enterprises. Capital constraints, access to land for non-farm uses, technology, infrastructure, information are all possible explanation but their relative importance is not yet clear. The proposed research activity should look at the following areas:

- dynamics of enterprise growth (transition from micro to small, medium, large)
- linkages between small and larger scale enterprises (e.g. sale of wet starch for purification) and mechanisms to enhance these linkages
- constraints to growth (credit, technology, land access, etc.)
- evaluation of constraints (which constraint is more important?)

World Markets and Export Opportunities

Starch exports are modest (about 21,000 tons) but already represent about 15 percent of total production of dry starch. Their further growth will partly depend on lower cost of raw material and quality improvement, the two research areas that we have considered above. Starch world markets are however, still little understood. The available information is limited and scattered. The market is

apparently organized around regional areas (Europe, North America, Asia). Barriers to trade might exist under various forms. A study of this market is not available and would certainly benefit a new potential entry like Viet Nam. The proposed research activity should look at the following areas:

- major importers, exporters, trade flows
- qualities and prices
- barriers to trade
- trends
- new emerging uses of starch (fermentation industry, biotechnology, food and non-food industry)

Appendix A: Description of the Model

The model described in the policy options chapter and below is a linear programming model designed to examine the effects of various policies and exogenous shocks on the starch subsector. The following is a list of the endogenous variables in the model. All quantities are denoted in thousand tons:

Variable	**Description**	**Number of Variables**
q_G^s	Total Supply of commodity G	4
q_G^d	Total Demand of commodity G	4
$q^d_{c,G}$	Demand for Cassava by commodity G	4
$q^s_{wet,N}$	Supply of wet starch from group N	2
$q^s_{dry,N}$	Supply of dry starch from group N	2
$q^d_{wet,W}$	Demand for wet starch by enduser W	5
$q^d_{dry,D}$	Demand for dry starch by enduser D	8
p_G^F	Farm Price for commodity G (Dong/kg)	4
p_G^R	Retail Price for commodity G (Dong/kg)	4
X^{feed}	Exports of Feed	1
X^{dry}	Exports of Dry Starch	1
M^{feed}	Imports of Feed	1
M^{dry}	Imports of Dry Starch	1
Y^{farm}	Farm Income (million USD)	1
Y^{feed}	Feed Income (million USD)	1
$Y^{wet, N}$	Wet Starch income for group N (million USD)	2
$Y^{dry, N}$	Dry Starch income for group N (million USD)	2
TOTAL		47

The exogenous variables used in the model are listed below:

Variable	Description
z	Exogenous shift parameters
γ	Conversion rate of the number of cassava roots required to generate one unit of feed or starch
p^x	Export Price (USD/ton)
p^M	Import Price (USD/ton)
MKT	Marketing Margins (Dong/kg)
TC	Transportation Costs (Dong/kg)
NER	Nominal Exchange Rate
$\pi^{G,(N)}$	Profit Share for commodity G (for starch, differs by processor size, N, as well)
θ^N	Initial Proportion of Dry Starch produced by group N

The labels used are defined as follows:

Label	Definition
c	Cassava
food	Cassava as food
feed	Cassava feed
wet	Wet Starch
dry	Dry Starch
G	All Commodities (cassava as food, feed, wet starch, and dry starch)
XG	Exported Commodities (feed and dry starch), a subset of G
N	Size of Processor (small or large)
W	Endusers using wet starch (intermediate uses, noodles, maltose, other food, and glucose)
D	Endusers using dry starch (noodles, maltose, other food, glucose, MSG, pharmaceuticals, textiles, and paper)

The first block of equations describes the cassava market. The supply of cassava roots (equation 1) is simply a function of the farmer price for cassava and exogenous supply shocks, such as technology.

$$\ln(q_c^s) = \alpha_c^s + \beta_{c,c}^s \ \ln(p_c^F) + \ln(z^c) \qquad \textbf{(1)}$$

Since cassava is used as an input for food, feed, and starch, we model each market separately (equations 2 through 5). Cassava demand for food (equation 2) is assumed to be a function of retail cassava prices and exogenous changes in demand. Cassava demand for feed (equation 3) and dry starch (equation 5) is assumed to be the root equivalent of the total supply of feed and starch, respectively. These conversion rates are provided in Table A.1. In the case of wet starch (equation 4), demand for cassava by wet starch is the root equivalent of the net supply of starch. Since a proportion of wet starch is used as an intermediate input in the production of dry starch, we must subtract intermediate uses in order to obtain net demand. Total demand for cassava roots (equation 6) is simply the sum of the demand for cassava from food, feed, and starch.

$$\ln(q_{c,food}^d) = \alpha_{c,food}^d + \beta_{c,food}^d \ \ln(p_c^R) + \ln(z_{food}^d) \qquad \textbf{(2)}$$

$$q_{c,feed}^d = \gamma_{c,feed} \ q_{feed}^s \qquad \textbf{(3)}$$

$$q_c^d = q_{c,food}^d + q_{c,feed}^d + q_{c,wet}^d + q_{c,dry}^d \qquad \textbf{(6)}$$

$$q^{d}_{c,wet} = \gamma_{c,wet} \; (q^{s}_{wet} - q^{d}_{wet,interm}) \qquad \textbf{(4)}$$

$$q^{d}_{c,dry} = \gamma_{c,dry} \; q^{s}_{dry} \qquad \textbf{(5)}$$

The second block of equations models the feed market. Feed demand (equation 7) is a function of retail feed prices and exogenous changes in meat demand. Feed supply (equation 8) depends on input prices (i.e. the retail price of cassava) and output prices (i.e. the producer price for feed).

$$\ln(q^{d}_{feed}) = \alpha^{d}_{feed} + \beta^{d}_{feed,feed} \; \ln(p^{R}_{feed}) + \ln(z^{meat}) \qquad \textbf{(7)}$$

$$\ln(q^{s}_{feed}) = \alpha^{s}_{feed} + \beta^{s}_{feed,c} \; \ln(p^{R}_{c}) \; + \delta^{s}_{feed,feed} \; \ln(p^{F}_{feed}) \qquad \textbf{(8)}$$

The third block of equations focuses on the market for wet starch. The supply of wet starch (equation 9) is differentiated by the size of the processing unit (small or large). While both groups face the same prices, they have different initial endowments of capital and starch. Total supply of wet starch (equation 10) is the sum of small processor supply and large processor supply.

$$\ln(q^{s}_{wet,N}) = \alpha^{s}_{wet,N} + \beta^{s}_{wet,N,c} \; \ln(p^{R}_{c}) + \delta^{s}_{wet,N,wet} \; \ln(p^{F}_{wet}) + \zeta^{S}_{wet,N} \; \ln(K^{N}), \qquad \textbf{(9)}$$

$$q^{s}_{wet} = q^{s}_{wet,small} + q^{s}_{wet,large} \qquad \textbf{(10)}$$

Wet starch demand (equation 11) depends on the various demands by different users of wet starch (e.g. noodle factories, maltose factories). Enduser demand for wet starch is a function of the retail price of wet starch as well as the retail price for dry starch, which can be a substitute for wet starch. Wet starch demand is also affected by exogenous shifts in demand for end-use products, such as noodles or maltose. Total wet starch demand is the sum of wet starch demand by endusers (equation 12).

$$\ln(q^{d}_{wet,W}) = \alpha^{d}_{wet,W} + \beta^{d}_{wet,W,wet}\ \ln(p^{R}_{wet}) + \delta^{d}_{wet,W,dry}\ \ln(p^{R}_{dry}) + \ln(z^{W}), \quad \textbf{(11)}$$

$$q^{d}_{wet} = \sum_{W} q^{d}_{wet,W} \quad \textbf{(12)}$$

The fourth block of equations is for dry starch supply and demand. These are similar to the relationships in wet starch. Dry starch supply is a function of cassava retail prices and the producer price for dry starch as well as the capital endowment for small and large processors (equation 13). Total dry starch supply is the sum of supply from small and large processors (equation 14). Dry starch demand depends on the individual demand from the different endusers for dry starch (equation 15). For noodles, maltose, other food, and glucose, dry starch demand depends on the retail price of both wet and dry starch and on exogenous shocks on those end-products, since both types of starch can be used as in input. For textiles, paper, pharmaceuticals, and MSG, dry starch demand is function of only dry starch price and exogenous shifters. [3] Total dry

[3] In the case of MSG, pharmaceuticals, textiles, and paper, which only use dry starch, we assume that in equation 15, $\beta^{d} = 0$.

starch demand is the sum of the individual enduser demand for dry starch (equation 16).

$$\ln(q^{s}_{dry,N}) = \alpha^{s}_{dry,N} + \beta^{s}_{dry,N,c}\ \ln(p^{R}_{c}) + \delta^{s}_{dry,N,dry}\ \ln(p^{F}_{dry}) + \zeta^{s}_{dry,N}\ \ln(K^{N}), \quad \textbf{(13)}$$

$$q^{s}_{dry} = q^{s}_{dry,small} + q^{s}_{dry,large} \quad \textbf{(14)}$$

$$\ln(q^{d}_{dry,D}) = \alpha^{d}_{dry,D} + \beta^{d}_{dry,D,wet}\ \ln(p^{R}_{wet}) + \delta^{d}_{dry,D,dry}\ \ln(p^{R}_{dry}) + \ln(z^{D}), \quad \textbf{(15)}$$

$$q^{d}_{dry} = \sum_{D} q^{d}_{dry,D} \quad \textbf{(16)}$$

The fifth block summarizes the trade and price relationships within the cassava, feed, and starch markets. Cassava and wet starch are assumed to be non-tradable, so that total supply equals total demand (equations 17 and 19, respectively). Since there are exports of feed and dry starch, we model these markets such that supply equals demand plus net exports (equations 18 and 20).

$$q^{s}_{c} = q^{d}_{c} \quad \textbf{(17)}$$

$$q^{s}_{feed} = q^{d}_{feed} + X^{feed} - M^{feed} \quad \textbf{(18)}$$

$$q^{s}_{wet} = q^{d}_{wet} \quad \textbf{(19)}$$

$$q^{s}_{dry} = q^{d}_{dry} + X^{dry} - M^{dry} \quad \textbf{(20)}$$

Domestic prices (equation 21) are defined such that the difference between retail and farm prices is the marketing margin. In addition, farmer prices plus transportation costs and marketing margins must be at least the level of the export price (equation 22). Similarly, the retail price must be less than or equal to the import price plus any marketing margins and transport costs (equation 23).

$$p_G^R = p_G^F + MKT + TC \tag{21}$$

$$p_{XG}^F + MKT + TC \geq p_{XG}^X \frac{NER}{1000} \tag{22}$$

$$p_{XG}^R \leq (p_{XG}^M \frac{NER}{1000}) + MKT + TC \tag{23}$$

The last block defines income for farmers, feed processors, and starch processors. Farm income (equation 24) is the value, in million US dollars, of cassava at producer prices multiplied by the profit share for cassava farmers (currently set at 0.53). Feed income (equation 25) is the product of the profit share (0.15) for feed processors and the value of feed supply. Since a portion of feed is exported, we value domestic consumption at farmer prices and exports at the world price for feed. Wet starch income (equation 26) is defined as the value of wet starch production for small and large processors, each of whom has a different profit share (0.15 for small processors, 0.24 for large processors). Dry starch income (equation 27) is similar to feed income, in that exports are

valued at the world price while domestic consumption is valued at the producer price. [4]

$$Y^{farm} = p_c^F q_c^s \pi^c / NER \tag{24}$$

$$\begin{aligned} Y^{feed} = & [p_{feed}^F (q_{feed}^s - X^{feed}) \pi^{feed} / NER] \\ & + p_{feed}^X X^{feed} \pi^{feed} / 1000 \end{aligned} \tag{25}$$

$$Y^{wet,N} = p_{wet}^F q_{wet,N}^s \pi^{wet,N} / NER \tag{26}$$

$$\begin{aligned} Y^{dry,N} = & [p_{dry}^F (q_{dry,N}^s - \theta^N X^{dry}) \pi^{dry,N} / NER] \\ & + p_{dry}^X X^{dry} \pi^{dry,N} \theta^N / 1000 \end{aligned} \tag{27}$$

The model is written in GAMS (General Algebraic Modeling System) using mixed complementarity programming (MCP). With MCP, the programmer specifies an equal number of equations and variables. In addition, each inequality of the form $f(x) \geq 0$ is explicitly linked to a complementary variable, λ, such that $\lambda f(x)=0$ (see Rutherford, 1995). Intuitively, when an inequality becomes binding, it effectively increases the number of equations in the system. In order to preserve the balance between the number of equations and the

[4] For this discussion, we have omitted the equations for total starch income, which are simply equations 26 and 27 summed over the group, N.

number of endogenous variables, a new variable must also enter the system by becoming positive. In this model, this only occurs with imports and exports. For example, when the price relationship between the export price and farm price becomes binding (i.e. farm price plus marketing costs equals the export price), an equation for exports (namely, $X > 0$) enters the system, thus allowing for external trade.

The data for the model was obtained from a combination of MARD data, derivations from the processor and enduser questionnaires, and, in the absence of data, assumptions by the authors. The total supply of cassava was obtained from 1997 MARD data. The proportions allocated to food, feed, and starch were derived both from MARD data and information in the processor survey. Feed exports were assumed to be the exports of cassava as given in MARD, since roots are typically not traded internationally. Similarly, the export price for cassava given by MARD was assumed to be the export price for feed. The level of dry starch exports was obtained from the processor survey. End-user demand was computed by taking the share of total demand for each industry from the enduser survey and applying it to the national figures. Retail prices for cassava, wet starch and dry starch and producer prices for wet starch and dry starch were calculated from the processor and enduser survey. The producer price for cassava was assumed to be 50 Dong/kg lower than the retail price. The export price for dry starch was based roughly on the export price reported in the processor survey from processors who export 1st class cassava starch. The level of capital was derived from the processor survey. All of the conversion factors used were also taken from the processor survey.

Table A.2 provides a summary of the elasticities used in the model. The elasticity for capital use by group was estimated econometrically using the

processor survey. Two simple regressions were run. First, only processors who produced dry starch were selected in the sample. This subsample was then divided into small processors and large processors. The following regression was then estimated using OLS.

$$\ln(DS) = \alpha + \beta \ln(TOTINV) \qquad \textbf{(28)}$$

The results are summarized in Tables A.3 and A.4. Both elasticities were highly significant at the 1% level.

All other parameters are based on the authors assumptions.

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Table 2.4.1—Area, yield, and production of roots used in starch production (1997)

Region	Cassava			Sweet Potatoes			Canna		
	Area 000' ha	Yield Quintal/ ha	Production 000' tons	Area 000' ha	Yield Quintal/h a	Production 000' tons	Area ha	Yield Quintal/ ha	Production tons
North Mountains & Mid.	116.6	60.4	704	65.3	54.9	359	153	20	3063
Red River Delta	5.7	86.7	49	55.3	77.3	428	47	19.9	937
North Central Coast	41.8	59.9	251	93.6	51.6	483	-	-	-
South Central Coast	42.3	87.3	369	22.9	52.1	119	-	-	-
Central Highlands	28.7	92.6	266	7.6	65.0	49	-	-	-
North East South	27.7	102.2	283	12.4	58.6	73	-	-	-
Mekong River Delta	7.9	77.2	61	10.3	128.3	132	-	-	-
Viet Nam	270.7	73.3	1983	267.4	61.4	1643	200	-	4000

Source: Ministry of Agriculture and Rural Development

Table 2.4.2—Production trend for cassava

Region	1986-1995			1986-1990			1991-1995		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
NMM	0.7	-2.7	-3.4	-1.6	-2.8	-1.2	-1.4	-8.5	-7.3
RRD	-15.0	-12.9	2.6	-2.3	0.3	2.7	-20.9	-21.5	-0.8
NCC	-2.0	-3.4	-1.4	-4.3	-6.2	-1.9	-1.3	-7.0	-5.7
SCC	-2.1	-3.4	-1.3	-2.8	-4.5	-1.7	-3.2	-7.4	-4.3
CH	3.04	1.3	-2.0	0.3	1.2	0.8	9.4	14.6	4.7
NES	-1.2	0.0	1.2	-17.6	-15.1	3.0	12.5	10.5	-1.8
MRD	-4.1	-4.8	-0.8	-3.3	-3.6	-0.3	-0.3	-3.4	-3.1
Viet Nam	-1.3	-2.5	-1.2	-4.4	-5.2	-0.8	0.2	-2.9	-3.0

Source: Computed by authors based on data from GSO

Table 2.4.3—Production trend for sweet potato

Region	1986-1995			1986-1990			1991-1995		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
NMM	5.9	4.2	-1.6	3.1	2.7	-0.3	-1.2	-7.7	-6.6
RRD	3.2	4.6	1.4	1.4	2.0	0.6	-8.6	-10.1	-1.7
NCC	0.1	-2.2	-2.3	1.0	-4.5	-5.4	-3.7	-5.0	-1.3
SCC	-4.1	-5.4	-1.3	-8.0	-7.5	0.6	-3.7	-5.4	-1.7
CH	-2.1	-4.0	-2.0	-7.9	-4.1	4.1	-3.8	-4.5	-0.7
NES	-8.7	-11.5	-3.1	-7.3	-6.8	0.5	-15.4	-25.7	-12.2
MRD	-6.0	-4.4	1.8	0.5	1.1	0.6	-7.9	-6.2	1.9
Viet Nam	0.6	-0.1	-0.7	-0.6	-1.7	-1.1	-4.7	-7.5	-3.0

Source: Computed by authors based on data from GSO

Table 2.5.1—Percent of Area Producing Root Crops by Region

Region	Cassava Area	Canna Area
RRD	0	6
NCC	24	0
SCC	14	2
CH	64	0

Source: Community Survey

Table 2.5.2—Importance of Starch Activities by Region

Region	% Households Involved in Starch
RRD	28
NCC	6
SCC	8
CH	1

Source: Community Survey

Table 2.5.3—Trends in Community-Level Starch Production

Type of Starch	Increasing Trend	Decreasing Trend
Wet Cassava	21	79
Wet Canna	57	43
1st Class Dry Cassava	50	50
2nd Class Dry Cassava	50	50
Dry Canna	100	0

Source: Community Survey

Table 3.1.1–Distribution of processors in Viet Nam by region

	Number	Percent
NMM	5	1.47
RRD	152	44.84
NCC	51	15.04
SCC	13	3.83
CH	15	4.42
NES	103	30.38

Source: Processor Survey

Table 3.1.2–Distribution of processors in Viet Nam by province

	Number	Percent
Vinh Phu	5	1.47
Ha Tay	91	26.84
Hai Hung	61	17.99
Thanh Hoa	37	10.91
Thua Thien-Hue	14	4.13
Quangnam-Danang	13	3.83
Gia Lai	15	4.42
Dong Nai	50	14.75
Tay Ninh	53	15.63

Source: Processor Survey

Table 3.1.3–Starting year of operation of starch processors by region (% within region)

	NMM	RRD	NCC	SCC	CH	NES	Viet Nam
Before 1988		44.08	29.41	38.46	26.67	35.92	37.76
1988		10.53	11.76	15.38		4.85	8.55
1989		3.29	5.88		6.67	4.85	4.13
1990		25.00	29.41	23.08	20.00	8.74	20.06
1991		2.63			13.33	3.88	2.95
1992		3.29	11.76	23.08	6.67	8.74	7.08
1993		4.61	5.88		6.67	8.74	5.90
1994		1.97	1.96			10.68	4.42
1995		1.97			20.00	4.85	3.24
1996	100.00	2.63				5.83	4.42
1997			1.96			2.91	1.18
1998			1.96				0.29

Source: Processor Survey

Table 3.1.4–Classification of processors by size

	Number	Percent
Less than 1 ton capacity per day	167	49.26
1-5 ton capacity per day	89	26.25
5-10 ton capacity per day	48	14.16
Greater than 10 ton capacity per day	35	10.32
Total	339	100.00

Source: Processor Survey

Table 3.1.5–Classification of processors by size and region

		NMM	RRD	NCC	SCC	CH	NES	Viet Nam
Less than 1 ton capacity per day	Number of Processors		85	37	13	10	22	167
	Percent within region		55.92	72.55	100.00	66.67	21.36	49.26
1-5 ton capacity per day	Number of Processors		65	13		3	8	89
	Percent within region		42.76	25.49		20.00	7.77	26.25
5-10 ton capacity per day	Number of Processors	5	1	1			41	48
	Percent within region	100.00	0.66	1.96			39.81	14.16
Greater than 10 ton capacity per day	Number of Processors		1			2	32	35
	Percent within region		0.66			13.33	31.07	10.32
Total	Number of Processors	5	152	51	13	15	103	339
	Percent within region	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Processor Survey

Table 3.1.6–Classification of processors by size and province

		Vinh Phu	Ha Tay	Hai Hung	Thanh Hoa	Thua Thien-Hue	Quangnam-Danang	Gia Lai	Dong Nai	Tay Ninh	Viet Nam
Less than 1 ton capacity per day	Number of Processors		70	15	36	1	13	10	22		167
	Percent within region		76.92	24.59	97.30	7.14	100.00	66.67	44.00		49.26
1-5 ton capacity per day	Number of Processors		20	45	1	12		3	8		89
	Percent within region		21.98	73.77	2.70	85.71		20.00	16.00		26.25
5-10 ton capacity per day	Number of Processors	5	1			1			12	29	48
	Percent within region	100.00	1.10			7.14			24.00	54.72	14.16
Greater than 10 ton capacity per day	Number of Processors			1				2	8	24	35
	Percent within region			1.64				13.33	16.00	45.28	10.32
Total	Number of Processors	5	91	61	37	14	13	15	50	53	339
	Percent within region	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Processor Survey

Table 3.1.7–Average design capacity by region

	Tons Per Day
NMM	8.00
RRD	1.04
NCC	0.64
SCC	0.50
CH	19.11
NES	15.47
Viet Nam	6.26

Source: Processor Survey

Table 3.1.8–Average workers employed by region

	Number of Workers
NMM	12.00
RRD	3.63
NCC	3.59
SCC	4.23
CH	15.73
NES	9.24
Total	6.01

Source: Processor Survey

Table 3.1.9–Distribution of sources of income by region (% income)

Region	Starch Production in 1997	Starch Production in 1996	Crop Production in 1997	Crop Production in 1996	Livestock Production in 1997	Livestock Production in 1996	Other Starch Related in 1997	Other Starch Related in 1996	Other Non-starch related in 1997	Other Non-starch related in 1996
NMM	42.00	42.00	6.00	6.00	14.00	14.00	14.00	14.00	24.00	24.00
RRD	48.26	51.32	20.14	18.49	22.60	21.81	1.71	1.58	7.29	6.15
NCC	35.29	38.24	39.02	38.43	21.73	18.73	0.63	0.59	3.33	4.02
SCC	43.85	41.54	34.23	34.23	11.54	12.69	0.00	0.00	10.38	11.54
CH	38.33	37.20	51.33	52.33	10.33	10.47	0.00	0.00	0.00	0.00
NES	78.30	75.34	5.15	4.61	13.83	15.78	0.87	0.58	1.84	1.75
Total	54.73	55.51	20.14	19.19	18.71	18.55	1.33	1.18	5.08	4.69

Source: Processor Survey

Table 3.2.1–Average quantity of equipment used by processors

Region	Processor Size	Washers	Graters	Sievers	Sedimentation Tanks	Dryers	Loading Equipment	Milling and Sifting Equipment	Packaging Equipment	Scales	Water Purification Systems	Water Purification Pumps	Stirring Systems	Complete Starch Systems	Motors
NMM	Medium	1.00	1.40	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80	0.00	0.00	0.00
	NMM average	1.00	1.40	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80	0.00	0.00	0.00
RRD	Micro	0.00	0.74	0.00	0.00	0.00	0.00	0.01	0.01	0.04	0.00	0.86	0.09	0.04	0.00
	Small	0.00	0.94	0.02	0.00	0.00	0.00	0.02	0.00	0.02	0.00	1.06	0.08	0.00	0.00
	Medium	0.00	0.00	1.00	0.00	2.00	0.00	1.00	0.00	1.00	0.00	1.00	2.00	0.00	0.00
	Large	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
	RRD average	0.00	0.82	0.01	0.00	0.01	0.00	0.02	0.01	0.03	0.00	0.95	0.10	0.02	0.00
NCC	Micro	0.00	1.00	0.03	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.05	0.00	0.00	0.00
	Small	0.00	1.00	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00
	Medium	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
	NCC average	0.00	1.00	0.27	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.27	0.00	0.00	0.00
SCC	Micro	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00	0.62	0.00	0.00	0.00
	SCC average	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00	0.62	0.00	0.00	0.00
CH	Micro	0.00	1.00	0.30	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.80	0.00	0.00	0.10
	Small	0.00	1.00	0.33	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.67	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
	CH average	0.00	0.87	0.27	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.67	0.00	0.13	0.07
NES	Micro	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	1.14	0.00	0.00	0.00
	Small	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.38	0.00	0.00	0.00
	Medium	0.54	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	1.78	0.00	0.00	0.00
	Large	0.59	0.44	0.13	0.06	0.03	0.00	0.00	0.00	0.53	0.00	1.84	0.00	0.06	0.00
	NES average	0.40	0.64	0.04	0.02	0.01	0.00	0.00	0.00	0.39	0.00	1.63	0.00	0.02	0.00
Viet Nam	Micro	0.00	0.87	0.02	0.00	0.00	0.00	0.01	0.01	0.14	0.00	0.69	0.05	0.02	0.01
	Small	0.00	0.96	0.16	0.00	0.00	0.00	0.01	0.00	0.02	0.00	1.04	0.06	0.00	0.00
	Medium	0.56	0.63	0.21	0.00	0.04	0.00	0.02	0.00	0.44	0.00	1.75	0.04	0.00	0.00
	Large	0.54	0.43	0.11	0.06	0.03	0.00	0.00	0.00	0.49	0.00	1.71	0.00	0.11	0.00
	Viet Nam average	0.14	0.81	0.09	0.01	0.01	0.00	0.01	0.00	0.19	0.00	1.04	0.04	0.02	0.00

Source: Processor Survey

Table 3.2.2–Ownership of equipment by processors (% owned within region)

Region	Processor Size	Washers	Graters	Sievers	Sedimentation Tanks	Dryers	Milling and Sifting Equipment	Packaging Equipment	Scales	Water Purification Pumps	Stirring Systems	Complete Starch Systems	Motors
NMM	Medium	100.00	100.00	100.00						100.00			
RRD	Micro		29.70				0.00	100.00	100.00	100.00	87.50	100.00	
	Small		23.30	100.00			100.00		100.00	100.00	100.00		
	Medium			100.00		100.00	100.00		100.00	100.00	100.00	100.00	
	Large		0.00							100.00			
NCC	Micro		2.70	100.00					100.00	100.00			
	Small		92.30	100.00						100.00			
	Medium		100.00	100.00						100.00			
SCC	Micro		100.00						100.00	100.00			
CH	Micro		100.00	100.00					100.00	100.00			100.00
	Small		100.00	100.00					100.00	100.00			
	Large											100.00	
NES	Micro		54.50						100.00	100.00			
	Small		87.50							100.00			
	Medium	100.00	95.10						100.00	100.00			
	Large	100.00	96.60	100.00	100.00	100.00		100.00	100.00	100.00		100.00	
Viet Nam	Micro		37.70	100.00			0.00	100.00	100.00	100.00	87.50	100.00	100.00
	Small		42.90	100.00			100.00		100.00	100.00	100.00		
	Medium	100.00	95.70	100.00		100.00	100.00		100.00	100.00	100.00	100.00	
	Large	100.00	93.30	100.00	100.00	100.00		100.00	100.00	100.00		100.00	

Source: Processor Survey

Table 3.2.3–Equipment country of origin

Country of Origin	Percentage of Equipment from:											
	Washers	Graters	Sievers	Sedimentation Tanks	Dryers	Milling and Sifting Equipment	Packaging Equipment	Scales	Water Purification Pumps	Stirring Systems	Complete Starch Systems	Motors
Viet Nam	100.00	83.24	96.15	50.00	66.67	100.00	50.00	68.35	13.96	76.92	50.00	0.00
Taiwan	0.00	0.00	3.85	50.00	33.33	0.00	0.00	1.27	0.00	0.00	16.67	0.00
China	0.00	12.14	0.00	0.00	0.00	0.00	50.00	26.58	43.40	7.69	16.67	100.00
USA	0.00	0.58	0.00	0.00	0.00	0.00	0.00	0.00	1.89	0.00	0.00	0.00
Japan	0.00	3.47	0.00	0.00	0.00	0.00	0.00	3.80	0.75	0.00	0.00	0.00
Russia	0.00	0.58	0.00	0.00	0.00	0.00	0.00	0.00	40.00	15.38	0.00	0.00
Thailand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.67	0.00

Source: Processor Survey

Table 3.2.4–Average age of operating equipment (years)

Region	Processor Size	Washer Age	Grater Age	Siever Age	Water Purification Pump Age	Scale Age	Stirring System Age	Complete Starch System Age	Milling and Sifting Equipment Age	Dryer Age	Motor Age	Sedimentation Age	Packaging Equipment Age
NMM	Medium	2.00	2.00	2.00	2.00								
	NMM average	2.00	2.00	2.00	2.00								
RRD	Micro		4.63		6.46	2.00	4.57	7.00					
	Small		6.83	5.00	6.21	18.00	3.00		1.00				
	Medium			10.00	1.00	1.00	1.00	1.00	1.00	1.00			
	Large				6.00								
	RRD average		5.57	7.50	6.26	7.00	3.75	4.00	1.00	1.00			
NCC	Micro		3.00	3.00	3.00								
	Small		3.55	3.55	3.36								
	Medium		5.00	5.00	5.00								
	NCC average		3.62	3.62	3.46								
SCC	Micro		14.00		6.25	14.00							
	SCC average		14.00		6.25	14.00							
CH	Micro		9.50	3.67	4.14	5.50					3.00		
	Small		9.00	3.00	3.00								
	Large							2.00					
	CH average		9.36	3.50	4.00	5.50		2.00			3.00		
NES	Micro		5.38		6.52	8.00							
	Small		4.67		8.13								
	Medium	2.76	8.70		6.41	6.61							
	Large	3.47	7.71	3.00	4.38	4.05		3.00		2.50		2.50	4.00
	NES average	3.10	7.68	3.00	5.97	5.53		3.00		2.50		2.50	4.00
Viet Nam	Micro		7.69	3.50	6.21	8.17	4.57	7.00			3.00		
	Small		5.59	3.62	5.94	18.00	3.00		1.00				
	Medium	2.64	7.98	4.20	5.95	6.41	1.00	1.00	1.00	1.00			
	Large	3.47	7.71	3.00	4.43	4.05		2.33		2.50		2.50	4.00
	Viet Nam average	3.00	7.36	3.67	5.83	5.90	3.75	3.00	1.00	2.00	3.00	2.50	4.00

Source: Processor Survey

Table 3.2.5–Average current value of investment in equipment (1998 thousand dong)

Region	Processor Size	Washers	Graters	Sievers	Sedimentation Tanks	Dryers	Loading Equipment	Milling and Sifting Equipment	Packaging Equipment	Scales	Water Purification Systems	Water Purification Pumps	Stirring Systems	Complete Starch Systems	Motors
NMM	Medium	4705.11	6333.81	3981.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1692.03	0.00	0.00	0.00
	NMM average	4705.11	6333.81	3981.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1692.03	0.00	0.00	0.00
RRD	Micro	0.00	362.55	0.00	0.00	0.00	0.00	0.00	1.12	1.06	0.00	234.42	38.59	34.59	0.00
	Small	0.00	370.77	46.15	0.00	0.00	0.00	29.39	0.00	0.23	0.00	328.68	64.84	0.00	0.00
	Medium	0.00	0.00	14327.96	0.00	85967.78	0.00	4775.99	0.00	286.56	0.00	52535.86	19103.95	19103.95	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	350.00	0.00	0.00	0.00
	RRD average	0.00	361.29	114.00	0.00	565.58	0.00	43.99	0.63	2.58	0.00	619.58	174.99	145.03	0.00
NCC	Micro	0.00	27.03	54.05	0.00	0.00	0.00	0.00	0.00	1.48	0.00	27.03	0.00	0.00	0.00
	Small	0.00	976.92	2076.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1015.38	0.00	0.00	0.00
	Medium	0.00	1000.00	2500.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.00
	NCC average	0.00	288.24	617.65	0.00	0.00	0.00	0.00	0.00	1.08	0.00	298.04	0.00	0.00	0.00
SCC	Micro	0.00	1846.15	0.00	0.00	0.00	0.00	0.00	0.00	206.15	0.00	134.62	0.00	0.00	0.00
	SCC average	0.00	1846.15	0.00	0.00	0.00	0.00	0.00	0.00	206.15	0.00	134.62	0.00	0.00	0.00
CH	Micro	0.00	2040.00	800.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	460.00	0.00	0.00	200.00
	Small	0.00	1566.67	1166.67	0.00	0.00	0.00	0.00	0.00	218.72	0.00	424.80	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	74947430.25	0.00
	CH average	0.00	1673.33	766.67	0.00	0.00	0.00	0.00	0.00	103.74	0.00	391.63	0.00	9992990.70	133.33
NES	Micro	0.00	484.09	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00	522.73	0.00	0.00	0.00
	Small	0.00	600.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	637.50	0.00	0.00	0.00
	Medium	6802.73	6547.94	0.00	0.00	0.00	0.00	0.00	0.00	1204.85	0.00	1842.42	0.00	0.00	0.00
	Large	10275.75	9188.21	398.56	416.01	11093.51	0.00	0.00	83.20	2068.63	0.00	2464.71	0.00	453981.60	0.00
	NES average	5900.35	5611.05	123.82	129.24	3446.53	0.00	0.00	25.85	1126.55	0.00	1660.29	0.00	141042.83	0.00
Viet Nam	Micro	0.00	520.16	59.88	0.00	0.00	0.00	0.00	0.57	24.94	0.00	232.19	19.64	17.61	11.98
	Small	0.00	520.22	376.40	0.00	0.00	0.00	21.47	0.00	7.54	0.00	459.99	47.35	0.00	0.00
	Medium	6300.78	6273.64	765.30	0.00	1791.00	0.00	99.50	0.00	1035.11	0.00	2865.31	398.00	398.00	0.00
	Large	9394.97	8400.65	364.40	380.35	10142.64	0.00	0.00	76.07	1891.32	0.00	2263.45	0.00	4697779.20	0.00
	Viet Nam average	1862.13	2148.45	274.30	39.27	1300.77	0.00	19.72	8.14	356.10	0.00	874.54	78.46	485086.48	5.90

Source: Processor Survey

Table 3.2.6–Total real investment in equipment, 1987-1998 (1998 thousand dong)

Size	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total
Micro	6616	4600	4526	20932	5713	19507	13680	13658	32817	4045	8884	0	134983
Small	2100	1000	108	2506	2370	2058	16240	20303	53964	3257	16660	0	120569
Medium	2200	4000	1800	13500	800	16500	27551	152986	117208	295329	220102	0	851978
Large	1600	2000	20800	35158	7600	74429	92715	595913	156663875	4584796	3436366	0	165515256
Viet Nam	12516	11600	27235	72097	16483	112496	150188	782862	156867866	4887429	3682012	0	166622788

Source: Processor Survey

Table 3.2.7–Average capacity by year of entry

Starting Date of Operation	Average Capacity per Day (tons)
Before 1988	3.47
1988	2.08
1989	3.29
1990	3.23
1991	1.37
1992	2.96
1993	7.63
1994	6.27
1995	56.84
1996	6.45
1997	74.13
1998	0.20
Total	6.26

Source: Processor Survey

Table 3.3.1–Year of investment in assets (% of processors investing in asset)

Year	Transportation	Buildings & Storage	Tanks	Sedimentation	Pipes
Before 1988	19.89	12.41	10.95	15.00	0.00
1988	4.55	3.45	4.98	0.00	33.30
1989	0.57	2.76	2.49	0.00	0.00
1990	40.91	6.90	46.27	5.00	66.70
1991	3.41	2.07	4.98	2.50	0.00
1992	6.82	8.97	7.96	5.00	0.00
1993	6.25	5.52	3.98	7.50	0.00
1994	5.68	8.97	4.98	27.50	0.00
1995	6.82	38.62	5.97	17.50	0.00
1996	3.41	6.90	4.98	12.50	0.00
1997	1.14	3.45	1.49	7.50	0.00
1998	0.57	0.00	1.00	0.00	0.00

Source: Processor Survey

Table 3.3.2–Year of asset purchase by size category (% within asset and size category)

Size	Year	Transportation	Buildings & Storage	Tanks	Sedimentation	Pipes
Micro	Before 1988	27.72	19.51	9.90	100.00	0.00
	1988	3.96	4.88	6.93	0.00	0.00
	1989	0.99	4.88	0.99	0.00	0.00
	1990	27.72	12.20	41.58	0.00	0.00
	1991	2.97	0.00	4.95	0.00	0.00
	1992	6.93	19.51	10.89	0.00	0.00
	1993	6.93	9.76	4.95	0.00	0.00
	1994	7.92	0.00	5.94	0.00	0.00
	1995	7.92	29.27	6.93	0.00	0.00
	1996	3.96	0.00	3.96	0.00	0.00
	1997	1.98	0.00	1.98	0.00	0.00
	1998	0.99	0.00	0.99	0.00	0.00
Small	Before 1988	10.29	8.16	5.63	0.00	0.00
	1988	1.47	2.04	4.23	0.00	0.00
	1989	0.00	2.04	0.00	0.00	0.00
	1990	61.76	2.04	63.38	0.00	0.00
	1991	4.41	0.00	2.82	0.00	0.00
	1992	5.88	2.04	4.23	0.00	0.00
	1993	4.41	2.04	2.82	0.00	0.00
	1994	2.94	2.04	5.63	0.00	0.00
	1995	5.88	77.55	7.04	0.00	0.00
	1996	2.94	0.00	1.41	0.00	0.00
	1997	0.00	2.04	1.41	0.00	0.00
	1998	0.00	0.00	1.41	0.00	0.00
Medium	Before 1988	0.00	13.79	36.84	15.00	0.00
	1988	0.00	3.45	0.00	0.00	50.00
	1989	0.00	0.00	5.26	0.00	0.00
	1990	100.00	3.45	15.79	5.00	50.00
	1991	0.00	3.45	5.26	0.00	0.00
	1992	0.00	3.45	5.26	0.00	0.00
	1993	0.00	3.45	5.26	5.00	0.00
	1994	0.00	24.14	0.00	30.00	0.00
	1995	0.00	10.34	0.00	15.00	0.00
	1996	0.00	31.03	26.32	20.00	0.00
	1997	0.00	3.45	0.00	10.00	0.00
	1998	0.00	0.00	0.00	0.00	0.00
Large	Before 1988	0.00	7.69	10.00	10.53	0.00
	1988	50.00	3.85	0.00	0.00	0.00
	1989	0.00	3.85	30.00	0.00	0.00
	1990	16.67	11.54	30.00	5.26	100.00

Size	Year	Transportation	Buildings & Storage	Tanks	Sedimentation	Pipes
	1991	0.00	7.69	20.00	5.26	0.00
	1992	16.67	11.54	10.00	10.53	0.00
	1993	16.67	7.69	0.00	10.53	0.00
	1994	0.00	19.23	0.00	26.32	0.00
	1995	0.00	11.54	0.00	21.05	0.00
	1996	0.00	3.85	0.00	5.26	0.00
	1997	0.00	11.54	0.00	5.26	0.00
	1998	0.00	0.00	0.00	0.00	0.00

Source: Processor Survey

Table 3.3.3–Types of transportation assets used (% within region and size category)

Size	Type of Transportation	Region			
		RRD	NCC	NES	Viet Nam
Micro	Cart	81.01		100.00	56.03
	Bicycle	16.46	30.56		20.69
	Cart and Bicycle	2.53			1.72
	Cyclo		69.44		21.55
Small	Cart	30.16		100.00	33.82
	Bicycle	66.67			61.76
	Cart and Bicycle	1.59			1.47
	Cyclo		100.00		1.47
	Truck and Motorbike	1.59			1.47
Medium	Cart			100.00	100.00
Large	Cart			60.00	50.00
	Bicycle	100.00			16.67
	Tractor			40.00	33.33
Viet Nam	Cart	58.04		81.82	48.17
	Bicycle	39.16	29.73		35.08
	Cart and Bicycle	2.10			1.57
	Cyclo		70.27		13.61
	Tractor			18.18	1.05
	Truck and Motorbike	0.70			0.52

Source: Processor Survey

Table 3.3.4–Type of building assets used (% within region and size category)

Size	Type of Building	Region			
		NMM	RRD	NCC	NES
Micro	House		83.33	100.00	
	Warehouse		16.67		
Small	Covered Roof		2.22		
	House		91.11	100.00	
	Warehouse		6.67		
Medium	Covered Roof	50.00			
	Warehouse	50.00			100.00
	Workshop		100.00		
Large	House		100.00		
	Warehouse				100.00
Viet Nam	Covered Roof	50.00	1.54		
	House		87.69	100.00	
	Warehouse	50.00	9.23		100.00
	Workshop		1.54		

Source: Processor Survey

Table 3.3.5–Types of tank assets used (% within region and size category)

Size	Type of Tank	Region				Total
		NMM	RRD	NCC	NES	
Micro	Containers		29.63	12.12		24.35
	Tanks		13.58	87.88	100.00	35.65
	Tanks and Containers		56.79			40.00
Small	Containers		13.85		100.00	19.72
	Tanks		60.00	100.00		56.34
	Tanks and Containers		26.15			23.94
Medium	Containers	100.00			85.71	88.89
	Tanks				14.29	11.11
Large	Containers				100.00	88.89
	Tanks		100.00			11.11
Viet Nam	Containers	100.00	22.45	11.76	89.29	30.99
	Tanks		34.69	88.24	10.71	39.44
	Tanks and Containers		42.86			29.58

Source: Processor Survey

Table 3.3.6–Types of sedimentation systems (% within region and size category)

Size	Type of Sedimentation System	Region		Total
		RRD	NES	
Micro	Water Purifying System	100.00		100.00
Medium	Bamboo Sheets		100.00	100.00
Large	Bamboo Sheets		100.00	100.00
Viet Nam	Water Purifying System	100.00		2.63
	Bamboo Sheets		100.00	97.37

Source: Processor Survey

Table 3.3.7–Total Investment in assets and equipment per capita (thousand dong)

Region	Size	Transportation	Buildings and Storage	Tanks	Sedimentation	Pipes	All Equipment
NMM	Medium	0.00	4524.15	5211.82	0.00	0.00	16712.20
	NMM Average	0.00	4524.15	5211.82	0.00	0.00	16712.20
RRD	Micro	208.03	1239.40	879.99	1.76	0.00	653.04
	Small	1372.29	1209.20	1206.21	0.00	0.00	831.37
	Medium	0.00	133727.65	0.00	0.00	0.00	196102.05
	Large	60.00	400.00	600.00	0.00	0.00	350.00
	RRD average	703.56	2092.60	1011.86	0.99	0.00	2013.16
NCC	Micro	13.51	21351.35	126.47	0.00	0.00	109.59
	Small	15.38	1538.46	19.23	0.00	0.00	4069.23
	Medium	0.00	0.00	0.00	0.00	0.00	4500.00
	NCC average	13.73	15882.35	96.65	0.00	0.00	1205.00
SCC	Micro	0.00	0.00	0.00	0.00	0.00	1648.46
	SCC average	0.00	0.00	0.00	0.00	0.00	1648.46
CH	Micro	0.00	0.00	0.00	0.00	0.00	3140.00
	Small	0.00	0.00	0.00	0.00	0.00	2043.52
	Large	0.00	0.00	0.00	0.00	0.00	74947430.25
	CH average	0.00	0.00	0.00	0.00	0.00	9995492.74
NES	Micro	22.73	0.00	18.18	0.00	0.00	1026.82
	Small	287.50	0.00	587.50	0.00	0.00	937.50
	Medium	7.32	376928.01	295.12	7395.81	146.34	13849.16
	Large	187.50	1340758.70	728.85	25483.33	164.04	488126.43
	NES average	88.35	566585.70	393.43	10861.12	109.22	157455.84
Viet Nam	Micro	111.87	5361.37	478.31	0.90	0.00	808.28
	Small	1030.32	1107.84	936.56	0.00	0.00	1354.72
	Medium	6	325216.60	794	6317	125	17749
	Large	173	1225847.95	683	23299	149	4729007
	Viet Nam average	344	175542.84	664	3300	33	491512

Source: Processor Survey

Table 3.3.8–Total real investment in assets, 1987-1998 (1998 thousand dong)

Size	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total
Micro	3150	36804	130809	136170	6489	415172	101665	9629	145845	4931	2746	650	994060
Small	380	23666	20000	66223	5570	10602	5771	26271	110880	1848	2190	250	273651
Medium	1700	12000	1200	69200	31000	42600	25700	15259000	102000	236301	177384	0	15958084
Large	0	21500	16700	453091	25162900	15160240	272500	518304	625856	72386	1451900	0	43755378
Viet Nam	5230	93970	168709	724684	25205959	15628613	405636	15813204	984581	315466	1634220	900	60981172

Source: Processor Survey

Table 3.4.2.1–Average peak and offpeak production days

Region	Size	Wet Cassava Starch		Wet Canna Starch		Dry 1st Class Cassava Starch		Dry 2nd Class Cassava Starch		Dry Canna Starch
		Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak
NMM	Medium	69.20	36.67							
	NMM average	69.20	36.67							
RRD	Micro	125.29	60.91	39.48	25.00	135.77	76.00	122.00	77.50	23.75
	Small	103.50	70.71	41.95	52.50	145.50	25.00	198.67	70.00	16.35
	Medium					50.00	60.00			
	Large			20.00						5.00
	RRD average	121.59	62.25	41.01	43.33	135.41	66.92	150.75	76.00	17.18
NCC	Micro	131.05	51.80							
	Small	104.62	53.85							
	Medium	120.00	90.00							
	NCC average	124.10	53.71							
SCC	Micro	178.40	0.00	137.50	0.00	200.00	0.00			
	SCC average	178.40	0.00	137.50	0.00	200.00	0.00			
CH	Micro	112.50	16.67	83.75	0.00					
	Small	206.67	30.00							
	Large					98.00	45.00			
	CH average	143.89	18.57	83.75	0.00	98.00	45.00			
NES	Micro	43.64	11.25			49.05	13.18			
	Small	60.00				60.00	15.00			
	Medium	88.33	24.00	40.00		108.97	30.00			40.00
	Large	88.33	30.00			151.82	42.50	120.00		
	NES average	76.80	22.50	40.00		100.13	22.76	120.00		40.00
Viet Nam	Micro	123.25	45.96	53.30	6.25	85.57	41.14	122.00	77.50	23.75
	Small	110.17	58.33	41.95	52.50	102.75	17.86	198.67	70.00	16.35
	Medium	85.96	35.56	40.00		107.00	33.00			40.00
	Large	88.33	30.00	20.00		147.33	43.33	120.00		5.00
	Viet Nam average	112.87	46.69	45.23	21.67	108.43	36.00	147.33	76.00	18.17

Source: Processor Survey

Table 3.4.3.1–Average peak and offpeak procurement days

Region	Size	Cassava Roots		Canna Roots		Wet Cassava Starch		Wet Canna Starch
		Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak
NMM	Medium	70.00	36.67					
	NMM average	70.00	36.67					
RRD	Micro	123.98	58.63	39.30	25.00	115.71	60.63	
	Small	98.33	68.33	35.77	42.50	106.25	57.00	10.00
	Medium					50.00	60.00	
	Large			20.00				
	RRD average	120.96	59.30	36.59	36.67	111.00	59.54	10.00
NCC	Micro	121.08	42.15					
	Small	103.08	52.69					
	Medium	120.00	90.00					
	NCC average	116.47	47.59					
SCC	Micro	53.73	0.00	83.00	0.00			
	SCC average	53.73	0.00	83.00	0.00			
CH	Micro	54.00	12.50	19.25	0.00			
	Small	83.33	10.00					
	Large	98.00	57.50					
	CH average	68.67	18.85	19.25	0.00			
NES	Micro	48.57	13.21			60.00	10.00	
	Small	58.13	15.00					
	Medium	107.93	30.00	40.00				
	Large	132.81	32.50			250.00		
	NES average	99.28	21.76	40.00		155.00	10.00	
Viet Nam	Micro	99.57	37.34	39.55	6.25	113.18	57.65	
	Small	88.17	40.40	35.77	42.50	106.25	57.00	10.00
	Medium	104.15	36.15	40.00		50.00	60.00	
	Large	130.70	37.50	20.00		250.00		
	Viet Nam average	103.47	37.79	36.90	18.33	113.75	57.56	10.00

Source: Processor Survey

Table 3.4.4.1–Average peak and offpeak sales days

Region	Size	Wet Cassava Starch		Wet Canna Starch		Dry 1st Class Cassava Starch		Dry 2nd Class Cassava Starch		Dry Canna Starch Peak Sales Days	
		Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
NMM	Medium	20.20	12.25								
	NMM average	20.20	12.25								
RRD	Micro	122.74	60.50	21.89	25.00	47.88	34.21	38.83	13.40	6.00	3.00
	Small	71.67	54.17	29.80	61.25	64.25	56.33	70.00	79.50	29.80	
	Medium					25.00	15.00	10.00	7.00		
	Large			5.00						1.00	
	RRD average	116.96	59.67	27.11	49.17	52.04	36.83	45.30	29.13	24.44	3.00
NCC	Micro	106.89	25.45								
	Small	79.23	40.00								
	Medium	120.00	45.00								
	NCC average	100.10	31.59								
SCC	Micro	56.70	0.00	16.00		50.00	0.00			100.00	0.00
	SCC average	56.70	0.00	16.00		50.00	0.00			100.00	0.00
CH	Micro	34.33	3.67	25.33	0.00					25.00	0.00
	Small	126.67	5.00								
	Large					98.00	60.00				
	CH average	65.11	4.00	25.33	0.00	98.00	60.00			25.00	0.00
NES	Micro	40.00	11.67			49.00	14.00				
	Small	60.00				59.29	15.00	65.00	15.00		
	Medium	82.75	33.33			87.07	36.33			40.00	
	Large	78.75	28.00			126.19	28.75	20.00			
	NES average	71.98	26.79			85.32	26.35	42.50	15.00	40.00	
Viet Nam	Micro	99.61	37.80	22.09	10.00	48.53	24.76	38.83	13.40	20.13	1.50
	Small	80.80	40.71	29.80	61.25	61.93	32.71	68.75	58.00	29.80	
	Medium	72.15	26.73			85.00	35.00	10.00	7.00	40.00	
	Large	78.75	28.00	5.00		123.74	35.00	20.00		1.00	
	Viet Nam average	90.98	36.85	26.87	32.78	77.07	30.31	44.83	27.56	27.06	1.50

Source: Processor Survey

Table 3.5.1–Average cassava starch production

Region	Size	Wet Cassava Starch Production (tons)		Dry 1st Class Cassava Starch Production (tons)		Dry 2nd Class Starch Production (tons)	
		Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
NMM	Medium	235.00	67.50	0.00	0.00	0.00	0.00
	NMM average	235.00	67.50	0.00	0.00	0.00	0.00
RRD	Micro	17.50	6.24	3.14	1.21	1.82	0.64
	Small	11.04	4.22	3.61	0.55	3.58	1.38
	Medium	0.00	0.00	75.00	54.00	37.50	27.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00
	RRD average	14.51	5.29	3.79	1.26	2.79	1.13
NCC	Micro	15.32	3.99	0.00	0.00	0.00	0.00
	Small	42.38	21.15	0.00	0.00	0.00	0.00
	Medium	126.00	16.00	0.00	0.00	0.00	0.00
	NCC average	24.39	8.60	0.00	0.00	0.00	0.00
SCC	Micro	27.30	0.00	1.75	0.00	0.00	0.00
	SCC average	27.30	0.00	1.75	0.00	0.00	0.00
CH	Micro	8.35	1.85	0.00	0.00	0.00	0.00
	Small	54.67	4.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	2450.00	1050.00	0.00	0.00
	CH average	16.50	2.03	326.67	140.00	0.00	0.00
NES	Micro	17.95	1.00	35.91	5.00	0.00	0.00
	Small	19.38	0.00	66.25	5.88	0.00	0.00
	Medium	89.29	2.73	98.41	8.12	0.00	0.00
	Large	157.06	10.00	957.13	5.72	0.31	0.00
	NES average	89.68	4.41	349.35	6.53	0.10	0.00
Viet Nam	Micro	17.29	4.30	6.47	1.27	0.93	0.33
	Small	17.84	6.31	8.59	0.93	2.61	1.01
	Medium	103.38	9.70	85.63	8.06	0.78	0.56
	Large	143.60	9.14	1015.09	65.23	0.29	0.00
	Viet Nam average	42.66	6.09	122.37	8.75	1.28	0.51

Source: Processor Survey

Table 3.5.2–Average canna starch production

Region	Size	Wet Canna Starch Production (tons)		Dry Canna Starch Production (tons)	
		Peak	Offpeak	Peak	Offpeak
NMM	Medium	0.00	0.00	0.00	0.00
	NMM average	0.00	0.00	0.00	0.00
RRD	Micro	1.90	0.12	0.19	0.00
	Small	8.94	0.89	0.89	0.00
	Medium	0.00	0.00	0.00	0.00
	Large	0.80	0.00	0.50	0.00
	RRD average	4.89	0.45	0.49	0.00
NCC	Micro	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00
	NCC average	0.00	0.00	0.00	0.00
SCC	Micro	3.08	0.00	0.00	0.00
	SCC average	3.08	0.00	0.00	0.00
CH	Micro	1.82	0.00	0.30	0.00
	Small	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00
	CH average	1.21	0.00	0.20	0.00
NES	Micro	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00
	Medium	0.20	0.00	0.15	0.00
	Large	0.00	0.00	0.00	0.00
	NES average	0.08	0.00	0.06	0.00
Viet Nam	Micro	1.31	0.06	0.11	0.00
	Small	6.53	0.65	0.65	0.00
	Medium	0.17	0.00	0.13	0.00
	Large	0.02	0.00	0.01	0.00
	Viet Nam average	2.39	0.20	0.25	0.00

Source: Processor Survey

Table 3.6.1–Average cassava root and starch procurement by season

Region	Size	Cassava Roots Procurement (tons)		Wet Cassava Starch Procurement (tons)	
		Peak	Offpeak	Peak	Offpeak
NMM	Medium	548.00	150.00	0.00	0.00
	NMM average	548.00	150.00	0.00	0.00
RRD	Micro	31.06	11.13	11.52	3.25
	Small	4.68	1.58	22.02	6.15
	Medium	0.00	0.00	250.00	180.00
	Large	0.00	0.00	0.00	0.00
	RRD average	19.37	6.90	17.50	5.63
NCC	Micro	38.12	9.38	0.00	0.00
	Small	129.08	60.77	0.00	0.00
	Medium	360.00	45.00	0.00	0.00
	NCC average	67.62	23.18	0.00	0.00
SCC	Micro	85.35	0.00	0.00	0.00
	SCC average	85.35	0.00	0.00	0.00
CH	Micro	25.32	5.00	0.00	0.00
	Small	166.00	10.00	0.00	0.00
	Large	8750.00	3750.00	0.00	0.00
	CH average	1216.75	505.33	0.00	0.00
NES	Micro	191.77	27.27	0.00	0.00
	Small	318.13	38.75	0.00	0.00
	Medium	655.98	25.85	0.00	0.00
	Large	3784.69	56.25	212.50	0.00
	NES average	1502.61	36.60	66.02	0.00
Viet Nam	Micro	57.68	11.64	5.86	1.65
	Small	56.46	13.85	16.08	4.49
	Medium	624.90	38.65	5.21	3.75
	Large	3960.29	265.71	194.29	0.00
	Viet Nam average	540.60	42.27	27.91	2.53

Source: Processor Survey

Table 3.6.2–Average canna starch procurement by season

Region	Size	Canna Root Procurement (tons)		Wet Canna Starch Procurement (tons)	
		Peak	Offpeak	Peak	Offpeak
NMM	Medium	0.00	0.00	0.00	0.00
	NMM average	0.00	0.00	0.00	0.00
RRD	Micro	8.49	0.47	0.14	0.07
	Small	36.37	3.66	0.34	0.00
	Medium	0.00	0.00	0.00	0.00
	Large	8.00	0.00	0.00	0.00
	RRD average	20.36	1.83	0.22	0.04
NCC	Micro	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00
	NCC average	0.00	0.00	0.00	0.00
SCC	Micro	8.00	0.00	0.00	0.00
	SCC average	8.00	0.00	0.00	0.00
CH	Micro	7.61	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00
	CH average	5.07	0.00	0.00	0.00
NES	Micro	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00
	Medium	0.49	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00
	NES average	0.19	0.00	0.00	0.00
Viet Nam	Micro	5.40	0.24	0.07	0.04
	Small	26.56	2.67	0.25	0.00
	Medium	0.42	0.00	0.00	0.00
	Large	0.23	0.00	0.00	0.00
	Viet Nam average	9.72	0.82	0.10	0.02

Source: Processor Survey

Table 3.7.1–Average cassava starch sales by season

Region	Size	Wet Cassava Starch Sales		1st Class Cassava Starch Sales		2nd Class Cassava Starch Sales		Export 1st Class Cassava Starch Sales	
		Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
						(tons)			
NMM	Medium	202.40	100.10	0.00	0.00	0.00	0.00	0.00	0.00
	NMM average	202.40	100.10	0.00	0.00	0.00	0.00	0.00	0.00
RRD	Micro	15.92	5.43	3.91	2.12	2.13	0.70	0.00	0.00
	Small	9.65	4.19	3.77	0.55	2.31	2.18	0.00	0.00
	Medium	0.00	0.00	75.00	54.00	37.50	27.00	10.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RRD average	13.03	4.83	4.29	1.77	2.43	1.50	0.07	0.00
NCC	Micro	15.86	3.99	0.00	0.00	0.00	0.00	0.00	0.00
	Small	42.38	21.15	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	126.00	16.00	0.00	0.00	0.00	0.00	0.00	0.00
	NCC average	24.78	8.60	0.00	0.00	0.00	0.00	0.00	0.00
SCC	Micro	22.45	0.00	1.75	0.00	0.00	0.00	0.00	0.00
	SCC average	22.45	0.00	1.75	0.00	0.00	0.00	0.00	0.00
CH	Micro	8.35	1.85	0.00	0.00	0.00	0.00	0.00	0.00
	Small	54.67	4.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	12.25	0.00	250.00	250.00	0.00	0.00	2200.00	800.00
	CH average	18.13	2.03	33.33	33.33	0.00	0.00	293.33	106.67
NES	Micro	17.95	0.96	36.23	4.68	0.00	0.00	0.00	0.00
	Small	19.38	0.00	66.25	5.88	0.00	0.00	0.00	0.00
	Medium	79.76	3.61	89.15	14.63	0.00	0.00	0.00	0.00
	Large	156.44	10.63	797.25	17.16	0.31	0.00	147.38	0.00
	NES average	85.69	4.94	296.06	12.61	0.10	0.00	45.79	0.00
Viet Nam	Micro	16.23	3.88	6.90	1.69	1.09	0.36	0.00	0.00
	Small	16.83	6.28	8.71	0.93	1.68	1.60	0.00	0.00
	Medium	91.83	13.84	77.71	13.63	0.78	0.56	0.21	0.00
	Large	143.73	9.71	743.20	29.97	0.29	0.00	260.46	45.71
	Viet Nam average	40.26	6.53	93.42	6.10	1.12	0.67	26.92	4.72

Source: Processor Survey

Table 3.7.2–Average canna starch sales by season

Region	Size	Wet Canna Starch Sales		Dry Canna Starch Sales	
		Peak	Offpeak	Peak	Offpeak
		(tons)			
NMM	Medium	0.00	0.00	0.00	0.00
	NMM average	0.00	0.00	0.00	0.00
RRD	Micro	1.68	0.12	0.21	0.03
	Small	7.70	0.89	1.06	0.00
	Medium	0.00	0.00	0.00	0.00
	Large	0.80	0.00	0.50	0.00
	RRD average	4.24	0.45	0.58	0.02
NCC	Micro	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00
	NCC average	0.00	0.00	0.00	0.00
SCC	Micro	0.54	0.00	1.15	0.00
	SCC average	0.54	0.00	1.15	0.00
CH	Micro	1.82	0.00	0.30	0.00
	Small	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00
	CH average	1.21	0.00	0.20	0.00
NES	Micro	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.15	0.00
	Large	0.00	0.00	0.00	0.00
	NES average	0.00	0.00	0.06	0.00
Viet Nam	Micro	1.01	0.06	0.22	0.01
	Small	5.63	0.65	0.78	0.00
	Medium	0.00	0.00	0.13	0.00
	Large	0.02	0.00	0.01	0.00
	Viet Nam average	1.98	0.20	0.33	0.01

Source: Processor Survey

Table 3.8.1.1–Average procurement of cassava for starch by source

Region	Size	Cassava roots from					Wet Cassava Starch from				
		Own Production	Farmers	Traders	Other Enterprises	Other	Own Production	Farmers	Traders	Other Enterprises	Other
						(tons)					
NMM	Medium	0.00	638.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NMM average	0.00	638.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	Micro	0.00	0.00	42.19	0.00	0.00	0.00	1.32	1.97	11.48	0.00
	Small	0.00	0.00	6.26	0.00	0.00	0.00	0.00	9.63	18.54	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	430.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RRD average	0.00	0.00	26.27	0.00	0.00	0.00	0.74	5.22	17.17	0.00
NCC	Micro	0.00	40.99	6.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	194.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	405.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NCC average	0.00	29.74	62.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCC	Micro	4.62	34.73	46.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCC average	4.62	34.73	46.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	Micro	3.00	23.40	3.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	5.00	171.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	12500.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CH average	3.00	1716.47	2.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	Micro	39.77	4.09	175.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	57.50	0.00	299.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	18.54	45.12	617.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	477.81	3359.38	3.75	0.00	0.00	0.00	56.25	156.25	0.00
	NES average	20.34	167.28	1350.33	1.17	0.00	0.00	0.00	17.48	48.54	0.00
Viet Nam	Micro	5.78	13.72	49.81	0.00	0.00	0.00	0.67	1.00	5.84	0.00
	Small	5.34	5.76	59.82	0.00	0.00	0.00	0.00	7.03	13.54	0.00
	Medium	15.83	105.00	542.50	0.00	0.00	0.00	0.00	0.00	8.96	0.00
	Large	0.00	1151.14	3071.43	3.43	0.00	0.00	0.00	51.43	142.86	0.00
	Viet Nam average	6.49	141.99	434.17	0.35	0.00	0.00	0.33	7.65	22.45	0.00

Source: Processor Survey

Table 3.8.1.2–Average procurement of canna by source

Region	Size	Canna Roots from					Wet Canna Starch from				
		Own Production	Farmers	Traders	Other Enterprises	Other	Own Production	Farmers	Traders	Other Enterprises	Other
		(tons)									
NMM	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NMM average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	Micro	3.36	1.25	5.06	0.00	0.00	0.00	0.00	0.00	0.21	0.00
	Small	10.51	3.54	25.68	0.00	0.00	0.11	0.00	4.71	0.23	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RRD average	6.43	2.21	13.81	0.00	0.00	0.05	0.00	2.01	0.22	0.00
NCC	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NCC average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCC	Micro	1.08	6.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCC average	1.08	6.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	Micro	0.92	6.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CH average	0.61	4.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NES average	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Viet Nam	Micro	1.85	1.57	2.57	0.00	0.00	0.00	0.00	0.00	0.11	0.00
	Small	7.68	2.58	18.75	0.00	0.00	0.08	0.00	3.44	0.17	0.00
	Medium	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Viet Nam average	2.95	1.45	6.25	0.00	0.00	0.02	0.00	0.90	0.10	0.00

Source: Processor Survey

Table 3.8.2.1–Average sales of wet cassava starch by destination

Region	Size	Sales of Wet Cassava Starch to:														
		Noodles	Maltose	Traders	Starch Enterprises	Packaging Paper	Paper Mill	Pharmaceutical	Textile	Adhesive	Plywood	Households	Exporters	Food Industry	Cosmetics	Petroleum
									(tons)							
NMM	Medium	0.00	172.90	129.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NMM average	0.00	172.90	129.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	Micro	1.27	12.47	2.70	4.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	4.37	6.16	1.08	0.28	1.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RRD average	2.58	9.61	1.97	2.86	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
NCC	Micro	0.41	0.00	19.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	6.46	0.00	58.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	5.54	0.00	0.00
	Medium	26.00	0.00	100.00	0.00	0.00	0.00	0.00	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NCC average	2.45	0.00	30.95	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.02	0.00	1.41	0.00	0.00
SCC	Micro	0.38	0.00	22.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCC average	0.38	0.00	22.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	Micro	1.10	0.00	10.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	3.33	6.67	48.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	12.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CH average	1.40	1.33	18.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	Micro	12.59	0.00	6.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	3.75	0.00	15.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	16.34	0.00	65.56	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00
	Large	50.94	0.00	114.56	1.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NES average	25.31	0.00	64.26	0.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00
Viet Nam	Micro	2.49	6.34	8.83	2.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	4.58	4.72	12.43	0.20	1.35	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.87	0.00	0.00
	Medium	14.50	18.01	71.58	0.83	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.42	0.00	0.00
	Large	46.57	0.00	105.44	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Viet Nam average	9.29	6.92	28.64	1.55	0.35	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.29	0.00	0.00

Source: Processor Survey

Table 3.8.2.2–Average sales of 1st class cassava starch by destination

Region	Size	Sales of 1st Class Cassava Starch to:															
		Noodles	Maltose	Traders	Starch Enterprises	Packaging Paper	Paper Mill	Pharmaceutical	Textile	Adhesive	Plywood	Households	Exporters	Food Industry	Cosmetics	Petroleum	Other
		(tons)															
NMM	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NMM average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	Micro	0.00	0.00	5.33	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00
	Small	0.00	0.00	2.36	1.06	0.00	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	119.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RRD average	0.00	0.00	3.99	0.85	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00
NCC	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NCC average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCC	Micro	0.00	0.00	1.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCC average	0.00	0.00	1.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2000.00	0.00	0.00	0.00	1500.00
	CH average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	266.67	0.00	0.00	0.00	200.00
NES	Micro	1.82	1.59	33.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00	2.73
	Small	0.00	0.00	72.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	3.54	1.46	87.93	1.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.16	6.56	296.88	2.81	34.06	0.00	0.00	0.63	0.00	0.00	0.47	497.19	87.50	0.00	1.56	23.44
	NES average	1.84	2.96	140.05	1.60	10.58	0.00	0.00	0.19	0.00	0.00	0.15	154.47	27.30	0.00	0.49	7.86
Viet Nam	Micro	0.24	0.21	7.30	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.36
	Small	0.00	0.00	8.21	0.78	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00
	Medium	3.02	1.25	75.10	1.56	0.00	0.00	2.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.14	6.00	271.43	2.57	31.14	0.00	0.00	0.57	0.00	0.00	0.43	568.86	80.00	0.00	1.43	107.14
	Viet Nam average	0.56	0.90	44.41	0.87	3.22	0.00	0.44	0.06	0.00	0.00	0.04	58.73	8.44	0.00	0.15	11.24

Source: Processor Survey

Table 3.8.2.3–Average sales of 2nd class cassava starch by destination

Region	Size	Sales of 2nd Class Cassava Starch to:															
		Noodles	Maltose	Traders	Starch Enterprises	Packaging Paper	Paper Mill	Pharmaceutical	Textile	Adhesive	Plywood	Households	Exporters	Food Industry	Cosmetics	Petroleum	Other
		(tons)															
NMM	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NMM average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	Micro	0.00	0.00	1.46	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.35	0.00	0.00	0.00
	Small	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.57	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.50	0.00	0.00	20.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RRD average	0.00	0.28	0.82	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	1.72	0.00	0.00	0.13
NCC	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NCC average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCC	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCC average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CH average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	Micro	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	7.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	7.19	6.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NES average	0.00	0.00	5.19	2.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Viet Nam	Micro	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.18	0.00	0.00	0.00
	Small	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.88	0.00	0.00	0.00
	Medium	0.00	0.00	6.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.34	0.00	0.00	0.42
	Large	0.00	0.00	6.57	6.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Viet Nam average	0.00	0.12	1.94	0.65	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.77	0.00	0.00	0.06

Source: Processor Survey

Table 3.8.2.4–Average sales of wet canna starch by destination

Region	Size	Sales of Wet Canna Starch to:														
		Noodles	Maltose	Traders	Starch Enterprises	Packaging Paper	Paper Mill	Pharma-ceutical	Textile	Adhesive	Plywood	Households	Exporters	Food Industry	Cosmetics	Petroleum
		(tons)														
NMM	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NMM average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	Micro	1.08	0.00	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	4.36	0.00	1.63	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.83	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RRD average	2.47	0.00	1.10	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.00
NCC	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NCC average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCC	Micro	0.23	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCC average	0.23	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	Micro	1.50	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CH average	1.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NES average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Viet Nam	Micro	0.66	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	3.18	0.00	1.19	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.34	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Viet Nam average	1.16	0.00	0.52	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00

Source: Processor Survey

Table 3.8.2.5–Average sales of dry canna starch by destination

Region	Size	Sales of Dry Canna Starch to:															
		Noodles	Maltose	Traders	Starch Enterprises	Packaging Paper	Paper Mill	Pharma-ceutical	Textile	Adhesive	Plywood	Households	Exporters	Food Industry	Cosmetics	Petroleum	Other
NMM	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NMM average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	Micro	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RRD average	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NCC	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NCC average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCC	Micro	0.46	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCC average	0.46	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	Micro	0.10	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CH average	0.07	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	Micro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NES average	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Viet Nam	Micro	0.04	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Medium	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Large	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Viet Nam average	0.04	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Processor Survey

Table 3.8.2.6–Dry cassava starch exports (tons)

Country of Destination	Exports	Share (%)
Singapore	11036	50
Taiwan	8760	40
Philippines	1000	5
Indonesia	550	3
Malaysia	500	2
Other	110	1
Total	21956	100

Source: Processor Survey

Table 3.9.1–Average procurement price for cassava roots and wet starch by season

Region	Size	Cassava Root Price (Dong/kg)		Wet Cassava Starch Price (Dong/kg)	
		Peak	Offpeak	Peak	Offpeak
NMM	Medium	262.00	266.67		
	NMM average	262.00	266.67		
RRD	Micro	408.44	450.00	1030.00	1193.33
	Small	418.33	453.33	985.71	1191.67
	Medium			1100.00	1200.00
	RRD average	409.61	450.23	1021.43	1193.18
NCC	Micro	266.49	343.00		
	Small	335.38	345.83		
	Medium	345.00	350.00		
	NCC average	285.59	344.24		
SCC	Micro	271.36			
	SCC average	271.36			
CH	Micro	315.00	350.00		
	Small	300.00	350.00		
	Large	310.00	350.00		
	CH average	310.00	350.00		
NES	Micro	329.52	334.52	1200.00	1250.00
	Small	330.00	332.14		
	Medium	370.00	337.22		
	Large	394.52	394.38	1300.00	
	NES average	365.94	345.33	1250.00	1250.00
Viet Nam	Micro	333.63	392.08	1038.10	1196.88
	Small	347.00	355.87	985.71	1191.67
	Medium	357.98	321.92	1100.00	1200.00
	Large	389.39	385.50	1300.00	
	Viet Nam average	348.35	378.15	1036.67	1195.65

Source: Processor Survey

Table 3.9.2–Average procurement prices for cassava roots and wet starch by source

Region	Size	Cassava Roots from				Wet Cassava Starch from		
		Farmers	Traders	Own Production	Other Enterprises	Farmers	Traders	Other Enterprises
					(Dong/kg)			
NMM	Medium	240.00	300.00					
	NMM average	240.00	300.00					
RRD	Micro		421.53			1075.00	1060.00	1098.24
	Small		415.00				1025.00	1033.33
	Medium							1150.00
	RRD average		421.26			1075.00	1046.00	1084.17
NCC	Micro	280.00	322.50					
	Small		337.08					
	Medium		350.00					
	NCC average	280.00	334.56					
SCC	Micro	267.50	280.50					
	SCC average	267.50	280.50					
CH	Micro	315.00	280.00					
	Small	300.00						
	Large	320.00						
	CH average	311.82	280.00					
NES	Micro	322.50	330.00	330.00			1150.00	1100.00
	Small		330.00	330.00				
	Medium	372.78	369.56	330.00				
	Large	398.89	398.71		450.00		1350.00	1300.00
	NES average	385.52	368.66	330.00	450.00		1250.00	1200.00
Viet Nam	Micro	284.68	383.35	330.00		1075.00	1082.50	1098.33
	Small	300.00	341.91	330.00			1025.00	1033.33
	Medium	331.92	367.39	330.00				1150.00
	Large	391.00	398.71		450.00		1350.00	1300.00
	Viet Nam average	318.25	376.78	330.00	450.00	1075.00	1104.29	1093.08

Source: Processor Survey

Table 3.9.3–Average procurement prices for canna roots and wet starch by season

Region	Size	Canna Root Price		Wet Canna Starch Price	
		Peak	Offpeak	Peak	Offpeak
		(Dong/kg)			
RRD	Micro	394.44	540.00		
	Small	423.75	487.50	1300.00	1100.00
	RRD average	413.20	505.00	1300.00	1100.00
SCC	Micro	650.00			
	SCC average	650.00			
CH	Micro	550.00			
	CH average	550.00			
NES	Medium	600.00			
	NES average	600.00			
Viet Nam	Micro	457.14	540.00		
	Small	423.75	487.50	1300.00	1100.00
	Medium	600.00			
	Viet Nam average	444.52	505.00	1300.00	1100.00

Source: Processor Survey

Table 3.9.4–Average procurement price of canna roots and wet starch by source

Region	Size	Canna Roots from		Wet Canna Starch from
		Farmers	Traders	Other Enterprises
			(Dong/kg)	
RRD	Micro	216.67	466.00	1050.00
	Small	300.00	477.71	
	RRD average	264.29	472.83	1050.00
SCC	Micro	575.00		
	SCC average	575.00		
CH	Micro	550.00		
	CH average	550.00		
Viet Nam	Micro	444.44	466.00	1050.00
	Small	300.00	477.71	
	Viet Nam average	400.00	472.83	1050.00

Source: Processor Survey

Table 3.9.5–Average sales prices for wet and dry cassava starch by season

Region	Size	Wet Cassava Starch Price		1st Class Cassava Starch Price		2nd Class Cassava Starch Price		Exported 1st Class Cassava Starch Price	
		Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
					(Dong/kg)				
NMM	Medium	1030.00	1037.50						
	NMM average	1030.00	1037.50						
RRD	Micro	1025.20	1181.03	2350.00	2412.86	1958.33	2260.00		
	Small	1271.00	1400.00	2525.00	2966.67	2200.00	2500.00		
	Medium			5700.00	5700.00	2300.00	2300.00	6500.00	
	RRD average	1062.30	1214.35	2540.00	2687.78	2065.00	2325.00	6500.00	
NCC	Micro	1091.89	1310.00						
	Small	1388.46	1438.46						
	Medium	1500.00	1600.00						
	NCC average	1175.49	1367.65						
SCC	Micro	937.00		3500.00					
	SCC average	937.00		3500.00					
CH	Micro	1015.00	1133.33						
	Small	940.00	980.00						
	Large			2000.00	2000.00			2400.00	2400.00
	CH average	990.00	1095.00	2000.00	2000.00			2400.00	2400.00
NES	Micro	1095.00	1100.00	1515.00	1565.00				
	Small	1100.00		1493.75	1530.00				
	Medium	1128.95	1200.00	1882.76	1930.00				
	Large	1196.88	1220.00	2055.00	2137.50	1600.00		2700.00	
	NES average	1142.71	1192.31	1791.56	1825.00	1600.00		2700.00	
Viet Nam	Micro	1045.78	1216.56	1929.73	2059.58	1958.33	2260.00		
	Small	1271.78	1403.81	2009.38	2068.75	2200.00	2500.00		
	Medium	1124.00	1177.27	2010.00	2165.63	2300.00	2300.00	6500.00	
	Large	1196.88	1220.00	2052.38	2122.22	1600.00		2550.00	2400.00
	Viet Nam average	1105.30	1251.39	1989.90	2100.53	2022.73	2325.00	3340.00	2400.00

Source: Processor Survey

Table 3.9.6–Average wet cassava starch sales price by destination

Region	Size	Wet Cassava Starch Price to:						
		Maltose	Traders	Starch Enterprises	Packaging Paper	Food Industry	Households	Textiles
					(Dong/kg)			
NMM	Medium	1000.00	1050.00					
	NMM average	1000.00	1050.00					
RRD	Micro	1061.76	1200.00	1085.48				
	Small	1250.00	1775.00		1300.00	1250.00		
	RRD average	1072.22	1295.83	1085.48	1300.00	1250.00		
NCC	Micro		1148.65					
	Small		1441.67			1400.00	2400.00	
	Medium		1500.00					1700.00
	NCC average		1226.00			1400.00	2400.00	1700.00
SCC	Micro		1087.00					
	SCC average		1087.00					
CH	Micro		1276.67					
	Small	920.00	930.00					
	CH average	920.00	1161.11					
NES	Micro		1100.00					
	Small		1100.00					
	Medium		1168.75	1300.00		1300.00		
	Large		1241.11	1300.00				
	NES average		1181.72	1300.00		1300.00		
Viet Nam	Micro	1061.76	1157.38	1085.48				
	Small	1140.00	1360.00		1300.00	1350.00	2400.00	
	Medium	1000.00	1173.68	1300.00		1300.00		1700.00
	Large		1241.11	1300.00				
	Viet Nam average	1064.62	1201.25	1104.13	1300.00	1337.50	2400.00	1700.00

Source: Processor Survey

Table 3.9.7–Average dry cassava starch sales prices by destination

Region	Size	1st Class Cassava Sales Price to:												2nd Class Cassava Starch Sales Price to:			
		Traders	Starch Enterprises	Food Industry	Pharma-ceutical	Other	Noodles	Maltose	Packaging Paper	Textiles	House-holds	Exporters	Petro-leum	Traders	Adhesives	Food Industry	Maltose
		(Dong/kg)															
RRD	Micro	2407.69	1850.00	2550.00										1950.00	2200.00	2000.00	
	Small	2480.00	1950.00	2650.00												2050.00	2000.00
	Medium				5700.00											2300.00	
	RRD average	2427.78	1900.00	2600.00	5700.00									1950.00	2200.00	2116.67	2000.00
SCC	Micro	1400.00															
	SCC average	1400.00															
CH	Large					2600.00											
	CH average					2600.00											
NES	Micro	1497.37		1750.00		1900.00	1600.00	1633.33									
	Small	1493.75															
	Medium	1893.75	2333.33				1950.00	1675.00						1800.00			
	Large	2152.38	2425.00	2600.00		2400.00	1650.00	2000.00	2300.00	2800.00	1725.00	2500.00	1850.00				
	NES average	1820.14	2385.71	2316.67		2066.67	1750.00	1750.00	2300.00	2800.00	1725.00	2500.00	1850.00	1800.00			
Viet Nam	Micro	1853.03	1850.00	2150.00		1900.00	1600.00	1633.33						1950.00	2200.00	2000.00	
	Small	1873.08	1950.00	2650.00												2050.00	2000.00
	Medium	1893.75	2333.33		5700.00		1950.00	1675.00						1800.00		2300.00	
	Large	2152.38	2425.00	2600.00		2500.00	1650.00	2000.00	2300.00	2800.00	1725.00	2500.00	1850.00				
	Viet Nam average	1935.71	2209.09	2430.00	5700.00	2200.00	1750.00	1750.00	2300.00	2800.00	1725.00	2500.00	1850.00	1920.00	2200.00	2116.67	2000.00

Source: Processor Survey

Table 3.9.8–Average sales prices of canna starch by season

Region	Size	Wet Canna Starch		Dry Canna Starch	
		Peak	Offpeak	Peak	Offpeak
		(Dong/kg)			
RRD	Micro	1876.19	2250.00	2971.43	2850.00
	Small	1936.36	2375.00	3092.31	
	Large	1800.00		3000.00	
	RRD average	1915.15	2333.33	3064.71	2850.00
SCC	Micro	2500.00		5000.00	
	SCC average	2500.00		5000.00	
CH	Micro	2500.00		5000.00	
	CH average	2500.00		5000.00	
NES	Medium			2700.00	
	NES average			2700.00	
Viet Nam	Micro	1976.00	2250.00	3422.22	2850.00
	Small	1936.36	2375.00	3092.31	
	Medium			2700.00	
	Large	1800.00		3000.00	
	Viet Nam average	1948.57	2333.33	3159.46	2850.00

Source: Processor Survey

Table 3.9.9–Average sales prices of canna starch by destination

Region	Size	Wet Canna Starch to:		Dry Canna Starch to:	
		Traders	Food Industry	Traders	Noodles
		(Dong/kg)			
RRD	Micro	1733.33		2700.00	
	Small	1847.06	2400.00	3015.00	3700.00
	Large	1700.00		3000.00	
	RRD average	1810.00	2400.00	2975.00	3700.00
SCC	Micro	2500.00			
	SCC average	2500.00			
CH	Micro			5000.00	5000.00
	CH average			5000.00	5000.00
Viet Nam	Micro	1781.25		3275.00	5000.00
	Small	1847.06	2400.00	3015.00	3700.00
	Large	1700.00		3000.00	
	Viet Nam average	1823.53	2400.00	3056.00	4350.00

Source: Processor Survey

Table 3.10.1–Transportation usage among processors (% usage by size category)

Size	NMM	RRD	NCC	SCC	CH	NES	Viet Nam
Micro		97.62	97.30		20.00	100.00	85.54
Small		100.00	7.69		33.33	87.50	83.15
Medium	100.00	100.00	100.00			7.50	21.28
Large		100.00			100.00	48.39	52.94

Source: Processor Survey

Table 3.10.2–Most important means of transportation

Means of transportation	Percent
Truck	9.02
Cart	69.26
Bicycle	18.03
Boat	0.41
Other	3.28
Total	100.00

Source: Processor Survey

Table 3.10.3–Most important means of transportation by region and size (% within region and size category)

Size	Transportation	NMM	RRD	NCC	CH	NES	Viet Nam
Micro	Truck		2.44				1.41
	Cart		91.46		100.00	100.00	69.72
	Bicycle		4.88	100.00			28.17
	Other		1.22				0.70
Small	Truck		4.62				4.05
	Cart		86.15		100.00	100.00	86.49
	Bicycle		4.62	100.00			5.41
	Boat		1.54				1.35
	Other		3.08				2.70
Medium	Truck	100.00	100.00			33.33	70.00
	Cart			100.00		33.33	20.00
	Other					33.33	10.00
Large	Truck				100.00	53.33	55.56
	Cart		100.00			20.00	22.22
	Other					26.67	22.22

Source: Processor Survey

Table 3.10.4–Average distance for root procurement by region

Region	Size	Distance (km)
NMM	Medium	20.20
	NMM average	20.20
RRD	Micro	1.18
	Small	0.38
	Large	0.00
	RRD average	0.80
NCC	Micro	24.38
	Small	1.54
	Medium	0.00
	NCC average	18.08
SCC	Micro	0.00
	SCC average	0.00
CH	Micro	0.00
	Small	0.00
	Large	40.00
	CH average	5.33
NES	Micro	0.65
	Small	0.00
	Medium	0.00
	Large	0.00
	NES average	0.13
Viet Nam	Micro	6.80
	Small	0.52
	Medium	2.15
	Large	2.35
	Viet Nam average	3.97

Source: Processor Survey

Table 3.10.5–Average distance for wet starch procurement

Region	Size	Distance (km)
RRD	Micro	0.90
	Small	2.60
	Medium	0.00
	RRD average	1.41
NES	Micro	0.00
	Large	0.00
	NES average	0.00
Viet Nam	Micro	0.86
	Small	2.60
	Medium	0.00
	Large	0.00
	Viet Nam average	1.32

Source: Processor Survey

Table 3.10.6–Average distance for wet starch sales

Region	Size	Distance (km)
NMM	Medium	72.00
	NMM average	72.00
RRD	Micro	0.88
	Small	1.09
	Large	0.00
	RRD average	0.97
NCC	Micro	0.35
	Small	1.15
	Medium	0.00
	NCC average	0.55
SCC	Micro	0.00
	SCC average	0.00
CH	Micro	0.00
	Small	0.00
	CH average	0.00
NES	Micro	0.11
	Small	0.00
	Medium	0.00
	Large	9.43
	NES average	2.83
Viet Nam	Micro	0.53
	Small	1.01
	Medium	13.33
	Large	8.80
	Viet Nam average	2.53

Source: Processor Survey

Table 3.10.7–Average distance for dry starch sales

Region	Size	Distance (km)
RRD	Micro	2.13
	Small	1.53
	Medium	25.00
	Large	0.00
	RRD average	2.00
CH	Large	160.00
	CH average	160.00
NES	Micro	2.20
	Small	0.00
	Medium	0.00
	Large	7.48
	NES average	2.77
Viet Nam	Micro	2.15
	Small	1.33
	Medium	0.89
	Large	13.28
	Viet Nam average	3.31

Source: Processor Survey

Table 3.10.8–Transportation costs by type of transport and region

Transport	Region	Distance purchase-sale	Average weight	Average cost per shipment	Unit cost
		(km)	(tons)	(th Dong)	(th Dong/ton/km)
Truck	NMM	74.00	6.40	660.00	4.24
	RRD	32.50	3.38	102.50	1.52
	CH	150.00	10.00	650.00	0.45
	NES	51.77	7.17	605.56	0.94
	Viet Nam average	57.26	6.85	523.00	1.83
Cart	RRD	4.96	1.02	10.00	2.08
	NCC	20.00	0.60	50.00	4.17
	CH	5.00	2.00	50.00	5.90
	Viet Nam average	5.22	1.06	12.76	2.32
Tractor	RRD	10.00	1.00	41.67	7.28
	Viet Nam average	10.00	1.00	41.67	7.28
Other	NES	113.33	7.50	583.33	1.18
	Viet Nam average	113.33	7.50	583.33	1.18
Total	NMM	74.00	6.40	660.00	4.24
	RRD	7.16	1.16	18.75	2.54
	NCC	20.00	0.60	50.00	4.17
	CH	63.00	5.20	290.00	3.72
	NES	57.21	7.20	600.00	1.00
	Viet Nam average	28.51	3.47	151.72	2.51

Source: Processor Survey

Table 3.10.9–Frequency of restrictions on the movement of goods (% within region replying yes)

Size	Region					Viet Nam
	NMM	RRD	NCC	CH	NES	
Micro		3.66				2.42
Small		9.23				8.11
Medium	100.00					50.00
Large				50.00	6.67	11.11
Total sample						7.10

Source: Processor Survey

Table 3.10.10–Most important type of restriction adversely affecting business

Type of regulation	Frequency	Percent
Police	9	64.29
Food company regulation	1	7.14
Other	4	28.57
Total	14	100.00

Source: Processor Survey

Table 3.10.11–Various transportation details

	Percentage
% Processors with transporter problems	0.00
% Processors who have choice among transporters	98.20
% Processors who negotiate fees	94.70

Source: Processor Survey

Table 3.10.12–Sources of information (% of processors)

	Source of information		
	Price and market	Regulations	Credit
Extension agents	0.30	38.22	0.54
Press	0.00	2.55	0.00
Radio/TV	0.00	1.91	26.49
Intermediaries	1.49	0.00	0.54
Personal contacts	6.55	0.00	8.11
Banks	0.60	0.00	40.54
Starch users	35.71	0.00	0.54
Other starch enterprises	6.25	0.00	0.00
Traders	48.81	0.00	0.54
Other	0.30	57.32	22.70

Source: Processor Survey

Table 3.10.13–Means of communication used by processors (% of processors)

Size	Telephone	Fax	Computer
Micro	0.60	0.00	0.00
Small	4.49	0.00	0.00
Medium	29.79	0.00	0.00
Large	68.57	8.57	5.71

Source: Processor Survey

Table 3.11.1–Percentage of processors using storage facilities (% within region)

Size	Region						Viet Nam
	NMM	RRD	NCC	SCC	CH	NES	
Micro		21.43	56.76			95.45	36.14
Small		27.69	7.69			25.00	23.60
Medium	100.00	100.00				41.46	47.92
Large					100.00	75.00	74.29
Total sample							38.46

Source: Processor Survey

Table 3.11.2–Type of facility used by processors

Facility	Percent
Open air	2.34
Roof covered	29.69
Concrete structure	32.03
Underground	3.91
Other (yard)	28.13
Other (bags)	3.91

Source: Processor Survey

Table 3.11.3–Type of storage used by region and size (% within region)

Size	Type of facility	Region					Viet Nam
		NMM	RRD	NCC	CH	NES	
Micro	Roof covered		16.67	10.00			8.47
	Concrete structure		11.11	5.00		100.00	40.68
	Underground		5.56	5.00			3.39
	Other (yard)		66.67	80.00			47.46
Small	Open air		16.67				14.29
	Roof covered		11.11				9.52
	Concrete structure		16.67			100.00	23.81
	Other (yard)		38.89	100.00			38.10
	Other (bags)		16.67				14.29
Medium	Roof covered					82.35	60.87
	Concrete structure		100.00			17.65	17.39
	Underground	60.00					13.04
	Other (bags)	40.00					8.70
Large	Roof covered					73.91	68.00
	Concrete structure				100.00	26.09	32.00

Source: Processor Survey

Table 3.11.4–Storage capacity by type of facility (quintals)

Region	Size	Type of facility						Total storage
		Open air	Roof covered	Concrete structure	Underground	Other (yard)	Other (bags)	
NMM	Medium				1166.67		200.00	780.00
	NMM average				1166.67		200.00	780.00
RRD	Micro		30.00	125.00	80.00	162.50		131.67
	Small	86.67	525.00	266.67		507.14	16.67	317.22
	Medium			500.00			16.67	500.00
	RRD average	86.67	228.00	258.33	80.00	289.47		231.89
NCC	Micro		40.00	10.00	10.00	135.00		113.00
	Small					40.00		40.00
	NCC average		40.00	10.00	10.00	129.41		109.52
CH	Large			3000.00				3000.00
	CH average			3000.00				3000.00
NES	Micro			100.00				100.00
	Small			100.00				100.00
	Medium		253.57	216.67				247.06
	Large		329.41	14033.33				3904.35
	NES average		295.16	2723.44				1528.57
Viet Nam	Micro		34.00	98.33	45.00	146.79		114.07
	Small	86.67	525.00	200.00		448.75	16.67	283.33
	Medium		253.57	287.50	1166.67		200.00	373.91
	Large		329.41	11275.00				3832.00
	Viet Nam average	86.67	272.89	2310.00	718.00	213.89	90.00	914.69

Source: Processor Survey

Table 3.11.5–Storage details for roots

Region	Size	Average roots stock		Average holding period		Average expected losses	
		Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
		(tons)		(days)		(%)	
NMM	Medium	0.00	0.00				
	NMM average	0.00	0.00				
RRD	Micro	1.72	0.00	2.00		1.00	
	Small	1.36	0.72	3.43	4.00		
	Medium	0.00	0.00				
	RRD average	1.50	0.35	2.71	4.00	1.00	
NCC	Micro	0.05	0.00	1.00			
	Small	0.00	0.00				
	NCC average	0.05	0.00	1.00			
CH	Large	100.00	100.00	2.00	2.00	0.00	0.00
	CH average	100.00	100.00	2.00	2.00	0.00	0.00
NES	Micro	0.00	0.00				
	Small	0.00	0.00				
	Medium	0.00	0.00				
	Large	0.83	0.00	1.00			
	NES average	0.31	0.00	1.00			
Viet Nam	Micro	0.53	0.00	1.88		1.00	
	Small	1.17	0.62	3.43	4.00		
	Medium	0.00	0.00				
	Large	8.46	7.69	1.50	2.00	0.00	0.00
	Viet Nam average	2.13	1.64	2.47	3.33	0.50	0.00

Source: Processor Survey

Table 3.11.6–Storage details of wet starch

Region	Size	Average wet starch stock		Average holding period		Average expected losses	
		Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
		(tons)		(days)		(%)	
NMM	Medium	96.00	59.00	26.60	62.50	0.00	1.33
	NMM average	96.00	59.00	26.60	62.50	0.00	1.33
RRD	Micro	3.85	4.24	27.92	70.33	1.75	2.20
	Small	14.90	6.22	38.50	45.71	3.33	2.67
	Medium	0.00	0.00				
	RRD average	9.12	5.09	33.00	57.08	2.59	2.45
NCC	Micro	0.70	0.83	2.76	4.74	1.24	2.08
	Small	0.60	1.00	10.00	7.00	2.00	
	NCC average	0.70	0.84	3.09	4.85	1.28	2.08
CH	Large	0.00	0.00				
	CH average	0.00	0.00				
NES	Micro	0.00	0.00				
	Small	0.00	0.00				
	Medium	1.76	2.41	11.00	30.00		
	Large	3.75	0.42	11.80	7.00	0.75	1.00
	NES average	1.88	0.80	11.57	18.50	0.75	1.00
Viet Nam	Micro	1.40	1.57	12.38	20.48	1.40	2.11
	Small	12.80	5.38	36.31	40.88	3.20	2.67
	Medium	22.17	14.61	22.14	56.00	0.00	1.33
	Large	3.46	0.38	11.80	7.00	0.75	1.00
	Viet Nam average	7.33	4.25	18.76	28.87	1.67	2.11

Source: Processor Survey

Table 3.11.7–Storage details for dry starch

Region	Size	Average dry starch stock		Average holding period		Average expected losses	
		Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
		(tons)		(days)		(%)	
NMM	Medium	0.00	0.00				
	NMM average	0.00	0.00				
RRD	Micro	2.21	0.81	91.25	31.50	0.50	0.25
	Small	1.43	0.04	20.63	20.00	1.00	0.00
	Medium	3.00	2.00	10.00	30.00	0.00	0.00
	RRD average	1.85	0.46	53.24	29.33	0.55	0.17
NCC	Micro	0.00	0.00				
	Small	0.00	0.00				
	NCC average	0.00	0.00				
CH	Large	125.00	115.00	7.50	13.50	0.00	0.00
	CH average	125.00	115.00	7.50	13.50	0.00	0.00
NES	Micro	0.24	0.00	10.00	0.00	0.00	0.00
	Small	0.00	0.00	10.00	0.00	0.00	0.00
	Medium	10.41	7.65	16.43	85.00	0.22	1.50
	Large	46.25	0.75	20.26	30.00	0.19	2.00
	NES average	20.19	2.31	15.09	13.79	0.10	0.26
Viet Nam	Micro	0.75	0.24	32.41	5.04	0.14	0.04
	Small	1.22	0.03	18.50	6.67	0.50	0.00
	Medium	7.83	5.74	16.00	74.00	0.20	1.00
	Large	52.31	9.54	19.05	21.75	0.17	1.00
	Viet Nam average	12.39	3.04	23.53	16.30	0.18	0.23

Source: Processor Survey

Table 3.12.1–Frequency of processors which borrow money (% within region)

Size	NMM	RRD	NCC	SCC	CH	NES	Viet Nam
Micro		42.86	62.86		20.00	54.55	43.90
Small		21.54			33.33	62.50	22.47
Medium	80.00	100.00	100.00			65.00	68.09
Large					100.00	76.67	75.76
Total Sample							44.74

Source: Processor Survey

Table 3.12.2–Average credit issued by source and size

Source	Size	Amount borrowed (th Dong)	Length of loan (months)	Interest rate per month
Friends and relatives	Micro	583	4.88	0.38
	Small	1500	4.00	1.10
	Medium	3125	9.00	1.53
	Large	1200	10.00	1.60
	Overall average	1355	6.82	1.01
Money lenders	Micro	479	3.75	2.70
	Small	0		
	Medium	468	6.00	3.00
	Large	4400	5.00	1.50
	Overall average	1070	4.43	2.25
Commercial bank	Micro	20	12.00	1.20
	Small	0		
	Medium	10781	6.60	1.19
	Large	64400	5.73	1.24
	Overall average	13130	6.41	1.21
Agricultural bank	Micro	4027	9.03	1.23
	Small	11650	7.06	1.20
	Medium	7031	7.43	1.19
	Large	21960	5.25	1.28
	Overall average	8704	8.15	1.22
Other credit institutions	Micro	27	6.00	0.20
	Small	1750	5.67	1.50
	Medium	0		
	Large	16080	6.00	1.20
	Overall average	2946	5.83	1.18

Source: Processor Survey

Table 3.12.3–Average level of loans from friends and relatives by region

Region	Size	Amount borrowed (th Dong)	Length of loan (months)	Interest rate per month (Dong)
NMM	Medium	7500	5.00	1.00
	NMM average	7500	5.00	1.00
RRD	Micro	555	2.00	1.00
	Small	1428		0.00
	Medium	0		
	RRD average	784	2.00	0.50
NCC	Micro	681	5.40	0.00
	Medium	10000	4.00	1.50
	NCC average	1086	5.17	0.25
CH	Micro	3500	5.00	1.00
	Small	10000	4.00	2.20
	Large	0		
	CH average	3400	4.67	1.40
NES	Micro	0		
	Small	0		
	Medium	2307	12.25	1.80
	Large	1304	10.00	1.60
	NES average	1363	11.80	1.73
Viet Nam	Micro	583	4.88	0.38
	Small	1500	4.00	1.10
	Medium	3125	9.00	1.53
	Large	1200	10.00	1.60
	Viet Nam average	1355	6.82	1.01

Source: Processor Survey

Table 3.12.4–Average level of loans from money lenders by region

Region	Size	Amount borrowed	Length of loan	Interest rate per month
		(thousand Dong)	(months)	(Dong)
NMM	Medium	0		
	NMM average	0		
RRD	Micro	402	3.75	3.00
	Small	0		
	Medium	0		
	RRD average	284	3.75	3.00
NCC	Micro	0		
	Medium	0		
	NCC average	0		
CH	Micro	0		
	Small	0		
	Large	0		
	CH average	0		
NES	Micro	1666		1.50
	Small	0		
	Medium	576	6.00	3.00
	Large	4782	5.00	1.50
	NES average	2196	5.33	1.75
Viet Nam	Micro	479	3.75	2.70
	Small	0		
	Medium	468	6.00	3.00
	Large	4400	5.00	1.50
	Viet Nam average	1070	4.43	2.25

Source: Processor Survey

Table 3.12.5–Average level of loans from commercial banks by region

Region	Size	Amount borrowed	Length of loan	Interest rate per month
		(thousand Dong)	(months)	(Dong)
NMM	Medium	7500	6.00	1.00
	NMM average	7500	6.00	1.00
RRD	Micro	0		
	Small	0		
	Medium	0		
	RRD average	0		
NCC	Micro	68	12.00	1.20
	Medium	0		
	NCC average	65	12.00	1.20
CH	Micro	0		
	Small	0		
	Large	300000	3.00	
	CH average	120000	3.00	
NES	Micro	0		
	Small	0		
	Medium	12115	6.67	1.21
	Large	43913	6.00	1.24
	NES average	20076	6.32	1.23
Viet Nam	Micro	21	12.00	1.20
	Small	0		
	Medium	10781	6.60	1.19
	Large	64400	5.73	1.24
	Viet Nam average	13131	6.41	1.21

Source: Processor Survey

Table 3.12.6–Average level of loans from agricultural banks by region

Region	Size	Amount borrowed	Length of loan	Interest rate per month
		(thousand Dong)	(months)	(Dong)
NMM	Medium	16250	6.00	1.00
	NMM average	16250	6.00	1.00
RRD	Micro	5708	8.73	1.18
	Small	14857	7.92	1.20
	Medium	100000	36.00	1.20
	RRD average	10069	9.14	1.19
NCC	Micro	1341	12.00	1.33
	Medium	0		
	NCC average	1283	12.00	1.33
CH	Micro	0		
	Small	0		
	Large	250000	6.00	1.80
	CH average	100000	6.00	1.80
NES	Micro	4583	5.00	1.20
	Small	5000	5.00	1.20
	Medium	2308	5.09	1.23
	Large	2130	5.14	1.20
	NES average	2864	5.06	1.21
Viet Nam	Micro	4028	9.03	1.23
	Small	11650	7.06	1.20
	Medium	7031	7.43	1.19
	Large	21960	5.25	1.28
	Viet Nam average	8705	8.15	1.22

Source: Processor Survey

Table 3.12.7–Average level of loans from other credit institutions

Region	Size	Amount borrowed	Length of loan	Interest rate per month
		(thousand Dong)	(months)	(Dong)
NMM	Medium	0		
	NMM average	0		
RRD	Micro	56	6.00	0.20
	Small	2500	5.67	1.50
	Medium	0		
	RRD average	725	5.75	1.18
NCC	Micro	0		
	Medium	0		
	NCC average	0		
CH	Micro	0		
	Small	0		
	Large	0		
	CH average	0		
NES	Micro	0		
	Small	0		
	Medium	0		
	Large	17478	6.00	1.20
	NES average	6091	6.00	1.20
Viet Nam	Micro	28	6.00	0.20
	Small	1750	5.67	1.50
	Medium	0		
	Large	16080	6.00	1.20
	Viet Nam average	2946	5.83	1.18

Source: Processor Survey

Table 3.12.8–Sufficiency of funds after borrowing (% within region answering yes)

Size	Region						Total
	NMM	RRD	NCC	SCC	CH	NES	
Micro		63.16	80.77			33.33	62.03
Small		71.43				20.00	52.38
Medium	80.00					37.04	41.18
Large					50.00	64.00	62.96
Total sample							56.50

Source: Processor Survey

Table 3.12.9–Average total credit requirements in peak period

Region	Size	Total credit requirement in peak period	Maximum interest rate per month
NMM	Medium	100,000,000	1.50
	NMM average	100,000,000	1.50
RRD	Micro	10,428,571	1.23
	Small	13,750,000	1.43
	Medium	350,000,000	1.50
	RRD average	29,000,000	1.29
NCC	Micro	3,801,000	1.08
	Small	2,000,000	0.10
	Medium	20,000,000	1.50
	NCC average	5,857,857	1.00
SCC	Micro	3,000,000	1.00
	SCC average	3,000,000	1.00
CH	Micro	7,500,000	1.35
	Small	20,000,000	2.50
	Large	0	0.50
	CH average	8,750,000	1.43
NES	Micro	25,000,000	1.28
	Small	22,500,000	1.20
	Medium	60,000,000	1.25
	Large	823,888,889	1.34
	NES average	229,605,263	1.27
Viet Nam	Micro	12,766,833	1.21
	Small	16,700,000	1.31
	Medium	74,500,000	1.29
	Large	741,500,000	1.26
	Viet Nam average	135,071,500	1.26

Source: Processor Survey

Table 3.12.10–Most important reason for inability to obtain more funds

Reason	Percent
No collateral	50.77
Difficulty with bank	38.46
Lack of connections	1.54
Interest rate too high	7.69
Other	1.54

Source: Processor Survey

Table 3.12.11–Sales on consignment (% within region)

Size	NMM	RRD	NCC	SCC	CH	NES	Viet Nam
Micro		80.00	100.00	92.31	90.00	90.91	87.43
Small		89.23	100.00		100.00	75.00	89.89
Medium	60.00	100.00	100.00			50.00	53.19
Large		100.00				78.13	74.29
Total sample							82.00

Source: Processor Survey

Table 3.12.12–Advance payment for raw materials (% within region)

Size	NMM	RRD	NCC	SCC	CH	NES	Viet Nam
Micro		3.53				45.45	7.78
Small		9.23				100.00	15.73
Medium		100.00				32.50	29.79
Large						43.75	40.00
Total sample							16.30

Source: Processor Survey

Table 3.13.1–Average employment of family and hired labor by processors

Region	Size	Number of own workers		Number of hired male workers				Number of female hired workers			
		Peak	Offpeak	Peak	Avg daily wage peak	Offpeak	Avg daily wage offpeak	Peak	Avg daily wage peak	Offpeak	Avg daily wage offpeak
					(Dong)		(Dong)		(Dong)		(Dong)
NMM	Medium	2.60	0.80	4.80	17250.00	2.60	12000.00	4.60	14666.67	4.20	12000.00
	NMM average	2.60	0.80	4.80	17250.00	2.60	12000.00	4.60	14666.67	4.20	12000.00
RRD	Micro	6.14	1.52	0.07	9750.00	0.00		0.33	10222.22	0.00	
	Small	2.68	0.43	0.37	10363.64	0.06	11000.00	0.75	10800.00	0.02	10000.00
	Medium	2.00	0.00	10.00		10.00		0.00		0.00	
	Large	2.00	0.00	0.00		0.00		0.00		0.00	
	RRD average	4.61	1.03	0.26	10200.00	0.09	11000.00	0.51	10647.06	0.01	10000.00
NCC	Micro	3.41	2.14	0.03	20000.00	0.03	20000.00	0.27	8833.33	0.27	7500.00
	Small	2.15	2.15	0.54	20000.00	0.54	20000.00	0.54	20000.00	0.54	20000.00
	Medium	2.00	2.00	1.00	25000.00	1.00	20000.00	1.00	25000.00	1.00	20000.00
	NCC average	3.06	2.14	0.18	20555.56	0.18	20000.00	0.35	15571.43	0.35	14642.86
SCC	Micro	4.15	0.31	0.00		0.00		0.00		0.00	
	SCC average	4.15	0.31	0.00		0.00		0.00		0.00	
CH	Micro	2.80	0.50	0.30	20000.00	0.30	20000.00	0.30	20000.00	0.30	20000.00
	Small	4.33	1.00	0.67	20000.00	0.67	20000.00	0.67	20000.00	0.67	20000.00
	Large	92.50	92.50	10.00	15000.00	0.00		7.50	15000.00	0.00	
	CH average	15.07	12.87	1.67	19000.00	0.33	20000.00	1.33	19000.00	0.33	20000.00
NES	Micro	4.50	2.09	0.14	15000.00	0.05	15000.00	0.00		0.00	
	Small	5.13	3.13	0.00		0.00		0.00		0.00	
	Medium	3.46	1.02	2.46	16535.71	0.00		0.54	16250.00	0.00	
	Large	2.56	0.81	12.44	18800.00	0.06	15000.00	1.66	21571.43	0.00	
	NES average	3.53	1.35	4.87	17555.56	0.03	15000.00	0.73	18733.33	0.00	
Viet Nam	Micro	4.96	1.57	0.08	14888.89	0.03	19000.00	0.25	11388.89	0.08	11666.67
	Small	2.88	0.94	0.37	14421.05	0.15	18200.00	0.65	13030.30	0.11	18888.89
	Medium	3.31	1.00	2.83	16878.79	0.50	14666.67	0.96	16583.33	0.46	14666.67
	Large	7.69	6.03	11.94	18653.85	0.06	15000.00	1.94	20750.00	0.00	
	Viet Nam average	4.46	1.79	1.77	16666.67	0.13	17684.21	0.63	14084.51	0.13	15190.48

Source: Processor Survey

Table 3.13.2–Average costs of production for processors (thousand dong)

Region	Size	Transport-ation cost	Truck loading fee	Hired labor cost	Communi-cation costs	Water use	Electricity and fuel	Storage rent	Equipment rent	Other rent	Taxes	Repair and maintenance	Cost of bags	Deprecia-tion	Other costs	TOTAL
NMM	Medium	27960	3851	11262	320	800	3700	0	0	0	0	1840	3800	0	600	54133
	NMM average	27960	3851	11262	320	800	3700	0	0	0	0	1840	3800	0	600	54133
RRD	Micro	210	0	68	0	11	312	38	833	0	4	79	198	0	32	1785
	Small	436	147	524	58	5	424	58	814	0	0	249	172	0	80	2969
	Medium	7000	0	19690	5400	0	24000	5000	0	0	10000	0	6800	0	0	77890
	Large	0	0	0	0	0	40	0	160	0	0	0	0	0	0	200
	RRD average	350	63	392	61	8	514	79	815	0	68	151	229	0	53	2782
NCC	Micro	5	0	210	0	0	110	0	890	0	1	6	8	0	0	1230
	Small	928	892	2492	0	0	2192	0	2234	0	282	15	102	0	0	9138
	Medium	5500	0	9600	1000	0	15000	0	0	0	600	0	100	0	0	31800
	NCC average	348	227	976	20	0	933	0	1215	0	85	8	34	0	0	3846
SCC	Micro	0	0	0	0	6	412	0	0	0	0	127	331	0	0	875
	SCC average	0	0	0	0	6	412	0	0	0	0	127	331	0	0	875
CH	Micro	225	0	1280	0	40	580	0	0	0	0	141	158	0	0	2424
	Small	720	0	2400	0	0	1025	0	0	0	0	450	467	0	0	5062
	Large	180000	0	292775	15675	0	48000	0	0	0	30000	0	37500	0	0	603950
	CH average	24294	0	40370	2090	27	6992	0	0	0	4000	184	5199	0	0	83155
NES	Micro	423	0	202	0	0	2445	0	566	0	0	659	125	0	0	4420
	Small	0	0	0	0	0	2275	0	763	313	0	375	0	0	0	3725
	Medium	185	502	6054	402	41	5178	0	298	0	6184	1566	1096	0	0	21507
	Large	12391	6421	77399	6475	125	135654	0	0	0	17478	20944	28327	0	0	305213
	NES average	4014	2195	26499	2172	55	44905	0	299	24	7892	7300	9264	0	0	104618
Viet Nam	Micro	177	0	185	0	9	572	20	696	0	2	147	154	0	16	1977
	Small	478	238	827	43	4	869	43	989	28	41	233	156	0	59	4009
	Medium	3331	830	6954	510	119	5621	104	254	0	5503	1529	1476	0	63	26295
	Large	21614	5870	87495	6816	114	126771	0	5	0	17695	19149	28041	0	0	313569
	Viet Nam average	2916	786	10326	787	34	14394	36	639	7	2618	2327	3221	0	32	38124

Source: Processor Survey

Table 3.13.3–Average cost shares of inputs to production

Region	Size	Transport-ation cost	Truck loading fee	Hired labor cost	Communi-cation costs	Water use	Electricity & fuel	Storage rent	Equip ment rent	Other rent	Taxes	Repair & maintenance	Cost of bags	Depre-ciation	Other costs
NMM	Medium	0.52	0.07	0.21	0.01	0.01	0.07	0.00	0.00	0.00	0.00	0.03	0.07	0.00	0.01
	NMM average	0.52	0.07	0.21	0.01	0.01	0.07	0.00	0.00	0.00	0.00	0.03	0.07	0.00	0.01
RRD	Micro	0.12	0.00	0.04	0.00	0.01	0.17	0.02	0.47	0.00	0.00	0.04	0.11	0.00	0.02
	Small	0.15	0.05	0.18	0.02	0.00	0.14	0.02	0.27	0.00	0.00	0.08	0.06	0.00	0.03
	Medium	0.09	0.00	0.25	0.07	0.00	0.31	0.06	0.00	0.00	0.13	0.00	0.09	0.00	0.00
	Large	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00
	RRD average	0.13	0.02	0.14	0.02	0.00	0.18	0.03	0.29	0.00	0.02	0.05	0.08	0.00	0.02
NCC	Micro	0.00	0.00	0.17	0.00	0.00	0.09	0.00	0.72	0.00	0.00	0.00	0.01	0.00	0.00
	Small	0.10	0.10	0.27	0.00	0.00	0.24	0.00	0.24	0.00	0.03	0.00	0.01	0.00	0.00
	Medium	0.17	0.00	0.30	0.03	0.00	0.47	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
	NCC average	0.09	0.06	0.25	0.01	0.00	0.24	0.00	0.32	0.00	0.02	0.00	0.01	0.00	0.00
SCC	Micro	0.00	0.00	0.00	0.00	0.01	0.47	0.00	0.00	0.00	0.00	0.14	0.38	0.00	0.00
	SCC average	0.00	0.00	0.00	0.00	0.01	0.47	0.00	0.00	0.00	0.00	0.14	0.38	0.00	0.00
CH	Micro	0.09	0.00	0.53	0.00	0.02	0.24	0.00	0.00	0.00	0.00	0.06	0.07	0.00	0.00
	Small	0.14	0.00	0.47	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.09	0.09	0.00	0.00
	Large	0.30	0.00	0.48	0.03	0.00	0.08	0.00	0.00	0.00	0.05	0.00	0.06	0.00	0.00
	CH average	0.29	0.00	0.49	0.03	0.00	0.08	0.00	0.00	0.00	0.05	0.00	0.06	0.00	0.00
NES	Micro	0.10	0.00	0.05	0.00	0.00	0.55	0.00	0.13	0.00	0.00	0.15	0.03	0.00	0.00
	Small	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.20	0.08	0.00	0.10	0.00	0.00	0.00
	Medium	0.01	0.02	0.28	0.02	0.00	0.24	0.00	0.01	0.00	0.29	0.07	0.05	0.00	0.00
	Large	0.04	0.02	0.25	0.02	0.00	0.44	0.00	0.00	0.00	0.06	0.07	0.09	0.00	0.00
	NES average	0.04	0.02	0.25	0.02	0.00	0.43	0.00	0.00	0.00	0.08	0.07	0.09	0.00	0.00
Viet Nam	Micro	0.09	0.00	0.09	0.00	0.00	0.29	0.01	0.35	0.00	0.00	0.07	0.08	0.00	0.01
	Small	0.12	0.06	0.21	0.01	0.00	0.22	0.01	0.25	0.01	0.01	0.06	0.04	0.00	0.01
	Medium	0.13	0.03	0.26	0.02	0.00	0.21	0.00	0.01	0.00	0.21	0.06	0.06	0.00	0.00
	Large	0.07	0.02	0.28	0.02	0.00	0.40	0.00	0.00	0.00	0.06	0.06	0.09	0.00	0.00
	Viet Nam average	0.08	0.02	0.27	0.02	0.00	0.38	0.00	0.02	0.00	0.07	0.06	0.08	0.00	0.00

Source: Processor Survey

Table 3.13.4–Average income for processors (thousand dong)

Region	Size	Equipment costs	Roots	Wet starch	Dry starch	Wet starch sales	Dry starch sales	Total sales	Total costs	Profit
NMM	Medium	54133	187800	0	187800	312625	0	312625	241933	70692
	NMM average	54133	187800	0	187800	312625	0	312625	241933	70692
RRD	Micro	1864	23026	20804	43830	33445	20572	54017	45695	8323
	Small	13499	11802	214712	226514	137937	168514	306451	240012	66439
	Medium	77890	0	491000	491000	0	948650	948650	568890	379760
	RRD average	4181	21481	48495	69976	44438	49498	93937	74157	19780
NCC	Micro	1230	13505	0	13505	22128	0	22128	14735	7393
	Small	9138	65106	0	65106	90735	0	90735	74244	16490
	Medium	31800	139950	0	139950	214600	0	214600	171750	42850
	NCC average	3846	29137	0	29137	43390	0	43390	32983	10407
SCC	Micro	903	27559	0	27559	30167	7255	37422	28462	8960
	SCC average	903	27559	0	27559	30167	7255	37422	28462	8960
CH	Micro	3407	16016	0	16016	17645	0	17645	19423	-1778
	Small	5062	50300	0	50300	55613	0	55613	55362	252
	Large	603950	4077500	0	4077500	0	8000000	8000000	4681450	3318550
	CH average	113048	763818	0	763818	24792	1454545	1479337	876866	602472
NES	Micro	4420	72944	0	72944	20891	63805	84696	77365	7331
	Small	3725	117875	0	117875	21313	108106	129419	121600	7819
	Medium	21930	256193	0	256193	99608	204304	303911	278122	25789
	Large	305213	1660069	276250	1936319	204425	2587254	2791679	2241532	550147
	NES average	105599	646252	86667	732918	109373	914047	1023420	838517	184903
Viet Nam	Micro	2089	28410	9510	37920	27547	20001	47548	40009	7539
	Small	8493	63584	53678	117262	81887	69155	151042	125755	25287
	Medium	26756	240993	10447	251439	122596	194060	316656	278196	38460
	Large	322786	1802271	260000	2062271	192400	2905651	3098051	2385057	712994
	Viet Nam average	50579	310735	48933	359668	74231	446348	520579	410247	110332

Source: Processor Survey

Table 3.13.5–Profitability in starch processing, 1996-1997

Profitability	1996	1997
Good	19.26	14.77
Normal	76.35	59.73
Bad	4.39	25.50

Source: Processor Survey

Table 3.13.6–Profitability in 1996 by region by size (% within region and size category)

Size	Profitability	Region				Viet Nam
		NMM	RRD	NCC	NES	
Micro	Good		23.53	38.89		23.78
	Normal		76.47	61.11	95.45	75.52
	Bad				4.55	0.70
Small	Good		16.92			14.86
	Normal		83.08	100.00	75.00	82.43
	Bad				25.00	2.70
Medium	Good			100.00	4.88	6.25
	Normal	100.00	100.00		82.93	83.33
	Bad				12.20	10.42
Large	Good				30.00	29.03
	Normal		100.00		53.33	54.84
	Bad				16.67	16.13

Source: Processor Survey

Table 3.13.7–Profitability in 1997 by region by size (% within region and size category)

Size	Profitability	Region					Viet Nam
		NMM	RRD	NCC	SCC	NES	
Micro	Good		28.24	2.78			17.36
	Normal		49.41	83.33	100.00	100.00	65.97
	Bad		22.35	13.89			16.67
Small	Good		12.31				10.81
	Normal		20.00	100.00		87.50	28.38
	Bad		67.69			12.50	60.81
Medium	Good	60.00	100.00				8.33
	Normal	40.00		100.00		92.68	85.42
	Bad					7.32	6.25
Large	Good					22.58	21.88
	Normal					67.74	65.63
	Bad		100.00			9.68	12.50

Source: Processor Survey

Table 3.13.8–Most important reason for change in profitability

Reason	Percent
Sale Price	62.96
Raw material price	22.22
Volume trade	8.99
Interest rate	0.53
Other operating costs	1.06
Competition	3.17
Other	1.06

Source: Processor Survey

Table 3.14.1–Policy recommendations of processors

Policy recommendation	Percent of processors
Increase credit	11.57
Lower interest rates	3.31
Facillitate dealings with banks	4.96
Solve pollution problem	22.31
Create stable market for starch	1.65
Longer terms for loans	14.05
Promote domestic market for starch	12.40
Promote starch exports	0.83
Construct water treatment facilities	8.26
Improve processing technology	12.40
Upgrade roads	3.31
Promote stability of raw material supply	2.48
Other	2.48

Source: Processor Survey

Table 3.14.2–Policy recommendations of processors by region and size (% within region and group)

Size		Region				Viet Nam
		NMM	RRD	NCC	NES	
Micro	Increase credit		7.27	21.05		10.81
	Lower interest rates		1.82	5.26		2.70
	Facillitate dealings with banks		3.64			2.70
	Solve pollution problem		40.00	5.26		31.08
	Create stable market for starch			5.26		1.35
	Longer terms for loans		18.18	10.53		16.22
	Promote domestic market for starch		12.73	10.53		12.16
	Construct water treatment facilities		3.64	31.58		10.81
	Improve processing technology		5.45	10.53		6.76
	Upgrade roads		3.64			2.70
	Promote stability of raw material supply		1.82			1.35
	Other		1.82			1.35
Small	Increase credit		16.67	100.00		20.00
	Facilitate dealings with banks		11.11			10.00
	Solve pollution problem		22.22			20.00
	Longer terms for loans		11.11			10.00
	Promote domestic market for starch		11.11			10.00
	Construct water treatment facilities		5.56			5.00
	Improve processing technology				100.00	5.00
	Upgrade roads		11.11			10.00
	Promote stability of raw material supply		11.11			10.00
Medium	Increase credit	25.00			9.09	12.50
	Lower interest rates				9.09	6.25
	Facilitate dealings with banks	25.00	100.00			12.50
	Create stable market for starch	25.00				6.25
	Longer terms for loans				9.09	6.25
	Promote domestic market for starch	25.00			18.18	18.75
	Improve processing technology				36.36	25.00
	Other				18.18	12.50
Large	Lower interest rates				9.09	9.09
	Longer terms for loans				18.18	18.18
	Promote domestic market for starch				9.09	9.09
	Promote starch exports				9.09	9.09
	Construct water treatment facilities				9.09	9.09
	Improve processing technology				45.45	45.45

Source: Processor Survey

Table 3.15.1–Production and cassava equipment

	Starch	Cassava Equivalent	Share of Cassava Production
	('000 tons)		(%)
Wet Starch	42307	105767	5.3
Dry Starch	89143	371429	18.7
Total	131450	477196	24

Source: Processor Survey

Table 3.15.2–Small and large contributions to starch production

	Wet Production	Share Wet Production	Dry Production	Share Dry Production
	('000 tons)	(%)	('000 tons)	(%)
Small Processors	36961	87	11522	13
Large Processors	5346	13	77621	87
Total	42307	100	89143	100

Source: Processor Survey

Table 3.15.3–Average value of equipment and assets ('000 dong)

Processor Size	Value of Equipment	Value of All Assets
Micro	808	6760
Small	1354	4429
Medium	17749	350209
Large	4729007	5979160
Viet Nam	491512	671398

Source: Processor Survey

Table 3.15.4–Output-capital ratio for small and large processors

	Tons of Starch per million Dong of Capital Equipment
Small	9.3
Large	0.6

Source: Processor Survey

Table 3.15.5–Cost structure (share in operation costs)

	Electricity and Fuel	Labor	Transport	Rental Equipment	Other
Micro	29	9	9	35	18
Small	2	21	12	25	20
Medium	21	26	13	1	39
Large	40	28	7	0	25
Viet Nam	38	27	8	2	25

Source: Processor Survey

Table 3.15.6–Sales and profit (million dong)

Processor Size	Sales	Profit	Share of Profit
Micro	47.55	7.54	16
Small	151.04	25.29	17
Medium	316.66	38.46	12
Large	3098.05	712.99	23
Viet Nam	520.58	110.33	21

Source: Processor Survey

Table 3.15.7–Access to credit

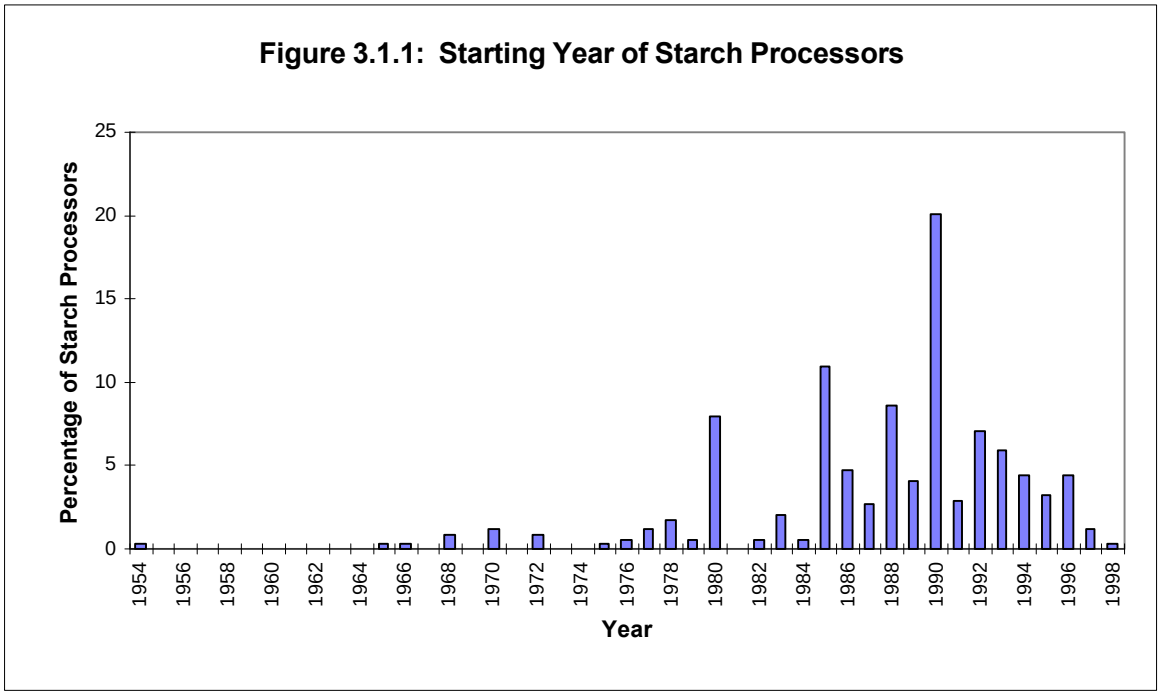
Processor Size	Credit (million Dong)	Percentage from Bank	Requirement Ratio
Micro	5.1	78	2.5
Small	14.9	89	1.1
Medium	21.4	83	3.5
Large	108	94	6.9

Source: Processor Survey

Table 3.15.8–Raw material costs

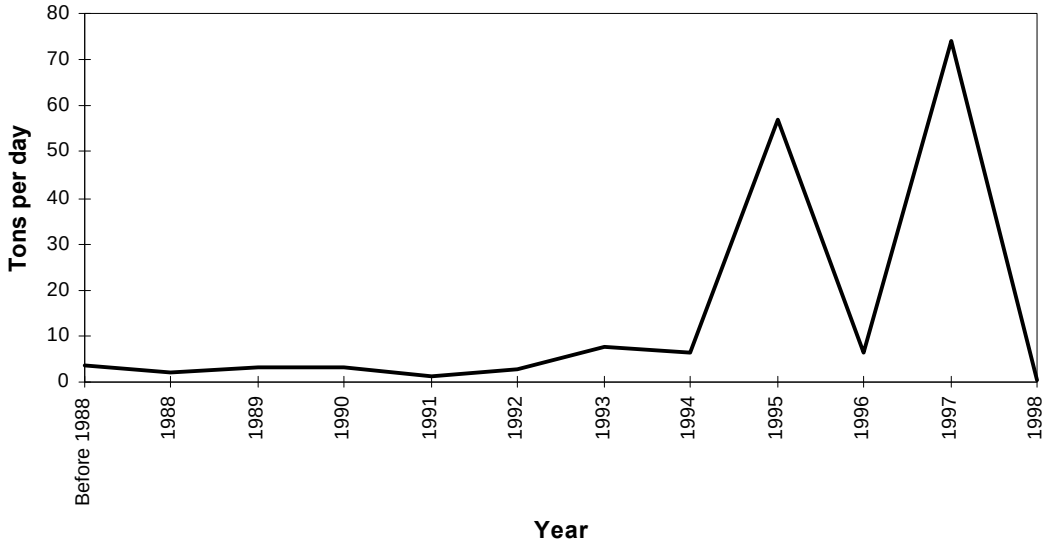
Processor Size	Cassava Price from: (Dong/kg)		Raw Material as % Total Cost
	Farmers	Traders	
Micro	285	383	94.4
Small	300	342	91.7
Medium	332	367	90.3
Large	391	399	86.5
Viet Nam	318	377	87.6

Source: Processor Survey



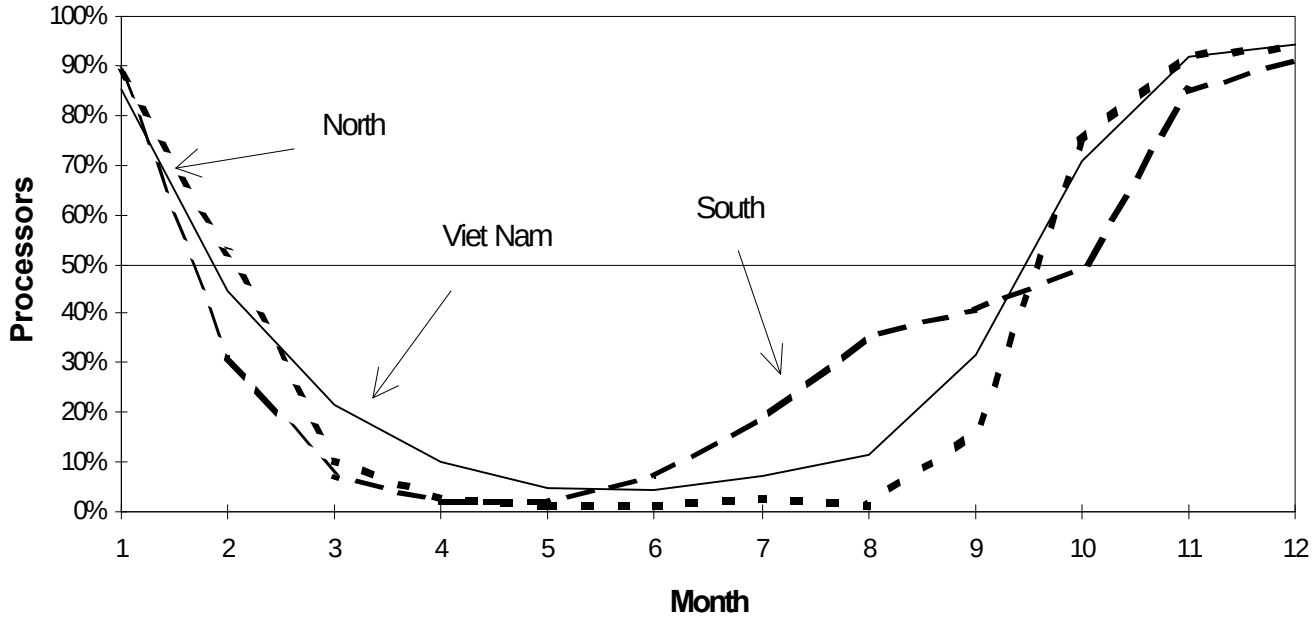
Source: Processor Survey

Figure 3.2.1: Average Design Capacity of Starch Processors



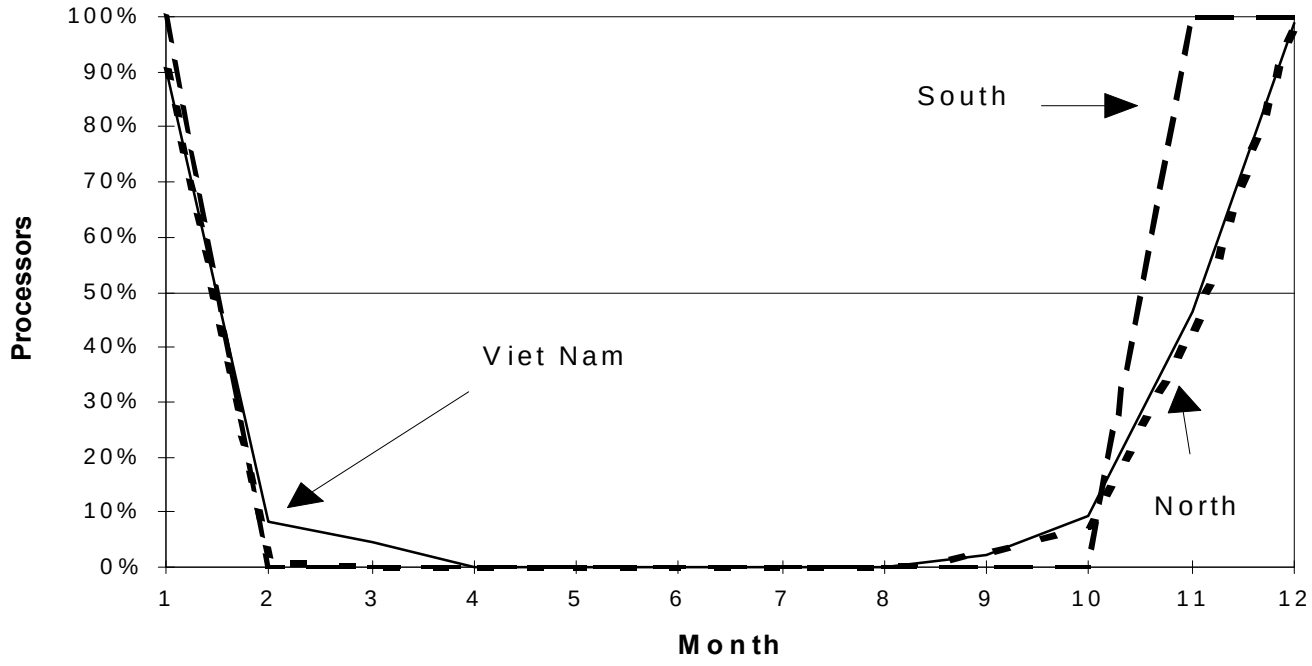
Source: Processor Survey

Figure 3.4.1.1: Peak Production Months for Wet Cassava Starch



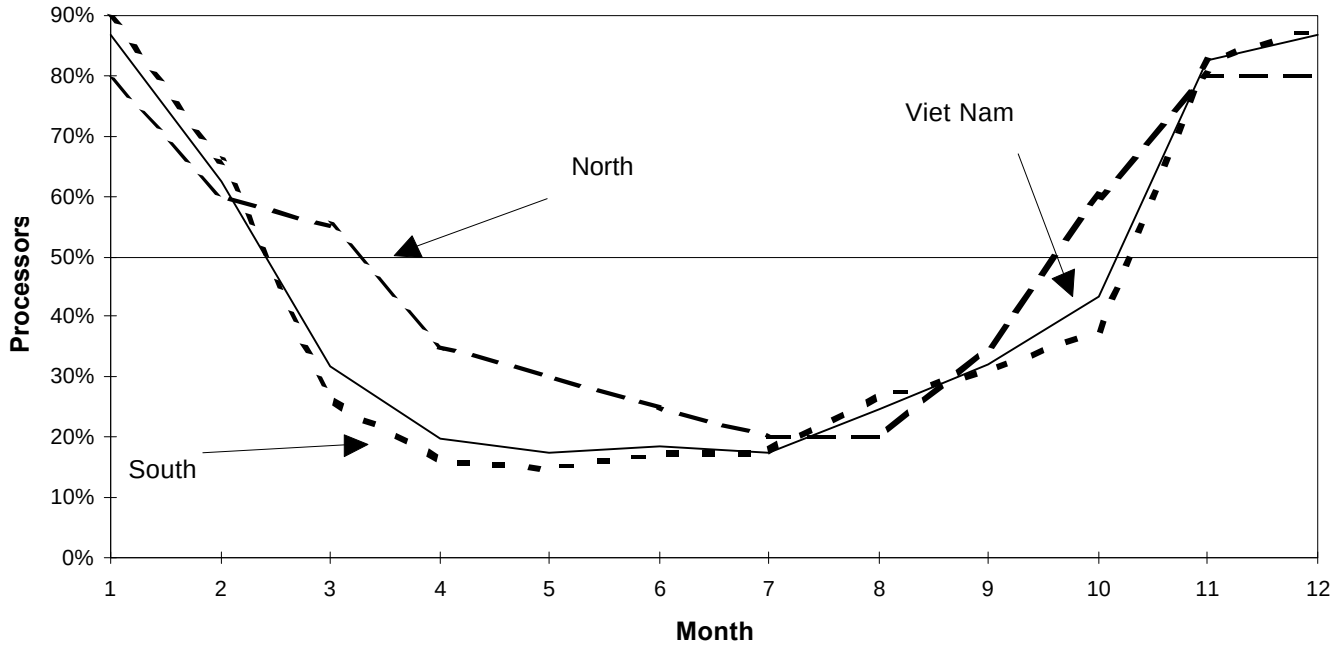
Source: Processor Survey

Figure 3.4.1.2: Peak Production Months of Wet Canna Starch

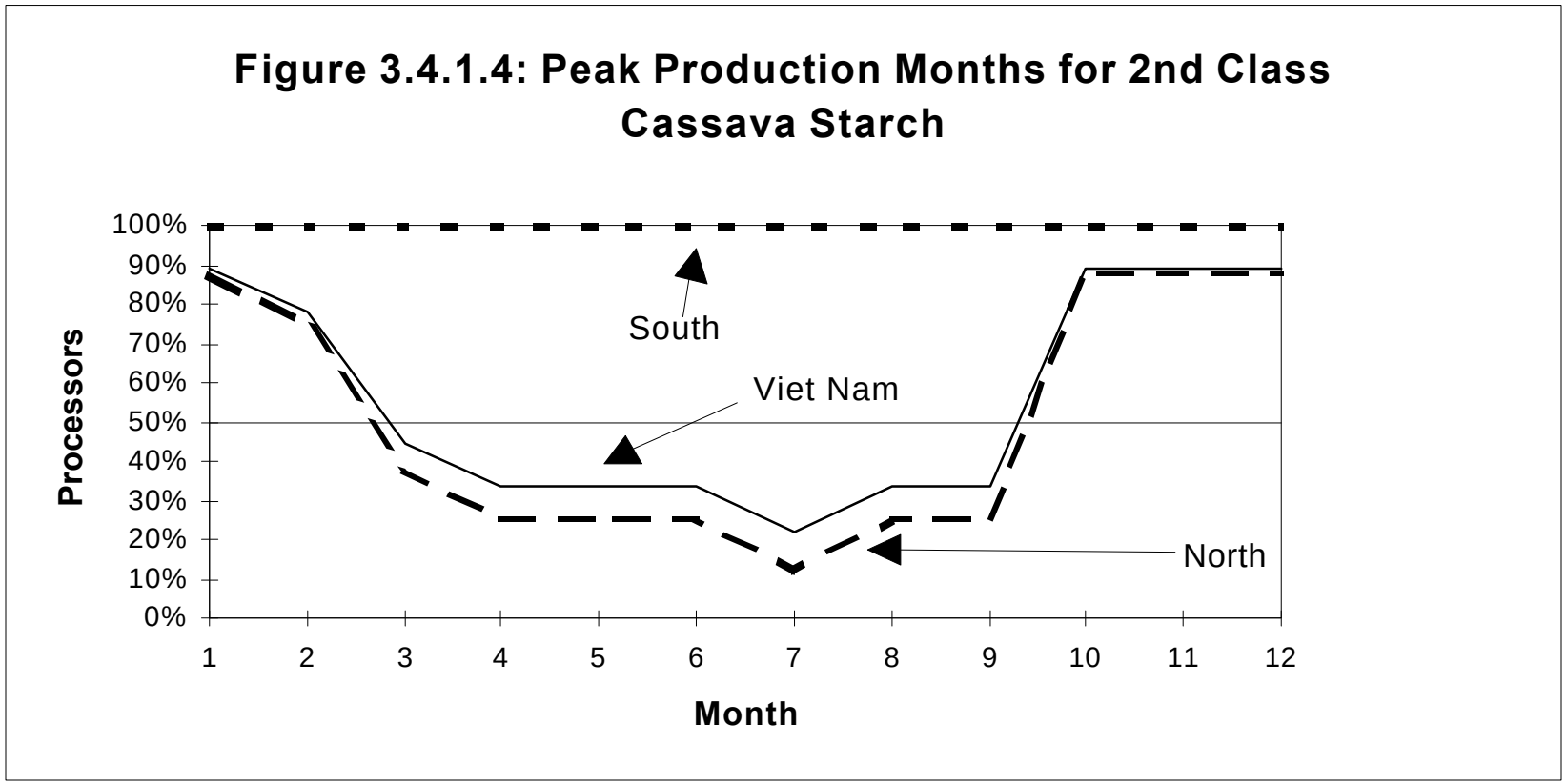


Source: Processor Survey

Figure 3.4.1.3: Peak Production Months for 1st Class Cassava Starch

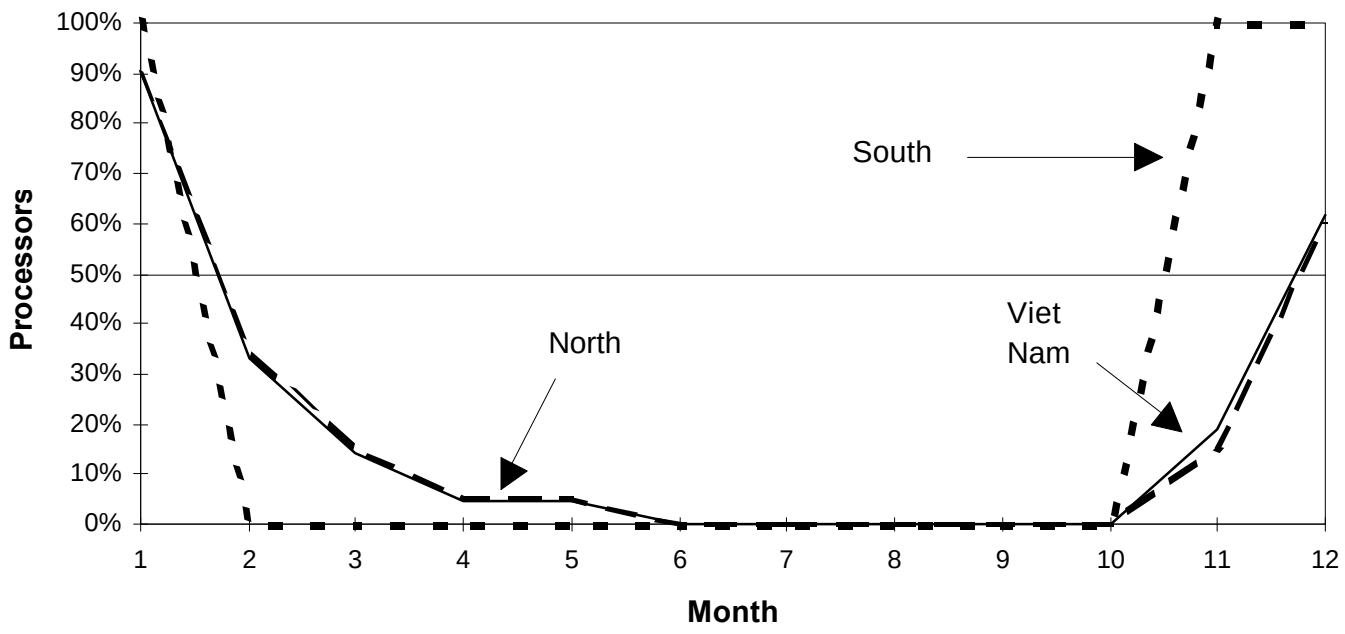


Source: Processor Survey



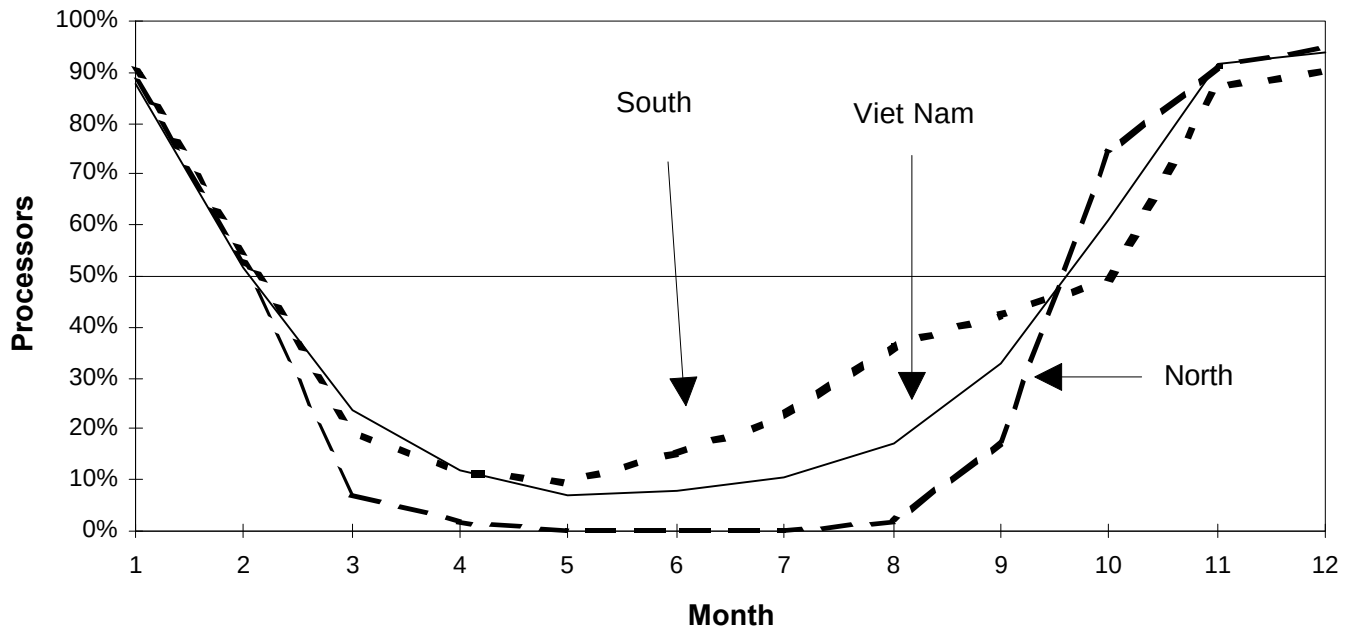
Source: Processor Survey

Figure 3.4.1.5: Peak Production Months of Dry Canna Starch

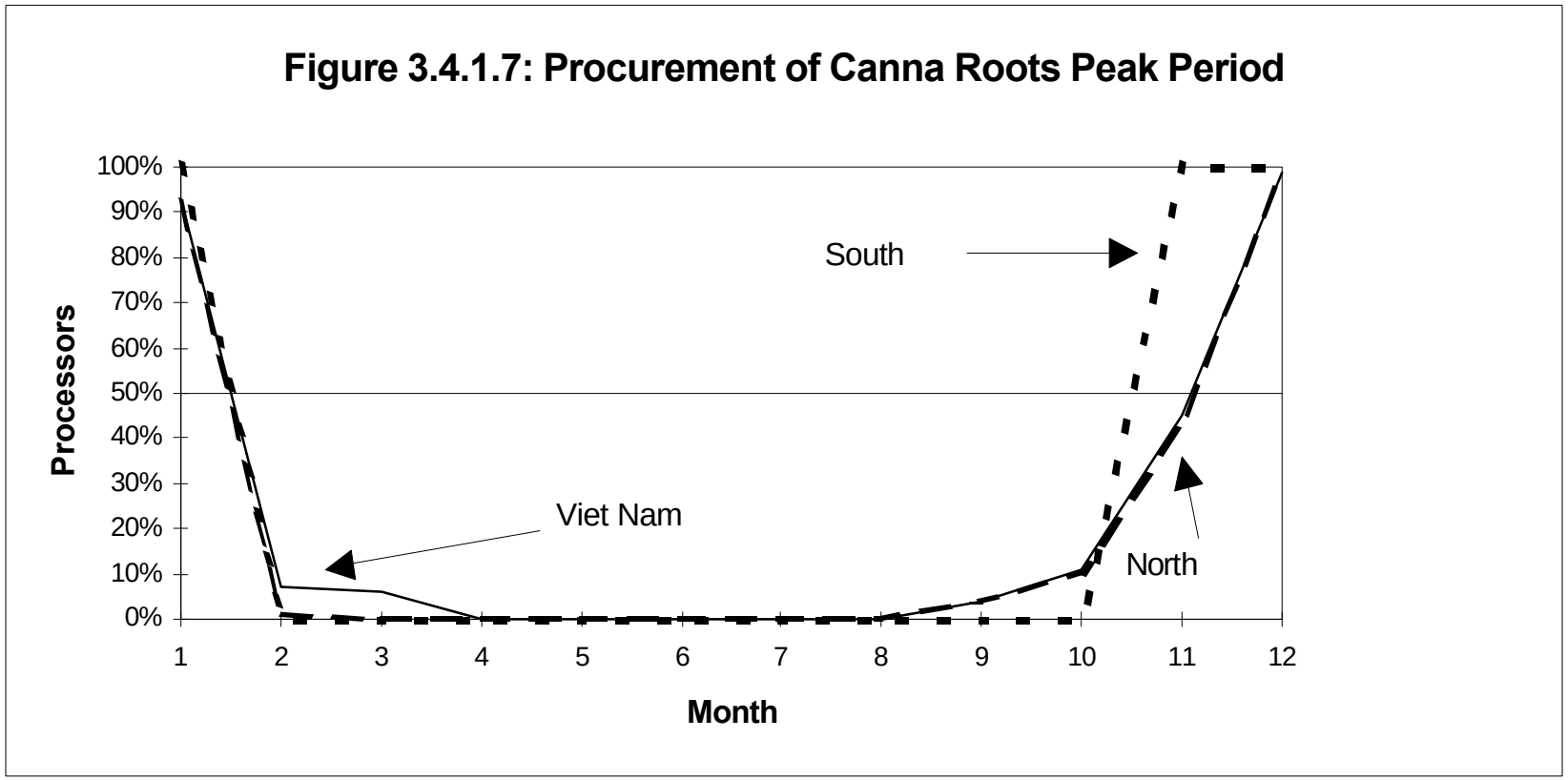


Source: Processor Survey

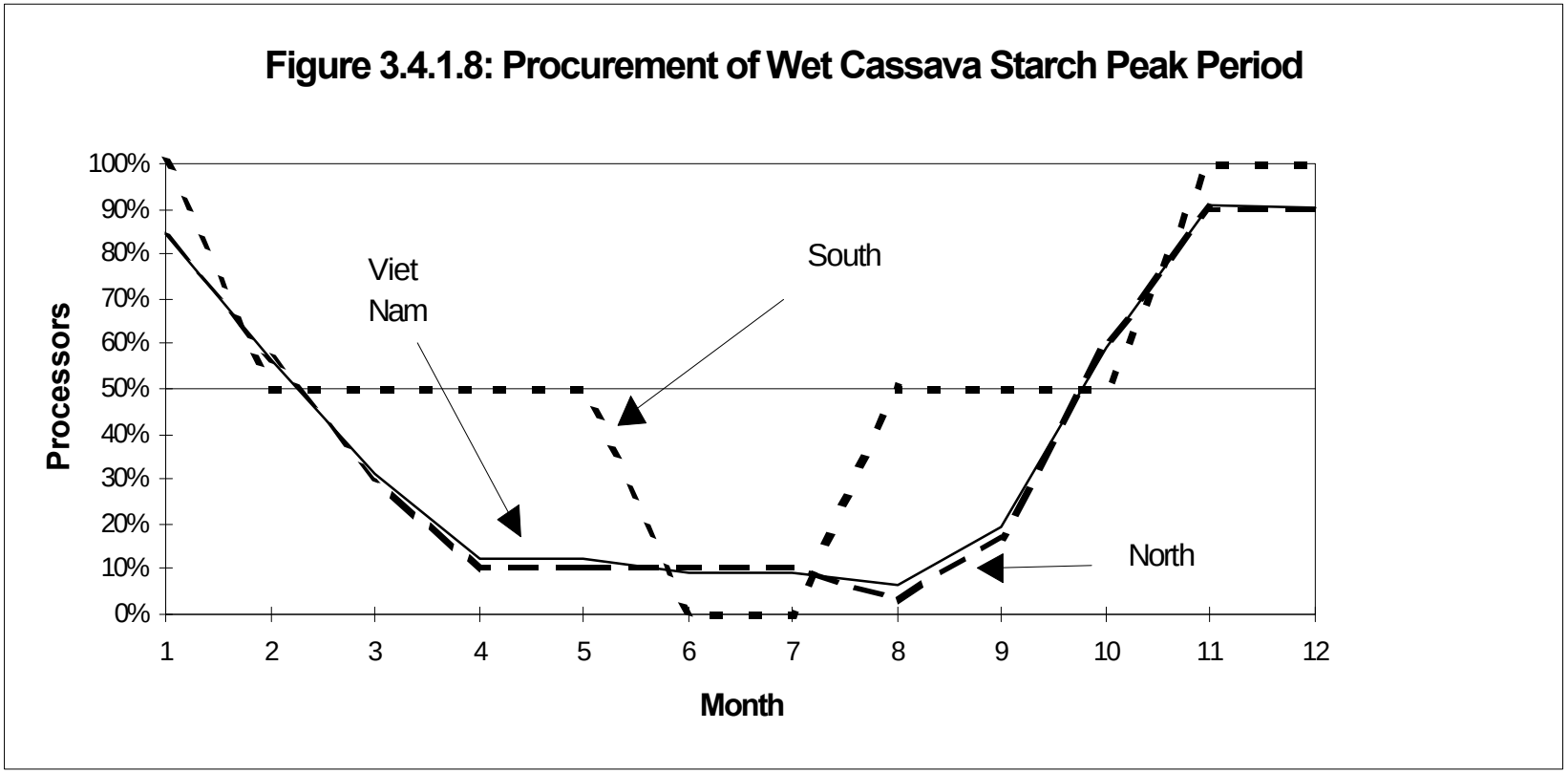
Figure 3.4.1.6: Procurement of Cassava Roots Peak Period



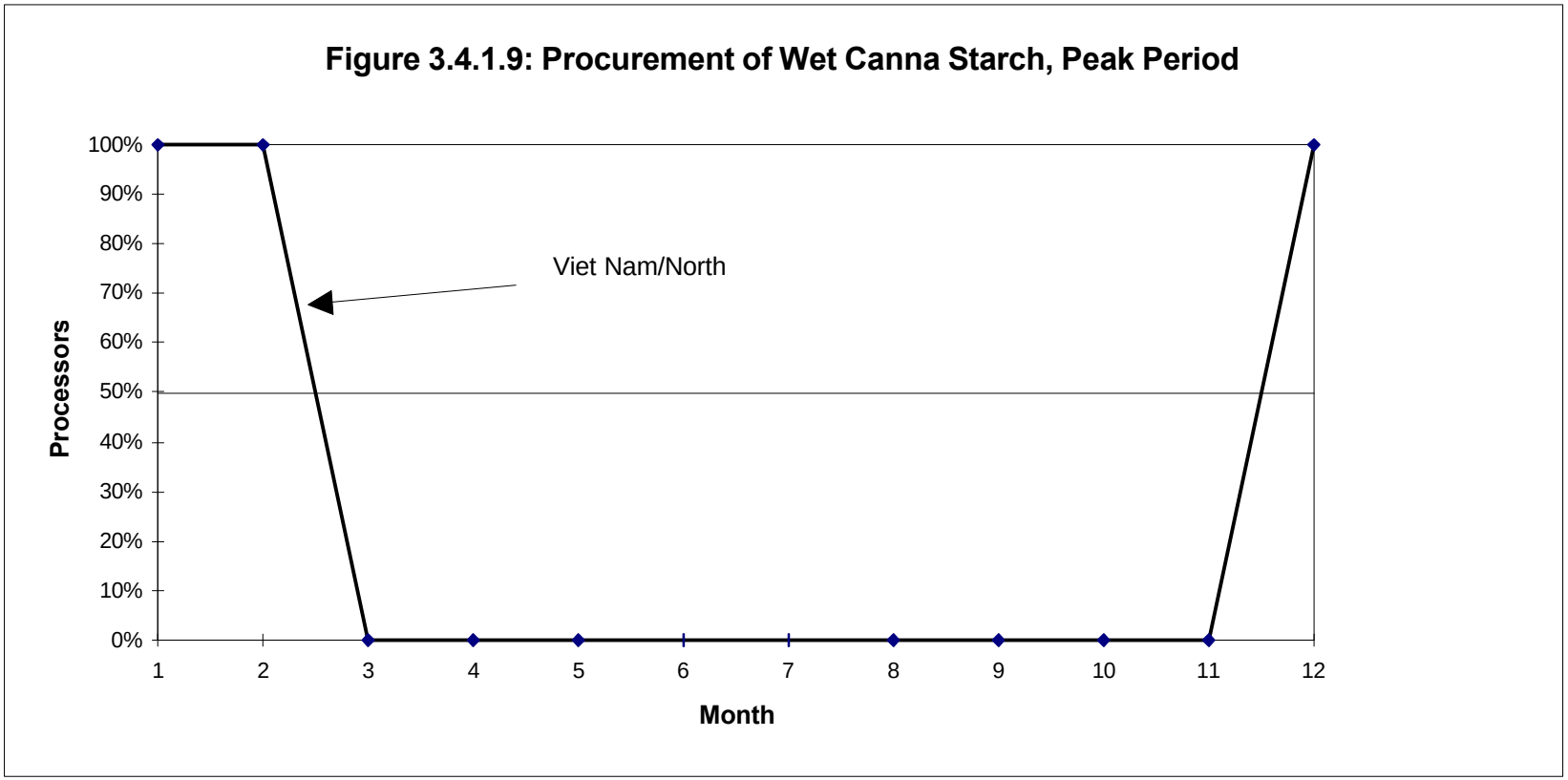
Source: Processor Survey



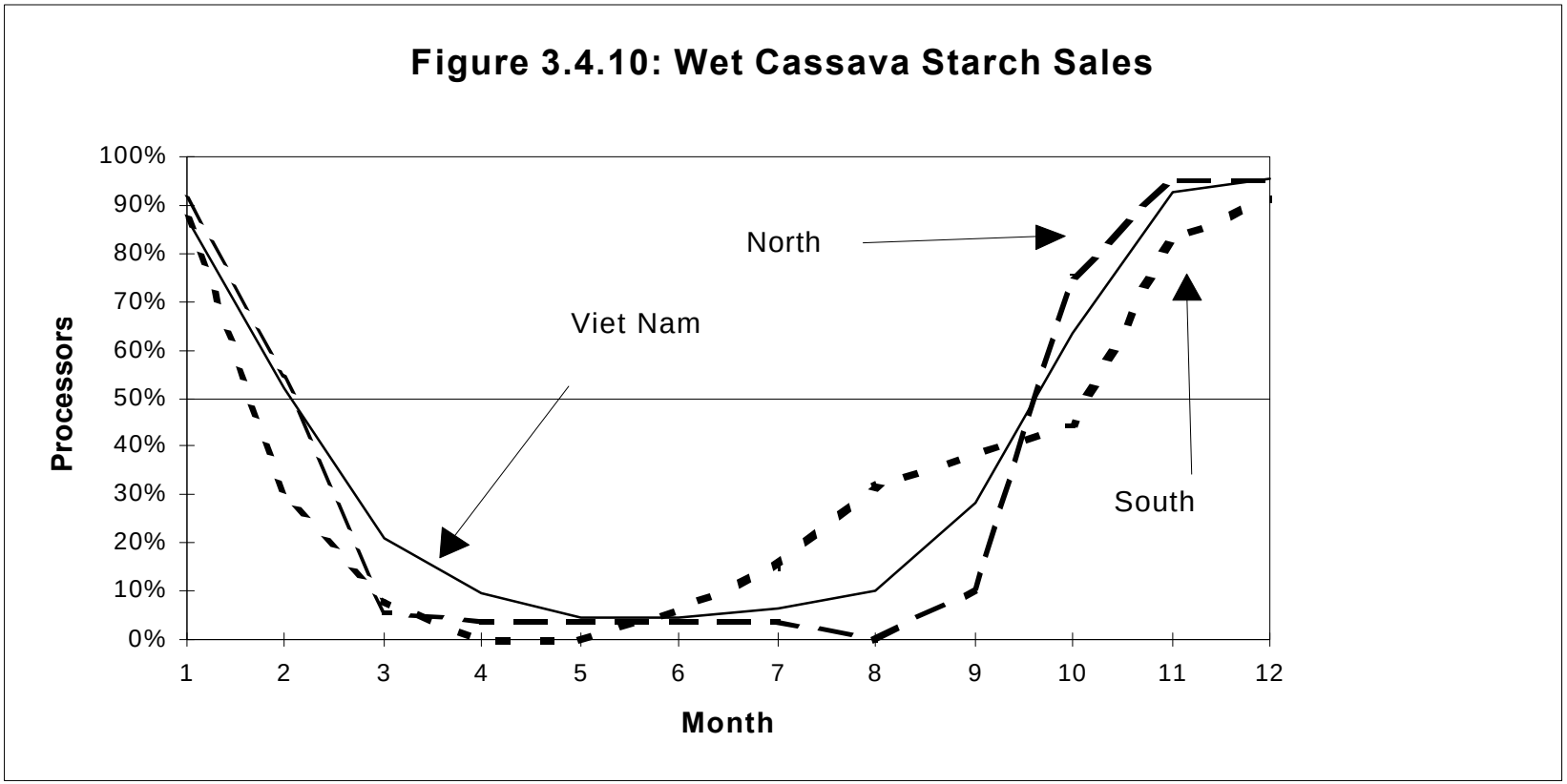
Source: Processor Survey



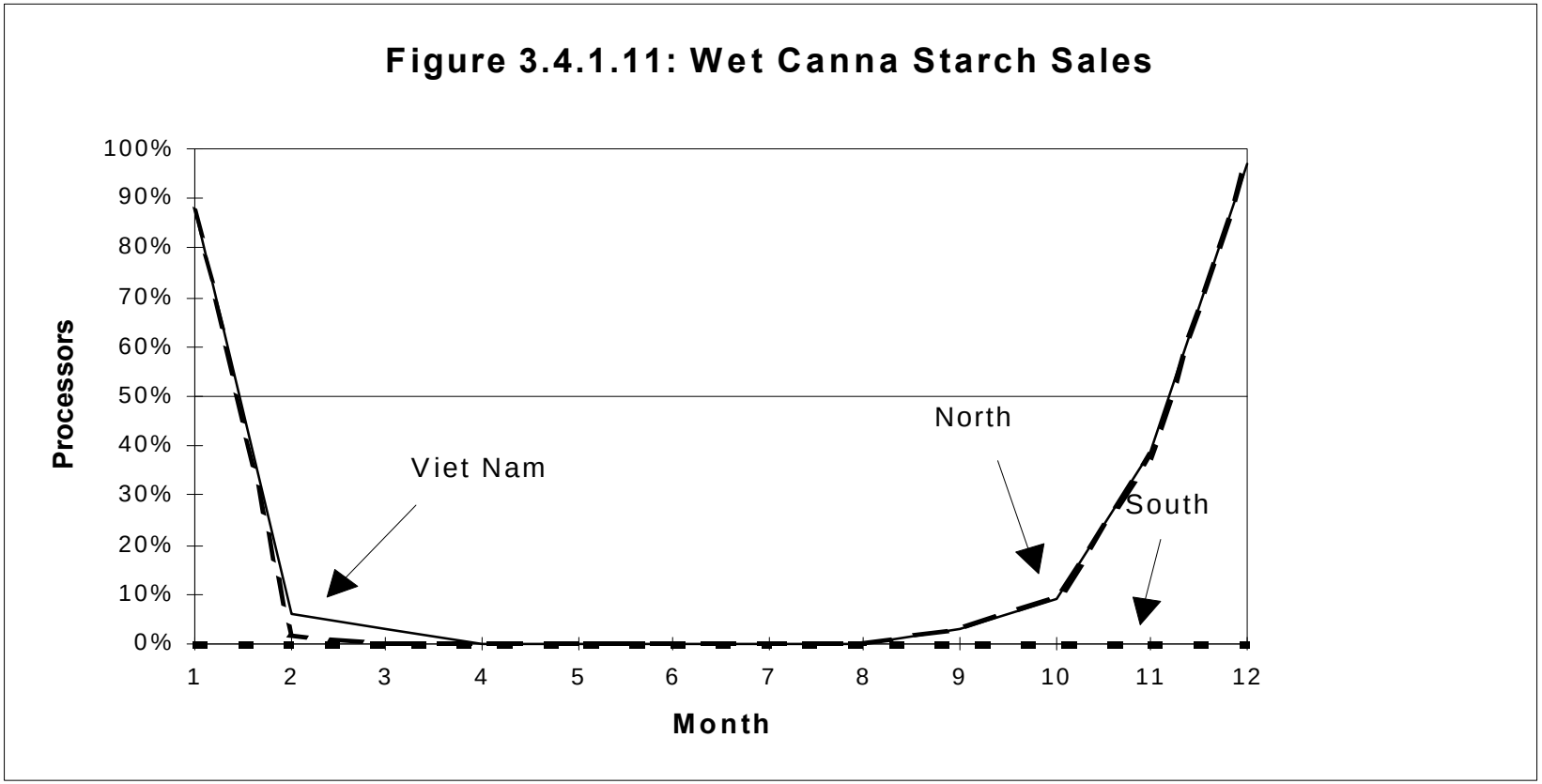
Source: Processor Survey



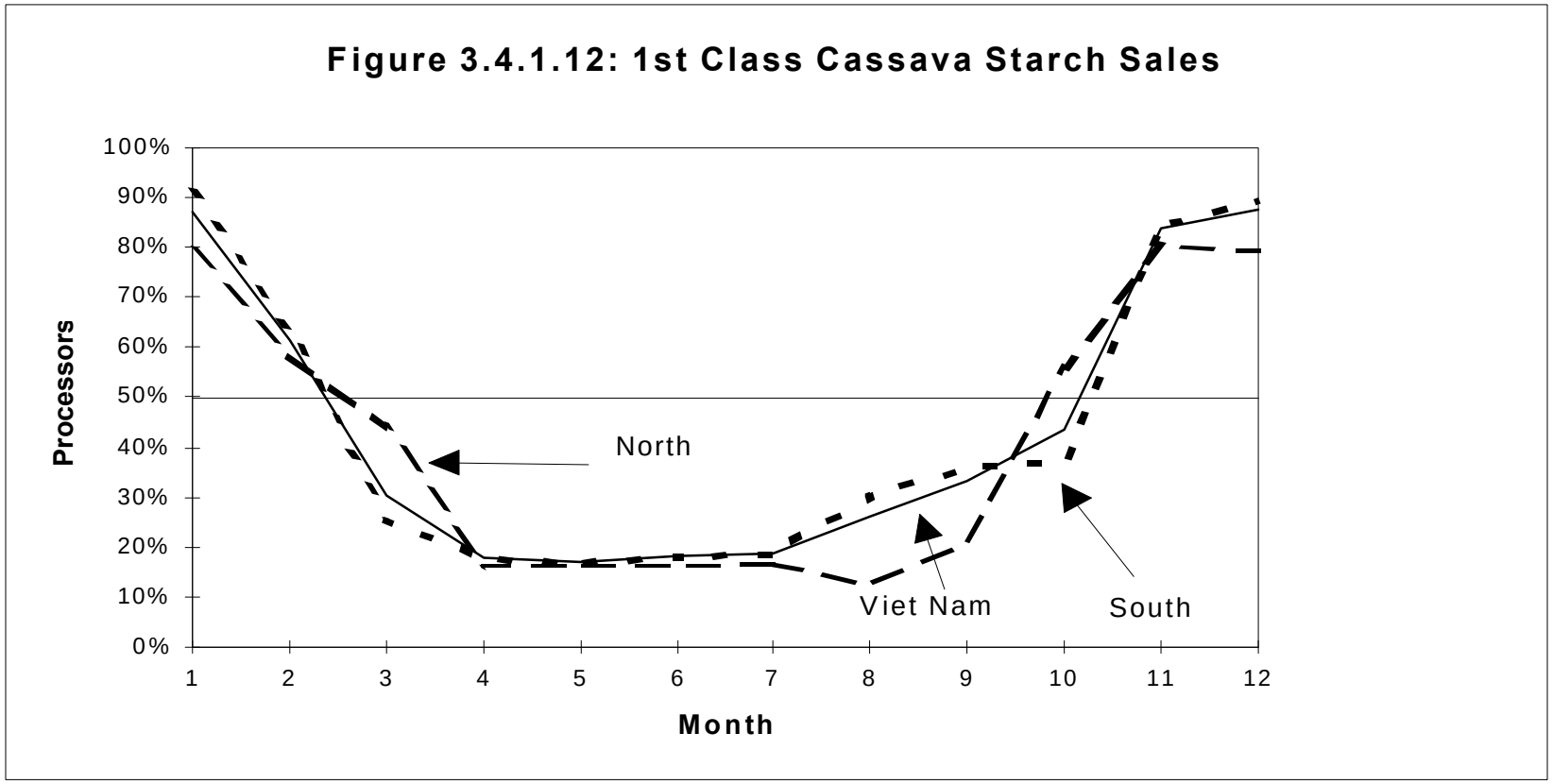
Source: Processor Survey



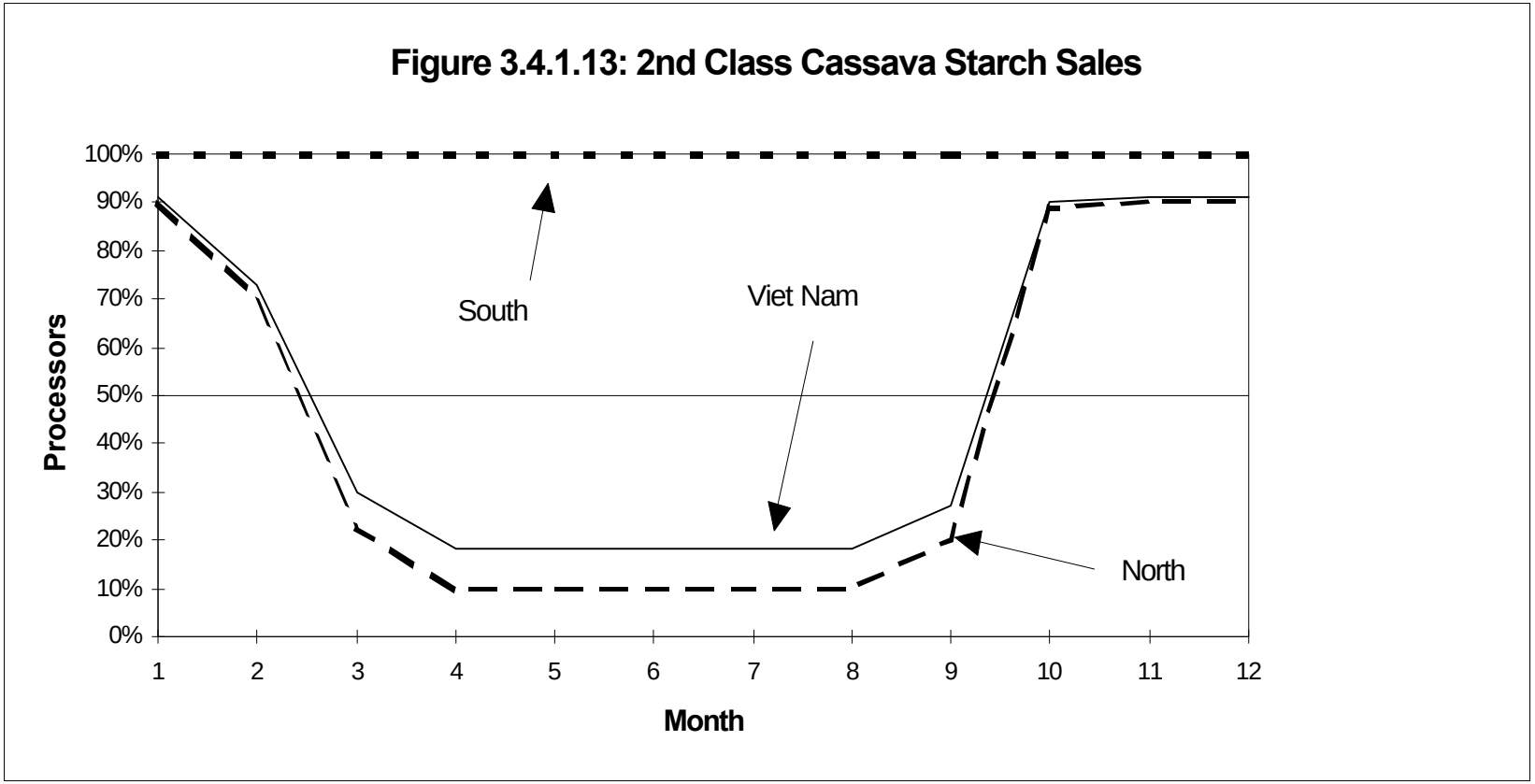
Source: Processor Survey



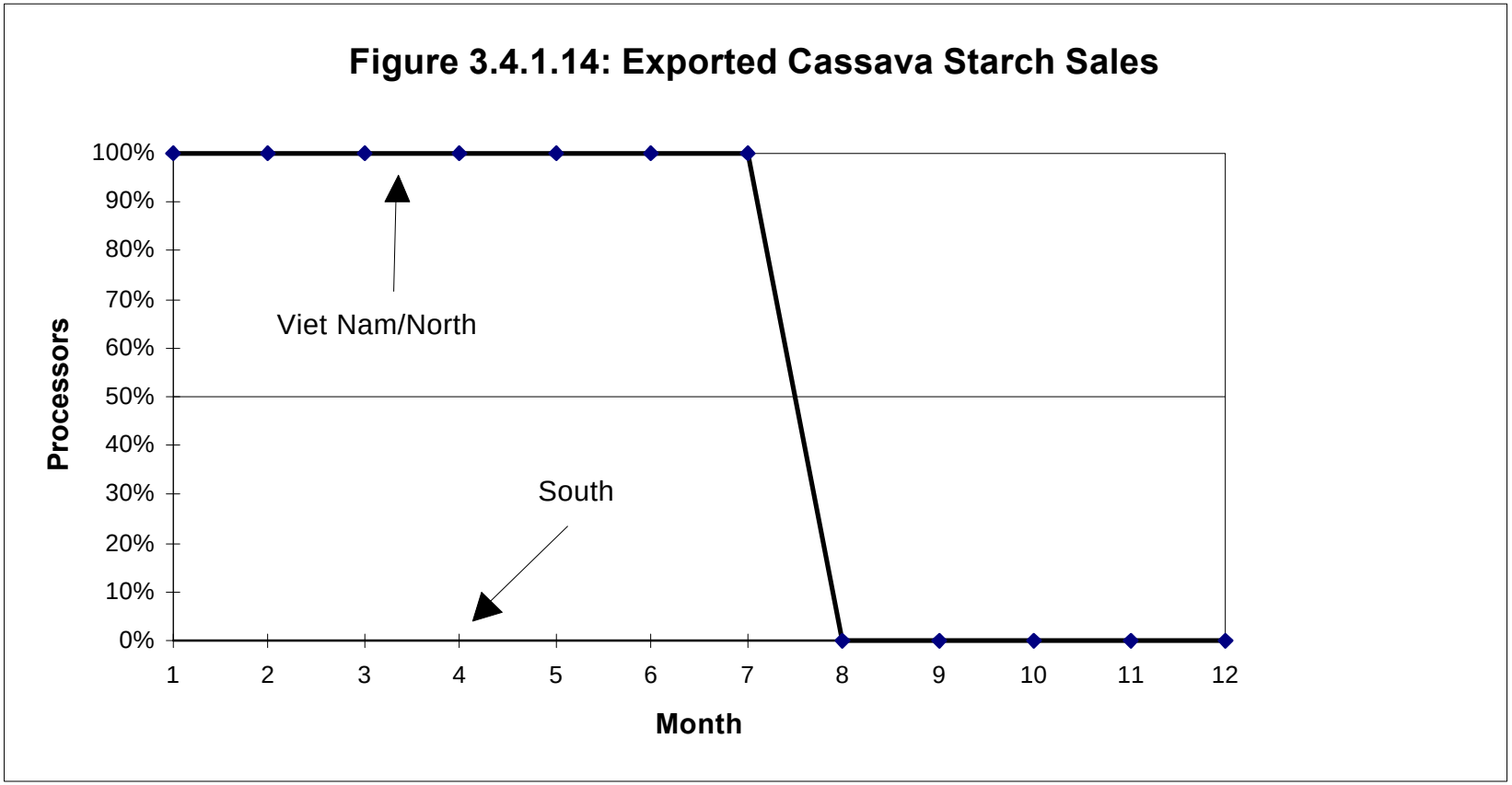
Source: Processor Survey



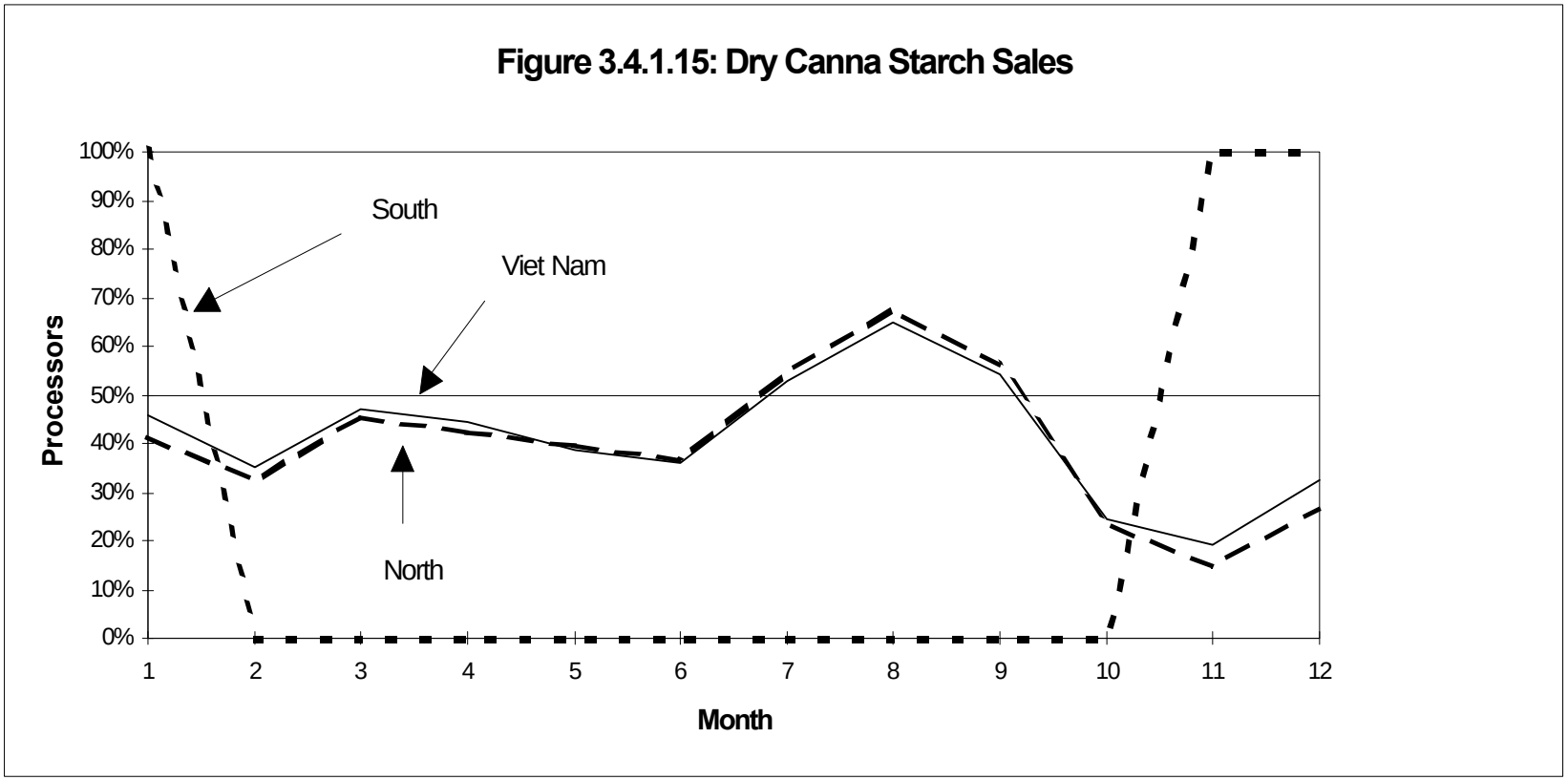
Source: Processor Survey



Source: Processor Survey



Source: Processor Survey



Source: Processor Survey

Table 4.1.1—Distribution of Traders across regions

Region	Number	Percent
NMM	1	0.87
RRD	62	53.91
NCC	15	13.04
SCC	6	5.22
CH	4	3.48
NES	27	23.48
Viet Nam	115	100.00

Source: Trader Survey

Table 4.1.2—Distribution of Traders across provinces

Province	Number	Percent
Vinh Phu	1	0.87
Ha Tay	37	32.17
Hai Hung	12	10.43
Hanoi	13	11.30
Thanh Hoa	7	6.09
Thua Thien-Hue	8	6.96
Quangnam-Danang	6	5.22
Gia Lai	4	3.48
HCMC	2	1.74
Dong Nai	18	15.65
Tay Ninh	7	6.09
Viet Nam	115	100.00

Source: Trader Survey

Table 4.1.3—Type of Trading Operation

Type of Operation	Frequency	Valid Percent
Household	114	99.13
Workshop	1	0.87
Total	115	100.00

Source: Trader Survey

Table 4.1.4—Distribution of Gender for Traders

Gender	Number	Percent
Male	92	80.00
Female	23	20.00
Total	115	100.00

Source: Trader Survey

Table 4.1.5—Legal Registration of Traders

	Number	Percent
Legally Registered	50	43.48
Not Registered	65	56.52

Source: Trader Survey

Table 4.1.6—Average Year of Entry and Number of Workers employed by traders

Region	Year of Opearation	Number of Workers
NMM	1996.00	1.00
RRD	1988.45	2.90
NCC	1988.80	1.93
SCC	1991.17	1.67
CH	1992.50	2.50
NES	1988.85	13.11
Viet Nam	1988.94	5.08

Source: Trader Survey

Table 4.1.7—Starting Year of Operation for Traders by Region

		Region						
		NMM	RRD	NCC	SCC	CH	NES	Viet Nam
Before 1988	Number		22	3			9	34
	% within Region		35.48	20.00			33.33	29.57
1988	Number		4	4			1	9
	% within Region		6.45	26.67			3.70	7.83
1989	Number		4		2		2	8
	% within Region		6.45		33.33		7.41	6.96
1990	Number		11	2	1	2	5	21
	% within Region		17.74	13.33	16.67	50.00	18.52	18.26
1991	Number		4					4
	% within Region		6.45					3.48
1992	Number		1	3	1			5
	% within Region		1.61	20.00	16.67			4.35
1993	Number		1		1		3	5
	% within Region		1.61		16.67		11.11	4.35
1994	Number		4	1	1		3	9
	% within Region		6.45	6.67	16.67		11.11	7.83
1995	Number		2	1		2	2	7
	% within Region		3.23	6.67		50.00	7.41	6.09
1996	Number	1	6	1			1	9
	% within Region	100.00	9.68	6.67			3.70	7.83
1997	Number		3				1	4
	% within Region		4.84				3.70	3.48
TOTAL	Number	1	62	15	6	4	27	115
	% within Region	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Trader Survey

Table 4.1.8—Distribution of Income by Source for Traders (%)

Region	Starch Production 1997	Starch Trading 1997	Crop Production 1997	Livestock Production 1997	Other Starch Related 1997	Other Non-starch 1997	Starch Production 1996	Starch Trading 1996	Crop Production 1996	Livestock Production 1996	Other Starch Related 1996	Other Non-starch 1996
NMM	0.00	60.00	0.00	0.00	0.00	40.00	0.00	40.00	0.00	0.00	0.00	60.00
RRD	3.39	26.77	12.90	10.81	23.31	17.82	2.50	26.29	12.74	12.10	22.90	18.71
NCC	3.33	61.33	20.67	11.33	2.00	0.00	3.33	60.67	21.33	11.33	2.00	0.00
SCC	0.00	35.83	31.67	10.00	22.50	0.00	0.00	30.83	32.50	10.83	25.83	0.00
CH	0.00	47.50	47.50	5.00	0.00	0.00	0.00	43.75	51.25	5.00	0.00	0.00
NES	10.74	54.26	3.70	0.00	6.11	23.33	8.89	45.37	2.59	0.00	4.07	32.04
Viet Nam	4.78	39.22	13.83	8.00	15.43	15.43	3.87	36.22	13.74	8.74	14.91	18.13

Source: Trader Survey

Table 4.2.1—Average Peak and Offpeak Procurement Days for Traders

	Cassava Roots (days)		Canna Roots Peak Procurement Days (days)		Wet Cassava Starch (days)		Wet Canna Starch (days)		Dry 1st Class Cassava (days)		Dry 2nd Class Cassava (days)		Dry Canna Starch (days)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
NMM					12.00	5.00								
RRD	93.33	51.94	72.56	17.00	125.00		35.65	12.25	47.60	39.50	87.50	50.00	25.50	13.00
NCC	106.67	65.00			189.23	21.67			132.00	11.67				
SCC					20.00		30.00		40.00				80.00	
CH	120.00				91.00	18.00	40.00	10.00					20.00	5.00
NES	107.27	10.00			62.35	11.67			89.75	26.00				
Viet Nam	98.57	46.58	72.56	17.00	110.26	13.41	35.59	12.00	86.30	29.10	87.50	50.00	28.22	11.86

Source: Trader Survey

Table 4.2.2—Average Procurement of Cassava Products by Season

	Cassava Roots (tons)		Wet Cassava Starch (tons)		Dry 1st Class Cassava Starch (tons)		Dry 2nd Class Cassava Starch (tons)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
NMM	0.00	0.00	800.00	200.00	0.00	0.00	0.00	0.00
RRD	699.19	143.23	8.06	0.00	14.09	2.86	13.34	4.34
NCC	30.67	20.53	62.27	1.93	20.93	1.33	0.00	0.00
SCC	0.00	0.00	1.00	0.00	13.00	0.00	0.00	0.00
CH	50.00	0.00	97.50	45.00	0.00	0.00	0.00	0.00
NES	429.07	17.96	293.33	3.63	73.89	4.89	0.00	0.00
Viet Nam	483.43	84.11	91.74	4.41	28.35	2.86	7.19	2.34

Source: Trader Survey

Table 4.2.3—Average Procurement of Canna Products by Season

	Canna Roots (tons)		Wet Canna Starch (tons)		Dry Canna Starch (tons)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
NMM	0.00	0.00	0.00	0.00	0.00	0.00
RRD	168.55	10.48	57.31	5.81	8.29	5.83
NCC	0.00	0.00	0.00	0.00	0.00	0.00
SCC	0.00	0.00	1.67	0.00	2.50	0.00
CH	0.00	0.00	20.00	5.00	7.50	2.00
NES	0.00	0.00	0.00	0.00	0.00	0.00
Viet Nam	90.87	5.65	31.68	3.30	4.86	3.21

Source: Trader Survey

Table 4.3.1—Average Peak and Offpeak Days for Sales of Traders

	Cassava Roots (Days)		Canna Roots (days)		Wet Cassava Starch (days)		Wet Canna Starch (days)		Dry 1st Class Cassava Starch (days)		Dry 2nd Class Cassava Starch (days)		Dry Canna Starch (days)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
NMM					20.00	10.00								
RRD	93.85	53.00	77.00	20.57	62.25	7.00	25.89	11.67	99.09	148.57	61.43	122.86	41.38	31.09
NCC	120.00	75.00			212.50	11.67	20.00	1.00	155.00	8.67				
SCC					20.00		30.00		250.00				300.00	
CH	120.00				111.00	54.00	40.00	10.00					20.00	5.00
NES	90.00	10.00			54.00	13.64			92.73	25.83				
Viet Nam	95.14	47.18	77.00	20.57	110.60	14.61	26.45	10.79	117.22	62.55	61.43	122.86	54.56	28.92

Source: Trader Survey

Table 4.3.2—Average Sales Volumes of Cassava Products by Season

	Wet Cassava Starch (tons)		Dry 1st Class Cassava Starch (tons)		Dry 2nd Class Cassava Starch (tons)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
NMM	700.00	300.00	0.00	0.00	0.00	0.00
RRD	8.06	0.00	13.28	3.66	12.37	5.15
NCC	63.60	1.93	20.93	1.33	0.00	0.00
SCC	1.00	0.00	13.00	0.00	0.00	0.00
CH	97.50	45.00	0.00	0.00	0.00	0.00
NES	80.37	8.07	262.41	9.70	0.00	0.00
Viet Nam	41.04	6.32	72.18	4.43	6.67	2.77

Source: Trader Survey

Table 4.3.3—Average Sales Volumes of Canna Products by Season

	Wet Canna Starch (tons)		Dry Canna Starch (tons)	
Region	Peak	Offpeak	Peak	Offpeak
NMM	0.00	0.00	0.00	0.00
RRD	57.55	7.66	13.16	0.85
NCC	0.00	0.00	0.00	0.00
SCC	1.67	0.00	2.50	0.00
CH	20.00	5.00	7.50	2.00
NES	0.00	0.00	0.00	0.00
Viet Nam	31.81	4.30	7.49	0.53

Source: Trader Survey

Table 4.4.1.1—Average Procurement of Cassava Roots by Source

	Roots from (tons):				
Region	Own Production	Farmers	Traders	Other Enterprises	Other
NMM	0.00	0.00	0.00	0.00	0.00
RRD	0.00	187.34	655.08	0.00	0.00
NCC	0.00	35.00	16.20	0.00	0.00
SCC	0.00	0.00	0.00	0.00	0.00
CH	0.00	0.00	50.00	0.00	0.00
NES	0.00	254.07	192.96	0.00	0.00
Viet Nam	0.00	165.22	402.33	0.00	0.00

Source: Trader Survey

Table 4.4.1.2—Average Procurement of Wet Cassava Starch by Source

	Wet Starch from (tons):				
Region	Own Production	Farmers	Traders	Other Enterprises	Other
NMM	0.00	0.00	0.00	1000.00	0.00
RRD	0.00	0.00	0.00	8.06	0.00
NCC	0.00	14.93	47.93	1.33	0.00
SCC	0.00	1.00	0.00	0.00	0.00
CH	0.00	142.50	0.00	0.00	0.00
NES	0.00	0.00	72.22	224.74	0.00
Viet Nam	0.00	6.96	23.21	65.98	0.00

Source: Trader Survey

Table 4.4.1.3—Average Procurement of Dry Cassava Starch by Source

	Dry Starch from (tons):				
Region	Own Production	Farmers	Traders	Other Enterprises	Other
NMM	0.00	0.00	0.00	1000.00	0.00
RRD	7.34	0.00	6.80	20.48	0.00
NCC	0.00	0.00	21.80	0.40	0.00
SCC	0.00	13.00	0.00	0.00	0.00
CH	0.00	0.00	0.00	0.00	0.00
NES	0.00	0.00	23.70	55.07	0.00
Viet Nam	3.96	0.68	12.08	24.03	0.00

Source: Trader Survey

Table 4.4.1.4—Average Procurement of Canna Roots by Source

	Roots from (tons):				
Region	Own Production	Farmers	Traders	Other Enterprises	Other
NMM	0.00	0.00	0.00	0.00	0.00
RRD	0.00	61.53	117.50	0.00	0.00
NCC	0.00	0.00	0.00	0.00	0.00
SCC	0.00	0.00	0.00	0.00	0.00
CH	0.00	0.00	0.00	0.00	0.00
NES	0.00	0.00	0.00	0.00	0.00
Viet Nam	0.00	33.17	63.35	0.00	0.00

Source: Trader Survey

Table 4.4.1.5—Average Procurement of Wet Canna Starch by Source

	Wet Starch from (tons):				
Region	Own Production	Farmers	Traders	Other Enterprises	Other
NMM	0.00	0.00	0.00	0.00	0.00
RRD	0.00	39.05	0.00	23.98	0.00
NCC	0.00	0.00	0.00	0.00	0.00
SCC	0.00	1.67	0.00	0.00	0.00
CH	0.00	25.00	0.00	0.00	0.00
NES	0.00	0.00	0.00	0.00	0.00
Viet Nam	0.00	22.01	0.00	12.93	0.00

Source: Trader Survey

Table 4.4.1.6—Average Procurement of Dry Canna Starch by Source

	Dry Starch from (tons):				
Region	Own Production	Farmers	Traders	Other Enterprises	Other
NMM	0.00	0.00	0.00	0.00	0.00
RRD	0.10	12.60	1.15	0.26	0.00
NCC	0.00	0.00	0.00	0.00	0.00
SCC	0.00	2.50	0.00	0.00	0.00
CH	0.00	9.50	0.00	0.00	0.00
NES	0.00	0.00	0.00	0.00	0.00
Viet Nam	0.06	7.25	0.62	0.14	0.00

Source: Trader Survey

Table 4.4.2.1—Average Sales of Wet Cassava Starch by Destination

	Wet Cassava Starch sales to (tons):															
Region	Noodles	Maltose	Traders	Starch Enterprises	Packaging Paper	Paper Mills	Pharma-ceuticals	Textiles	Adhesives	Plywood	House-holds	Exporters	Food Industry	Cosmetics	Petroleum	Other
NMM	0.00	1000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.65	0.00	0.00	2.42
NCC	22.47	0.00	1.33	0.00	0.00	0.00	0.13	0.00	0.00	0.00	19.27	0.00	6.00	0.00	0.00	16.33
SCC	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	37.50	0.00	105.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	9.96	1.30	64.52	7.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.56	0.00	0.00	0.00
Viet Nam	6.63	9.00	18.97	1.67	0.00	0.00	0.02	0.00	0.00	0.00	2.51	0.00	5.13	0.00	0.00	3.43

Source: Trader Survey

Table 4.4.2.2: Average Sales of 1st Class Cassava Starch by Destination

	1st Class Cassava Starch sales to (tons):															
Region	Noodles	Maltose	Traders	Starch Enterprises	Packaging Paper	Paper Mills	Pharma-ceuticals	Textiles	Adhesives	Plywood	Households	Exporters	Food Industry	Cosmetics	Petroleum	Other
NMM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	0.00	0.00	0.26	0.26	6.45	0.00	0.00	0.00	0.02	0.00	1.03	0.00	6.29	0.00	0.00	2.65
NCC	6.67	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.40	0.00	5.20	0.00	0.00	8.47
SCC	12.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00
CH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	0.37	1.22	55.56	20.89	4.81	0.37	0.00	1.48	0.00	0.00	2.22	173.33	0.00	0.00	0.00	0.00
Viet Nam	1.61	0.29	13.18	5.04	4.61	0.09	0.09	0.35	0.01	0.00	1.15	40.70	4.07	0.00	0.00	2.53

Source: Trader Survey

Table 4.4.2.3—Average Sales of 2nd Class Cassava Starch by Destination

	2nd Class Cassava Starch sales to (tons):															
Region	Noodles	Maltose	Traders	Starch Enterprises	Packaging Paper	Paper Mills	Pharma-ceuticals	Textiles	Adhesives	Plywood	Households	Exporters	Food Industry	Cosmetics	Petroleum	Other
NMM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	0.00	3.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.00	13.31	0.00	0.00	0.00
NCC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Viet Nam	0.00	1.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.00	7.17	0.00	0.00	0.00

Source: Trader Survey

Table 4.4.2.4—Average Sales of Wet Canna Starch by Destination

	Wet Canna Starch sales to (tons):															
Region	Noodles	Maltose	Traders	Starch Enterprises	Packaging Paper	Paper Mills	Pharma-ceuticals	Textiles	Adhesives	Plywood	Households	Exporters	Food Industry	Cosmetics	Petroleum	Other
NMM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	28.76	0.00	36.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NCC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCC	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Viet Nam	16.46	0.00	19.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Trader Survey

Table 4.4.2.5—Average Sales of Dry Canna Starch by Destination

	Dry Canna Starch sales to (tons):															
Region	Noodles	Maltose	Traders	Starch Enterprises	Packaging Paper	Paper Mills	Pharma-ceuticals	Textiles	Adhesives	Plywood	Households	Exporters	Food Industry	Cosmetics	Petroleum	Other
NMM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RRD	7.77	0.00	5.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.18
NCC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCC	2.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
CH	9.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.63	0.00	3.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.10

Source: Trader Survey

Table 4.5.1—Average Procurement Prices of Cassava Products by Season

	Cassava Roots (Dong/kg)		Wet Cassava Starch (Dong/kg)		Dry 1st Class Cassava (Dong/kg)		Dry 2nd Class Cassava (Dong/kg)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
NMM			900.00	1000.00				
RRD	285.56	340.59	900.00		2066.67	1933.33	1637.50	1750.00
NCC	343.33	373.33	1219.23	1300.00	2030.00	2266.67		
SCC			900.00		1293.33			
CH	230.00		1130.00	1400.00				
NES	349.55	348.00	1091.18	1137.50	1585.00	1612.00		
Viet Nam	305.12	346.00	1124.57	1173.53	1773.33	1816.84	1637.50	1750.00

Source: Trader Survey

Table 4.5.2—Average Procurement Prices of Cassava Roots by Source

Region	Roots from	
	Farmer (Dong/kg)	Traders (Dong/kg)
RRD	242.50	338.33
NCC	290.00	385.00
NES	351.82	382.50
Viet Nam	305.00	368.33

Source: Trader Survey

Table 4.5.3—Average Procurement Prices for Wet Cassava Starch by Source

Region	Wet Cassava Starch from		
	Other Enterprises (Dong/kg)	Farmers (Dong/kg)	Traders (Dong/kg)
NMM	970.00		
RRD	900.00		
NCC	1200.00	1350.00	1252.00
SCC		900.00	
CH		1150.00	
NES	1096.88		1225.00
Viet Nam	1085.26	1228.57	1247.50

Source: Trader Survey

Table 4.5.4—Average Procurement Prices for Dry Cassava Starch by Source

Region	Dry Cassava Starch from	
	Traders (Dong/kg)	Other Enterprises (Dong/kg)
RRD	1800.00	1700.00
NCC	2080.00	1800.00
NES	1500.00	1511.54
Viet Nam	2008.33	1543.33

Source: Trader Survey

Table 4.5.5—Average Procurement Prices for Canna Products by Source

	Canna Roots (Dong/kg)		Wet Canna Starch (Dong/kg)		Dry Canna Starch (Dong/kg)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
RRD	375.88	366.67	1747.37	1983.33	3281.82	2700.00
SCC			2500.00		4900.00	
CH			2000.00	2200.00	4000.00	
Viet Nam	375.88	366.67	1795.24	2014.29	3461.54	2700.00

Source: Trader Survey

Table 4.5.6—Average Procurement Prices for Wet Starch by Source

Region	Wet Canna Starch from	
	Farmers (Dong/kg)	Other Enterprises (Dong/kg)
RRD	1741.18	2025.00
SCC	1700.00	
CH	2100.00	
Viet Nam	1755.00	2025.00

Source: Trader Survey

Table 4.5.7—Average Procurement Prices for Dry Canna Starch by Source

Region	Dry Canna Starch from			
	Own Production (Dong/kg)	Farmers (Dong/kg)	Traders (Dong/kg)	Other Enterprises (Dong/kg)
RRD	1700.00	2600.00	2800.00	3650.00
SCC		4900.00		
CH		4600.00		
Viet Nam	1700.00	2958.33	2800.00	3650.00

Source: Trader Survey

Table 4.5.8—Average Sales Price for Cassava Products by Season

	Cassava Roots (Dong/kg):		Wet Cassava Starch (Dong/kg):		Dry 1st Class Cassava Starch (Dong/kg):		Dry 2nd Class Cassava Starch (Dong/kg):	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
NMM			1100.00	1100.00				
RRD	525.93	443.53	1170.00		2745.45	2400.00	1887.50	2050.00
NCC	375.00	410.00	1404.17	1533.33	2200.00	2600.00		
SCC			950.00		1350.00			
CH	250.00		1355.00	1800.00				
NES	376.25	362.50	1266.67	1422.73	1999.09	1958.33		
Viet Nam	479.21	426.52	1305.63	1446.88	2178.44	2186.36	1887.50	2050.00

Source: Trader Survey

Table 4.5.9—Average Sales Prices for Wet Cassava Starch by Destination

	Wet Starch Sales to (Dong/kg):					
Region	Maltose	Food Industry	Traders	Pharmaceuticals	Households	Starch Enterprises
NMM	1100.00					
RRD		1000.00				
NCC		1850.00	1600.00	1600.00	2160.00	
CH			1770.00			
NES	1200.00	1200.00	1225.00			1386.00
Viet Nam	1150.00	1475.00	1340.00	1600.00	2160.00	1386.00

Source: Trader Survey

Table 4.5.10—Average Sales Prices for 1st Class Dry Cassava Starch by Destination

	1st Class Cassava Starch to (Dong/kg):												
Region	Traders	Starch Enterprises	Packaging Paper	Adhesives	Households	Food Industry	Other	Noodles	Pharmaceutical	Maltose	Paper	Textiles	Exporters
RRD	2400.00	2400.00	2600.00	4000.00	2175.00	1900.00	4025.00						
NCC					3000.00	2933.33	2083.33	3000.00	3000.00				
SCC					1360.00			1360.00					
NES	1840.91	1835.71	2200.00		2300.00			1600.00		1725.00	3500.00	3500.00	2600.00
Viet Nam	1887.50	1906.25	2400.00	4000.00	2207.50	2675.00	2860.00	1736.00	3000.00	1725.00	3500.00	3500.00	2600.00

Source: Trader Survey

Table 4.5.11—Average Sales Prices for 2nd Class Dry Cassava Starch by Destination

	2nd Class Cassava Starch to		
Region	Maltose (Dong/kg)	Households (Dong/kg)	Food Industry (Dong/kg)
RRD	2000.00	1800.00	2033.33
NCC			
SCC			
NES			
Viet Nam	2000.00	1800.00	2033.33

Source: Trader Survey

Table 4.5.12—Average Sales Prices of Canna Products by Season

	Canna Roots (Dong/kg)		Wet Canna Starch (Dong/kg)		Dry Canna Starch (Dong/kg)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
RRD	493.33	496.67	2030.00	2271.43	3800.00	3866.67
NCC			1800.00			
SCC			2600.00		5000.00	
CH			2600.00	2800.00	5000.00	5000.00
Viet Nam	493.33	496.67	2069.57	2337.50	3926.32	4028.57

Source: Trader Survey

Table 4.5.13—Average Sales Prices for Wet Canna Starch by Destination

Region	Wet Starch to Traders (Dong/kg)
RRD	1950.00
Viet Nam	1950.00

Source: Trader Survey

Table 4.5.14—Average Sales Prices for Dry Canna Starch by Destination

Region	Dry Canna Starch to		
	Noodles (Dong/kg)	Traders (Dong/kg)	Households (Dong/kg)
RRD	3442.86	2920.00	6166.67
SCC	5000.00		5000.00
CH	5000.00		
Viet Nam	3788.89	2920.00	5875.00

Source: Trader Survey

Table 4.6.1—Transportation Usage among traders (% Usage within region)

Region	% within region
NMM	0.00
RRD	77.42
NCC	86.67
SCC	100.00
CH	100.00
NES	74.07
Viet Nam	78.95

Source: Trader Survey

Table 4.6.2—Most important means of transportation for traders

Means of Transportation	Frequency	Valid Percent
Truck	52	57.78
Cart	14	15.56
Bicycle	7	7.78
Cyclo	6	6.67
Boat	1	1.11
Other	10	11.11

Source: Trader Survey

Table 4.6.3—Most important means of transportation by region (% within region)

Means of Transportation	Region					
	RRD	NCC	SCC	CH	NES	Viet Nam
Truck	70.83		16.67	100.00	70.00	57.78
Cart	6.25	7.69	83.33		25.00	15.56
Bicycle		53.85				7.78
Cyclo	4.17	30.77				6.67
Boat	2.08					1.11
Other	16.67	7.69			5.00	11.11
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: Trader Survey

Table 4.6.4—Average Distance for Fresh Root Purchases

Region	Distance (km)
RRD	120.17
NCC	1.67
CH	0.00
NES	22.45
Viet Nam	79.37

Source: Trader Survey

Table 4.6.5—Average Distance for Wet Starch Purchases

Region	Distance (km)
NMM	60.00
RRD	45.69
NCC	2.77
SCC	0.00
CH	0.00
NES	12.56
Viet Nam	22.66

Source: Trader Survey

Table 4.6.6—Average Distance for Dry Starch Purchases

Region	Distance (km)
RRD	25.58
NCC	3.30
SCC	32.50
CH	0.00
NES	6.10
Total	15.24

Source: Trader Survey

Table 4.6.7—Average Distance for Fresh Root Sales

Region	Distance (km)
RRD	105.04
NCC	15.00
CH	0.00
NES	23.38
Viet Nam	78.23

Source: Trader Survey

Table 4.6.8—Average Distance for Wet Starch Sales

Region	Distance (km)
NMM	0.00
RRD	109.14
NCC	7.31
SCC	0.00
CH	357.00
NES	17.27
Viet Nam	63.07

Source: Trader Survey

Table 4.6.9—Average Distance for Dry Starch Sales

Region	Distance (km)
RRD	141.76
NCC	4.50
SCC	0.00
CH	14.00
NES	24.00
Viet Nam	67.72

Source: Trader Survey

Table 4.6.10—Average Transportation Costs by Type of Transport and Region

Means of Transport	Region	Distance Purchase-Sale (km)	Average Weight (quintals)	Average Cost per shipment (thousand Dong)	Unit Cost (thousand Dong/ton/km)
Truck	RRD	233.24	115.48	673.50	1.17
	SCC	150.00	50.00	350.00	0.47
	CH	245.00	60.00	616.67	1.04
	NES	47.33	37.92	279.17	1.95
	Viet Nam	171.65	84.05	528.33	1.40
Cart	SCC	1.33	2.00	30.00	125.00
	Viet Nam	1.33	2.00	30.00	125.00
Cyclo	RRD	2.50	4.00	5.00	5.28
	NCC	5.00	3.00	15.00	10.00
	Viet Nam	4.00	3.40	11.00	8.11
Boat	RRD	100.00	100.00	6000.00	6.00
	Viet Nam	100.00	100.00	6000.00	6.00
Tractor	RRD	38.00	25.50	170.63	2.65
	NCC	26.67	12.33	70.00	2.94
	Viet Nam	34.91	21.91	143.18	2.73
Other	NES	70.00	200.00	1500.00	1.07
	Viet Nam	70.00	200.00	1500.00	1.07
Total	RRD	165.84	85.53	672.42	1.97
	NCC	15.83	7.67	42.50	6.47
	SCC	38.50	14.00	110.00	93.87
	CH	245.00	60.00	616.67	1.04
	NES	49.08	50.38	373.08	1.88
	Viet Nam	119.47	63.34	495.44	8.83

Source: Trader Survey

Table 4.6.11—Frequency of Restrictions on movement of goods (% responding yes)

Region	% reporting restrictions
RRD	58.70
NCC	0.00
SCC	20.00
CH	0.00
NES	17.65
Viet Nam	37.80

Source: Trader Survey

Table 4.6.12—Most Important type of restriction adversely affecting business

Type of Restriction	Number	Percent
Police	26	86.67
Inter-district blocks	2	6.67
Inter-province blocks	1	3.33
Tolls	1	3.33
Total	30	100.00

Source: Trader Survey

Table 4.6.13—Various Transportation Details

	Percentage
% Processors with Transporters Problems	4.76
% Processors who have choice among transporters	93.33
% Processors who Negotiate Fees	72.41

Source: Trader Survey

Table 4.6.14—Sources of Information (% of Traders)

Source of Information	Type of Information		
	Price and Market	Regulations	Credit
Radio/TV	0.95	4.76	0.00
Letter/Courier	3.81	0.00	9.09
Intermediaries	0.95	0.00	0.00
Personal Contacts	14.29	4.76	0.00
Banks	2.86	0.00	90.91
Starch Users	39.05	14.29	0.00
Other Starch Enterprises	5.71	0.00	0.00
Traders	32.38	0.00	0.00
Extension Agents	0.00	52.38	0.00
Press	0.00	23.81	0.00

Source: Trader Survey

Table 4.6.15— Means of Communication for Traders (% of traders)

Type of Communication	Percentage
Telephone	49.56
Fax Machine	1.79
Computer	0.88
Email	0.88

Source: Trader Survey

Table 4.7.1—Percentage of traders using storage facilities (% within region)

Region	Percentage
NMM	0.00
RRD	46.77
NCC	86.67
SCC	16.67
CH	25.00
NES	55.56
Viet Nam	51.30

Source: Trader Survey

Table 4.7.2—Type of Facility used by Traders

Type of Facility	Number	Percent
Open Air	2	3.51
Roof Covered	23	40.35
Concrete Structure	27	47.37
Other (Yard)	4	7.02
Other (Bags)	1	1.75
Total	57	100.00

Source: Trader Survey

Table 4.7.3—Type of Storage Facility of Traders by Region (% within region)

	Region					
Type of Facility	RRD	NCC	SCC	CH	NES	Viet Nam
Open Air	3.70	7.69				3.51
Roof Covered	25.93	46.15		100.00	60.00	40.35
Concrete Structure	59.26	38.46	100.00		33.33	47.37
Other (Yard)	11.11	7.69				7.02
Other (Bags)					6.67	1.75

Source: Trader Survey

Table 4.7.4—Average Storage Capacity by Type of Facility for traders

Type of Facility	Region	Capacity (quintals)
Open Air	RRD	100.00
	NCC	30.00
	Viet Nam	65.00
Roof Covered	RRD	650.29
	NCC	150.00
	CH	100.00
	NES	238.89
	Viet Nam	334.87
Concrete Structure	RRD	159.69
	NCC	104.00
	SCC	100.00
	NES	4640.00
	Viet Nam	976.85
Other (Yard)	RRD	466.67
	NCC	70.00
	Viet Nam	367.50
Other (Bags)	NES	10.00
	Viet Nam	10.00
Total	RRD	318.78
	NCC	116.92
	SCC	100.00
	CH	100.00
	NES	1690.67
	Viet Nam	626.09

Source: Trader Survey

Table 4.7.5—Storage details of Roots for traders

	Average Root Stock (tons):		Average Holding Period (Days)		Average expected Losses (%)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
RRD	0.28	0.28	2.00	2.00	2.00	5.00
NCC	0.08	0.08	2.00	2.00	0.00	0.00
SCC	0.00	0.00				
CH	0.00	0.00				
NES	0.00	0.00				
Total	0.15	0.15	2.00	2.00	1.00	2.50

Source: Trader Survey

Table 4.7.6—Storage details of Wet Starch for traders

	Average Wet Starch Stock (tons)		Average Holding Period (Days)		Average Expected Losses (%)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
RRD	9.72	1.34	6.56	31.00	2.38	2.17
NCC	6.62	2.54	26.45	54.00	1.25	2.50
SCC	0.00	0.00				
CH	3.00	0.00	50.00			
NES	7.20	0.30	20.00	13.00	0.60	0.50
Total	8.12	1.29	19.29	35.69	1.52	1.90

Source: Trader Survey

Table 4.7.7—Storage Details of Traders for Dry Starch

	Average Dry Starch Stock (tons)		Average Holding Period (days)		Average expected losses (%)	
Region	Peak	Offpeak	Peak	Offpeak	Peak	Offpeak
RRD	10.01	3.28	60.06	11.00	0.80	0.00
NCC	4.46	1.69	26.67	36.67	0.17	0.00
SCC	5.00	0.00	15.00			
CH	0.00	0.00				
NES	16.70	4.67	30.17	16.00	1.55	2.00
Total	10.23	3.17	42.00	17.80	0.96	1.11

Source: Trader Survey

Table 4.8.1—Proportion of Traders who receive enough funds after borrowing (% within region)

Region	Percent
RRD	68.18
NCC	87.50
SCC	0.00
CH	25.00
NES	54.55
Viet Nam	60.27

Source: Trader Survey

Table 4.8.2—Most important for inability to obtain more funds

Reason	Percent
No Collateral	47.37
Difficulty with bank	31.58
Interest Rate too high	21.05

Source: Trader Survey

Table 4.8.3—Number of Traders that sell goods on consignment

Region	Percent
NMM	100.00
RRD	77.05
NCC	86.67
SCC	16.67
CH	75.00
NES	62.96
Viet Nam	71.93

Source: Trader Survey

Table 4.8.4—Percentage of Total Sales within region that are made on consignment basis

Region	Percentage of Sales made on consignment	Length of Consignment Period (days)
NMM	100.00	30.00
RRD	51.61	13.00
NCC	43.33	5.33
SCC	5.00	1.17
CH	32.50	5.50
NES	27.78	3.37
Viet Nam	42.26	9.01

Source: Trader Survey

Table 4.8.5—Percentage of Traders who receive advance payment for raw materials

Region	Percent
NMM	0.00
RRD	53.23
NCC	66.67
SCC	16.67
CH	50.00
NES	70.37
Viet Nam	56.52

Source: Trader Survey

Table 4.8.6—Percentage of Total Sales where advance payment received

Region	Percentage of Sales where advance payment received	Length of time which advance payment received (days)
NMM	0.00	0.00
RRD	28.71	7.03
NCC	35.33	2.67
SCC	8.33	1.67
CH	25.00	2.00
NES	30.74	3.63
Viet Nam	28.61	5.15

Source: Trader Survey

Table 4.9.1—Seasonal Prices for Cassava Roots (Dong/kg)

Region	October-97	November-97	December-97	January-98	February-98	March-98
RRD	395.20	394.00	406.54	409.63	424.07	448.52
NCC	370.00	380.00	380.00	386.67	416.67	416.67
CH	190.00	190.00	190.00	200.00	200.00	200.00
NES	374.57	368.13	361.88	364.38	370.63	390.00
Viet Nam	383.39	381.76	389.34	393.21	406.79	428.68

Source: Trader Survey

Table 4.9.2—Seasonality of Prices of Canna Roots (Dong/kg)

Region	October-97	November-97	December-97	January-98	February-98	March-98
RRD	471.11	466.67	466.00	435.00	477.27	485.45
Viet Nam	471.11	466.67	466.00	435.00	477.27	485.45

Source: Trader Survey

Table 4.9.3—Seasonality of Prices of Wet Cassava Starch (Dong/kg)

Region	October-97	November-97	December-97	January-98	February-98	March-98
NMM	1100.00	1100.00	1100.00	1100.00	1100.00	1100.00
RRD	2000.00	1900.00	1550.00	1700.00	1750.00	1750.00
NCC	1507.69	1461.54	1461.54	1553.85	1564.62	1598.46
SCC	950.00	950.00	950.00	950.00	950.00	950.00
CH	1310.00	1335.00	1345.00	1350.00	1375.00	1375.00
NES	1295.00	1290.00	1266.67	1286.67	1346.43	1411.11
Viet Nam	1421.38	1378.53	1348.24	1401.47	1439.09	1492.14

Source: Trader Survey

Table 4.9.4—Seasonality of Prices of Wet Canna Starch

Region	October-97	November-97	December-97	January-98	February-98	March-98
RRD	2225.00	2085.00	1975.00	1980.00	2072.22	2236.11
SCC	2600.00	2600.00	2600.00	2620.00	2620.00	2620.00
CH	2500.00	2500.00	2500.00	2700.00	2600.00	2600.00
Viet Nam	2261.11	2127.27	2027.27	2041.82	2126.00	2273.50

Source: Trader Survey

Table 4.9.5—Seasonality of Prices of 1st Class Cassava Starch (Dong/kg)

Region	October-97	November-97	December-97	January-98	February-98	March-98
RRD	2818.18	2781.82	2770.00	2730.00	2772.73	2872.73
NCC	2680.00	2460.00	2460.00	2520.00	2400.00	2400.00
SCC	1360.00	1360.00	1360.00	1386.67	1386.67	1386.67
NES	1844.44	1857.50	1870.00	1890.00	1947.50	2039.47
Viet Nam	2207.57	2157.18	2144.21	2154.21	2195.13	2276.58

Source: Trader Survey

Table 4.9.6—Seasonality of Prices of 2nd Class Cassava Starch (Dong/kg)

Region	October-97	November-97	December-97	January-98	February-98	March-98
RRD	2085.71	2114.29	2142.86	1957.14	2042.86	2128.57
Viet Nam	2085.71	2114.29	2142.86	1957.14	2042.86	2128.57

Source: Trader Survey

Table 4.9.7—Seasonality of Prices of Dry Canna Starch (Dong/kg)

Region	October-97	November-97	December-97	January-98	February-98	March-98
RRD	4378.57	4213.33	4587.50	4425.00	3692.86	3731.25
SCC	5000.00	5000.00	5000.00	5100.00	5100.00	5100.00
Viet Nam	4420.00	4262.50	4633.33	4500.00	3786.67	3811.76

Source: Trader Survey

Table 4.10.1—Profitability in trading, 1996-1997

	1996	1997
Good	29.20	29.57
Normal	58.41	66.96
Bad	12.39	3.48

Source: Trader Survey

Table 4.10.2—Profitability in 1996 by Region (% within region)

	Region						Total
Profitability	NMM	RRD	NCC	SCC	CH	NES	
Good		37.70	46.67		50.00	3.85	29.20
Normal	100.00	60.66	53.33	100.00	50.00	46.15	58.41
Bad		1.64				50.00	12.39

Source: Trader Survey

Table 4.10.3—Profitability in 1997 by region (% within region)

	Region						Total
	NMM	RRD	NCC	SCC	CH	NES	
Good	100.00	22.58	33.33	100.00	100.00	14.81	29.57
Normal		74.19	66.67			77.78	66.96
Bad		3.23				7.41	3.48

Source: Trader Survey

Table 4.10.4—Most Important Reason for Change in Profitability for Traders

Reason	Percent
Sale Price	32.10
Raw Material Price	8.64
Volume Trade	50.62
Interest Rate	2.47
Labor Costs	1.23
Competition	4.94

Source: Trader Survey

Table 4.10.5—Degree of Profitability among Traders

Reason	Region	Positive (1) or Negative (2) Effect	Price or Volume in 1997	Price or Volume in 1996
Sale Price	RRD	1.67	1358.18	1690.00
	NCC	1.14	1133.33	1523.33
	CH	1.00	1020.00	975.00
	NES	1.00	1090.00	875.00
	Viet Nam	1.42	1253.33	1492.22
Raw Material Price	RRD	1.33	1716.67	2633.33
	NES	1.50	950.00	833.33
	Viet Nam	1.43	1333.33	1733.33
Volume Trade	NMM	1.00	10000.00	5000.00
	RRD	1.33	22610.00	25650.00
	NCC	1.50	2206.33	1938.00
	SCC	1.00	221.67	181.67
	CH	1.00	2050.00	1750.00
	NES	1.15	1923.08	1115.38
	Viet Nam	1.23	5052.06	5063.44
Interest Rate	RRD	2.00	7.00	10.00
	Viet Nam	2.00	7.00	10.00
Labor Costs	RRD	2.00		
	Viet Nam	2.00		
Competition	RRD	2.00		
	NCC	2.00		
	Viet Nam	2.00		
Total	NMM	1.00	10000.00	5000.00
	RRD	1.58	6657.35	7737.50
	NCC	1.36	1848.67	1782.50
	SCC	1.00	221.67	181.67
	CH	1.00	1535.00	1362.50
	NES	1.21	1668.33	1041.67
	Viet Nam	1.38	3401.47	3496.49

Source: Trader Survey

Table 4.10.6—Policy Recommendations of Traders

Policy	Frequency	Percent
More Credit	4	8.70
Reduce Transportation Regulations	3	6.52
Increase Length of Loan	12	26.09
Improve Dealings with Bank	6	13.04
Lower Road Fees	3	6.52
Improve Starch Market	4	8.70
Improve Police Regulation	1	2.17
Better Roads	4	8.70
Lower Taxes	1	2.17
Improve Environment	1	2.17
Reduce Number of Inspection Stations	4	8.70
Introduce High Starch Cassava varieties	2	4.35
Put Processing Units where raw materials located	1	2.17

Source: Trader Survey

Table 4.10.7—Policy Recommendations by Region (% within region)

	Region					
Policy	NMM	RRD	NCC	SCC	NES	Viet Nam
More Credit		11.43				8.70
Reduce Transportation Regulations		8.57				6.52
Increase Length of Loan		31.43			20.00	26.09
Improve Dealings with Bank		11.43	25.00		20.00	13.04
Lower Road Fees		8.57				6.52
Improve Starch Market		5.71	25.00		20.00	8.70
Improve Police Regulation		2.86				2.17
Better Roads		5.71	50.00			8.70
Lower Taxes		2.86				2.17
Improve Environment		2.86				2.17
Reduce Number of Inspection Stations		8.57		100.00		8.70
Introduce High Starch Cassava varieties					40.00	4.35
Put Processing Units where raw materials located	100.00					2.17

Source: Trader Survey

Table 4.11.1— Distribution of Trader Sales by Size (% of traders)

	Sales of Cassava Roots	Sales of Canna Roots	Sales of Wet Cassava Starch	Sales of Wet Canna Starch	Sales of Dry Cassava Starch	Sales of Dry Canna Starch
0-100 Tons	70.43	87.61	91.30	88.70	86.09	99.13
100-500 Tons	14.78	5.31	6.96	10.43	11.30	0.87
Over 500 Tons	14.78	7.08	1.74	0.87	2.61	0.00

Source: Trader Survey

Table 4.11.2—Income of Traders in Viet Nam by Region

Region	Operation Costs (thousand Dong)	Total Raw Material Costs (thousand Dong)	Cassava Root Costs (thousand Dong)	Wet Cassava Starch Costs (thousand Dong)	Dry Cassava Starch Costs (thousand Dong)	Canna Root Costs (thousand Dong)	Wet Canna Starch Costs (thousand Dong)	Dry Canna Starch Costs (thousand Dong)	Cassava Root Sales (thousand Dong)	Wet Cassava Starch Sales (thousand Dong)	Dry Cassava Starch Sales (thousand Dong)	Canna Root Sales (thousand Dong)	Wet Canna Starch Sales (thousand Dong)	Dry Canna Starch Sales (thousand Dong)	Total Costs (thousand Dong)	Total Sales (thousand Dong)	Profit (thousand Dong)	Profit/Total Sales (percent)
NMM	1000	920000	0	920000	0	0	0	0	0	1100000	0	0	0	0	921000	1100000	179000	16
RRD	40504	549640	286316	7258	33411	72467	112589	37596	337920	10524	38276	86260	133703	45205	590144	651890	61745	9
NCC	5339	156430	16870	87166	52393	0	0	0	17550	95208	54621	0	0	0.00	161769	167380	5610	3
SCC	1140	34050	0	900	16733	0	4166	12250	0	950	17550	0	4333	12500	35190	35333	143	0
CH	32562	276025	11500	178125	0	0	51000	35400	12500	222225	0	0	66000	47500	308587	348225	39637	11
NES	198383	682802	177213	376431	129157	0	0	0	105157	114620	666294	0	0	0	881186	886072	4886	1
Total	70311	496419	198568	117904	56044	39069	62691	22139	209596	62347	185110	46505	74605	26675	566730	604841	38110	6

Source: Trader Survey

FIGURE 4.4.1.1: PROCUREMENT OF CASSAVA ROOTS BY SOURCE (%)

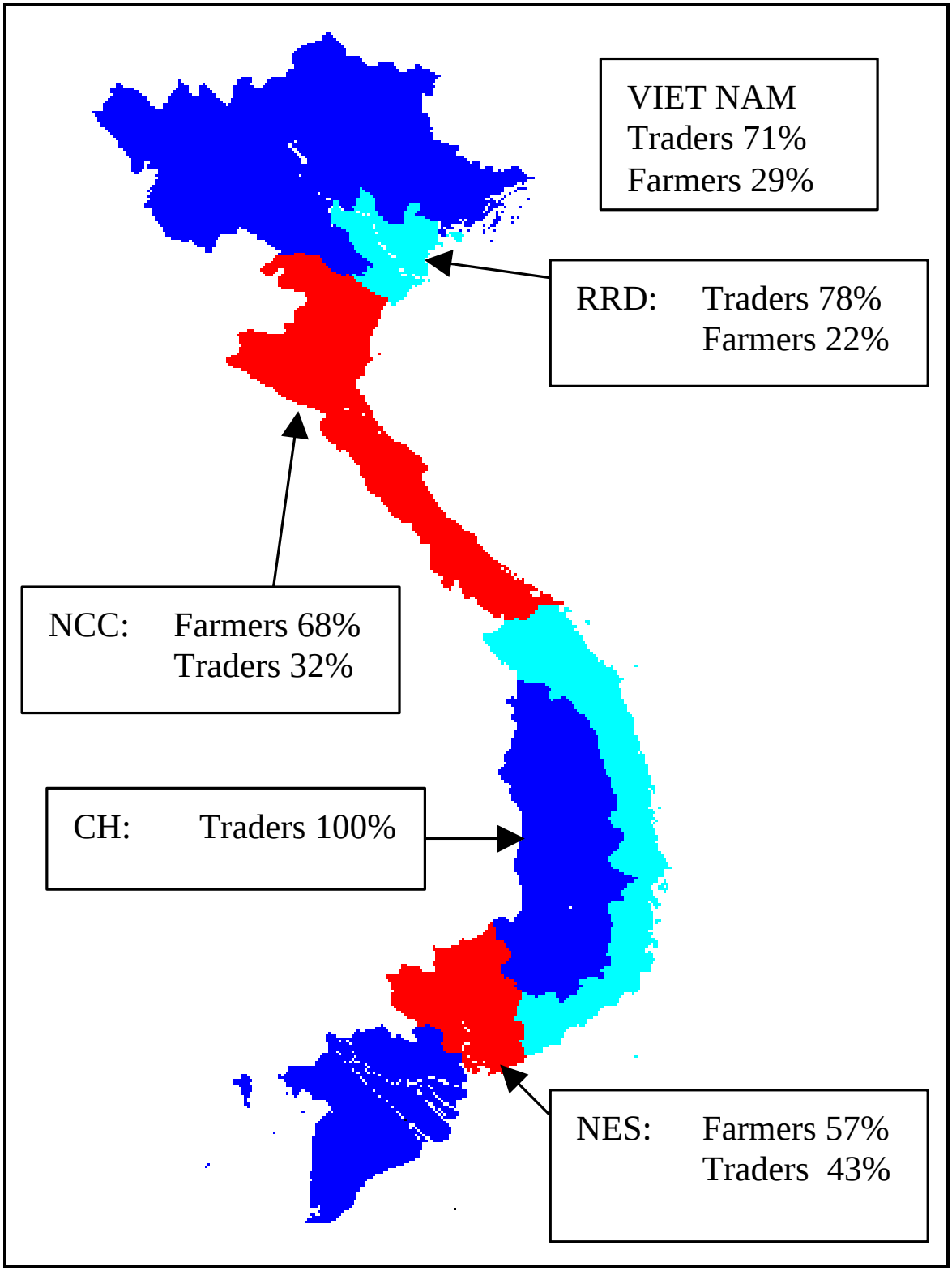


FIGURE 4.4.1.2: PROCUREMENT OF WET CASSAVA STARCH BY SOURCE

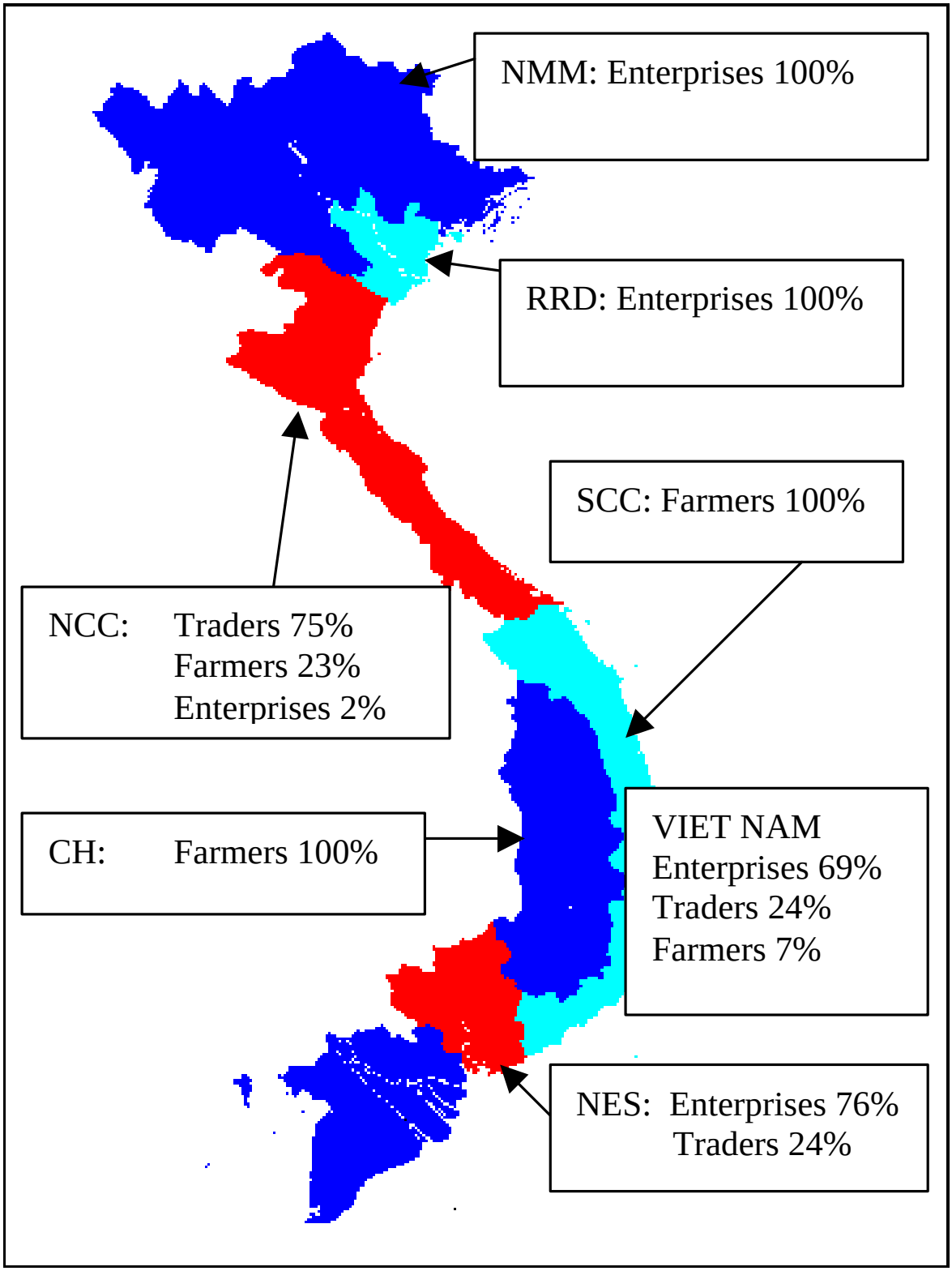


FIGURE 4.4.1.3: PROCUREMENT OF DRY CASSAVA STARCH BY SOURCE

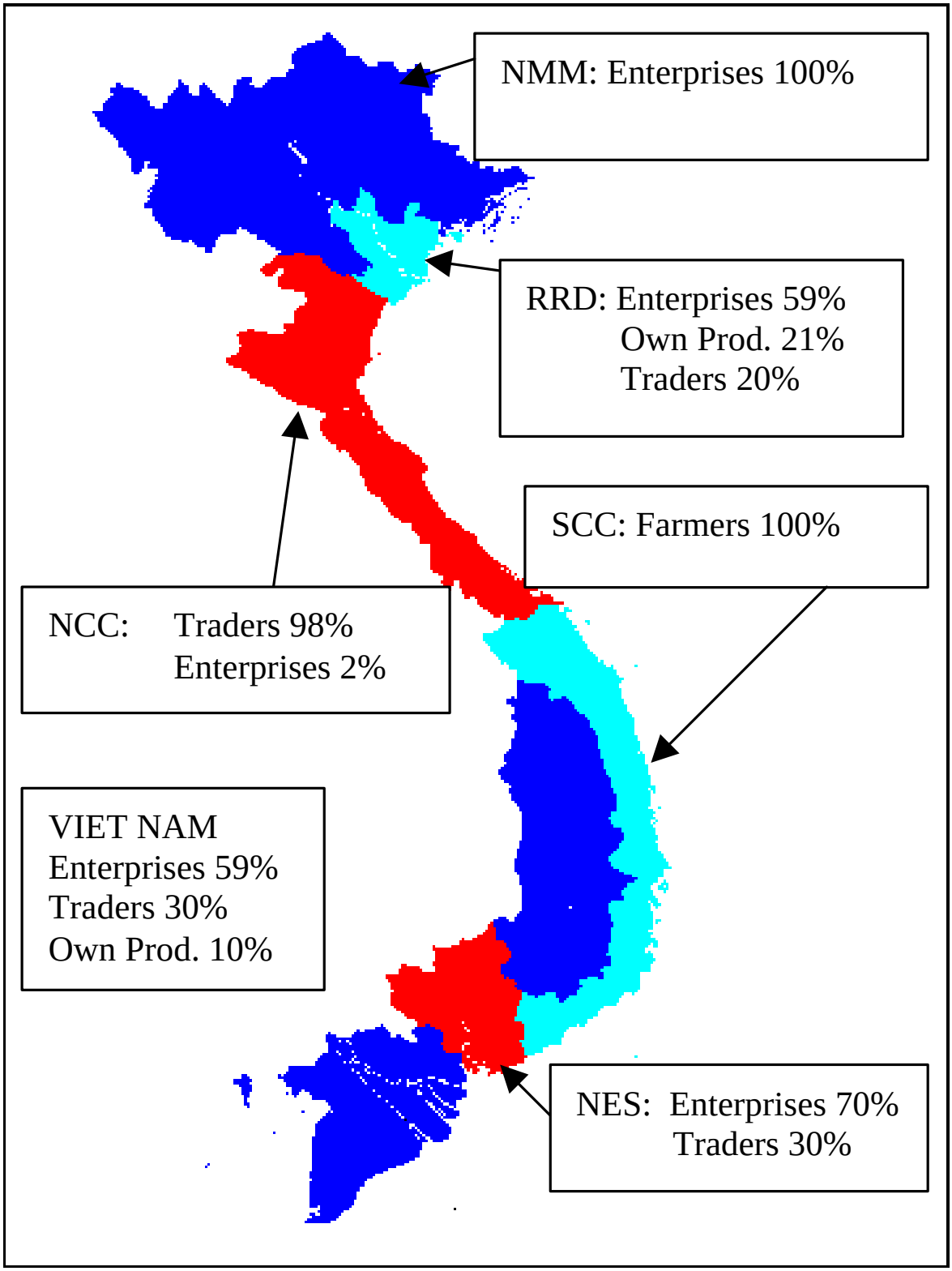


FIGURE 4.4.2.1: SALES OF WET CASSAVA STARCH BY TOP 3 DESTINATIONS

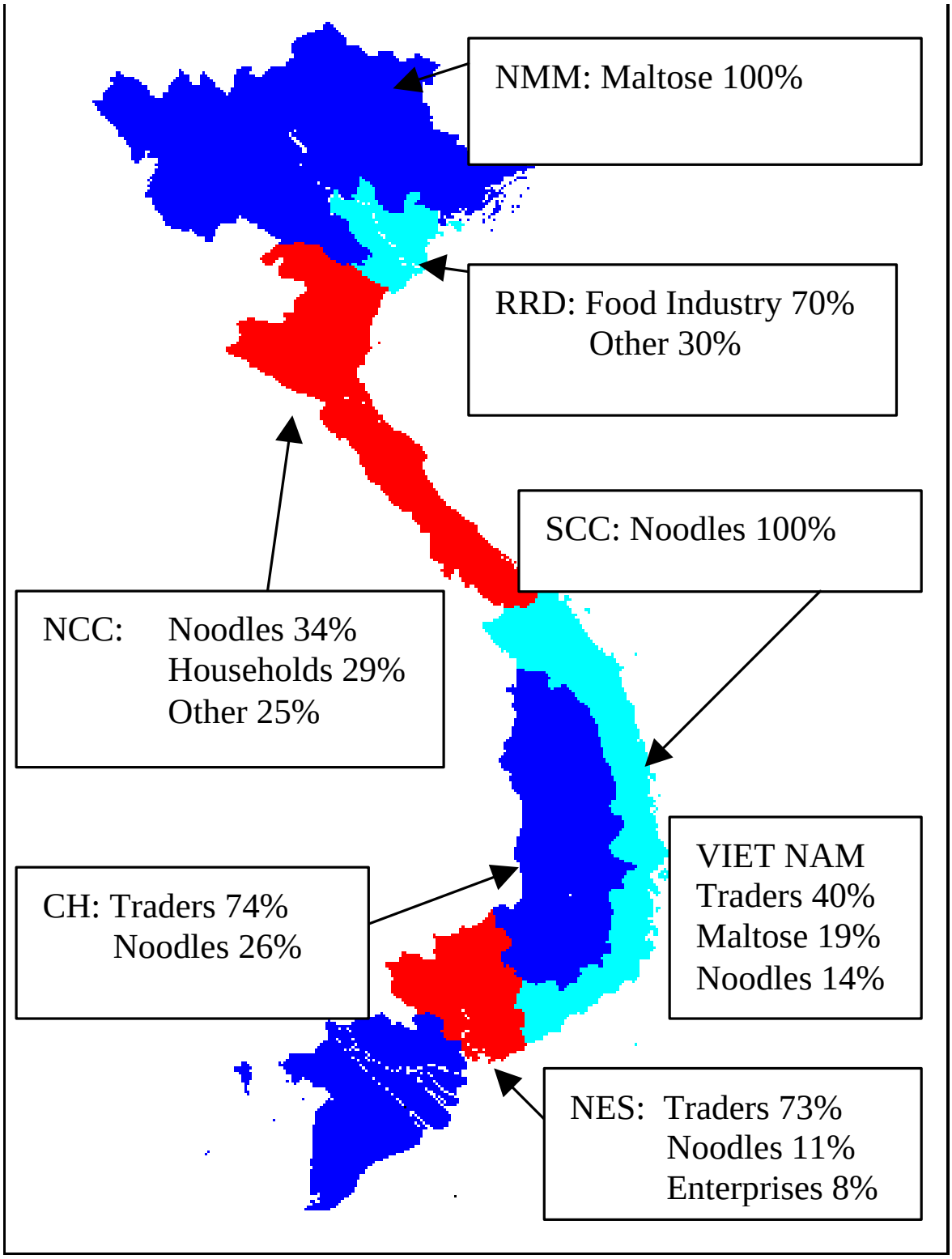


FIGURE 4.4.2.2: SALES OF 1ST CLASS CASSAVA STARCH BY TOP 3 DESTINATIONS

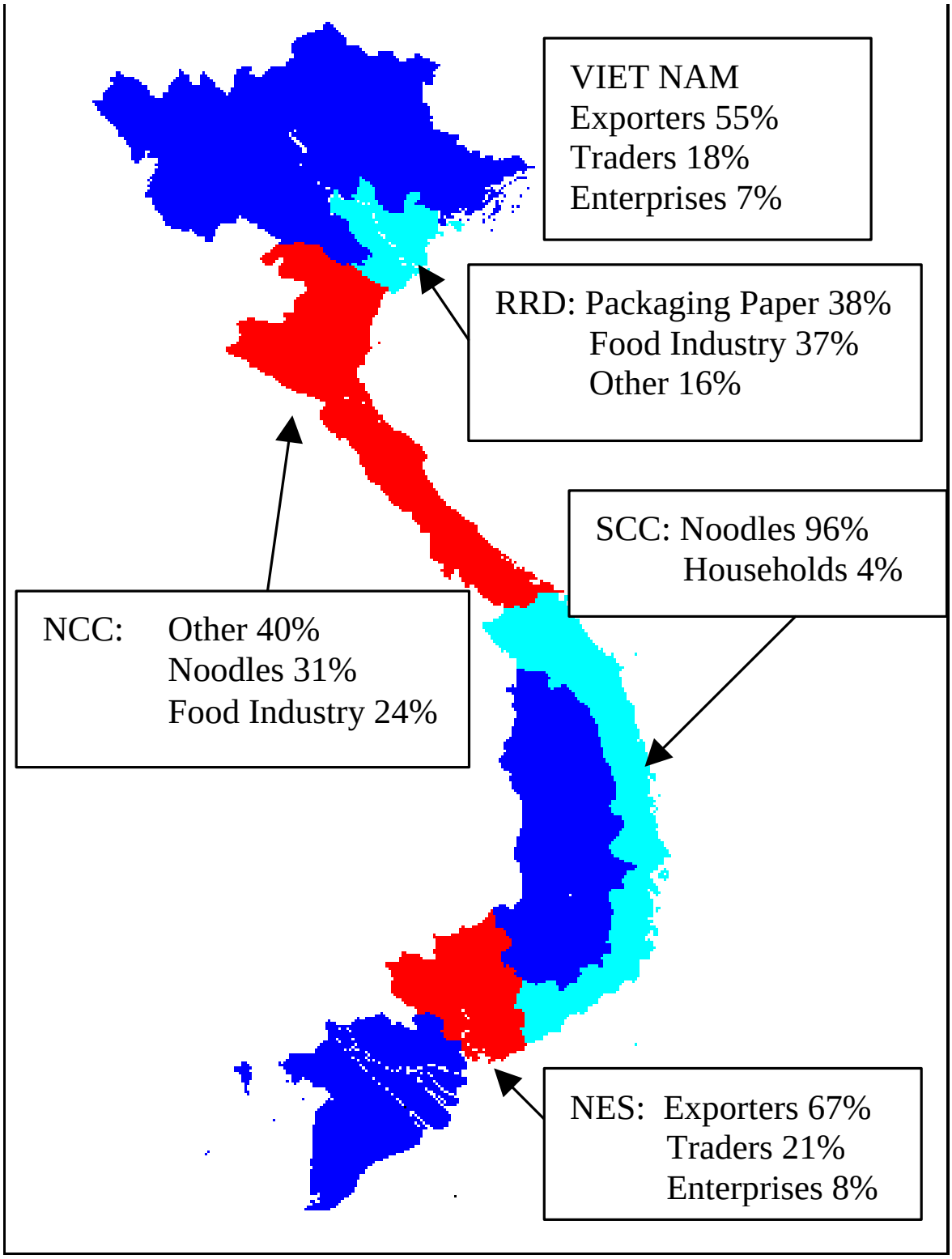


Table 5.1.1—Geographical location of starch using enterprises included in the study.

Region of Vietnam	Code	Provinces	Number of enterprises	% of sample
North Mountains	10	Vinh Phu	5	2.1
Red River Delta	20	Ha Tay, Hai Hung, Hanoi	140	59.6
North Central Coast	30	Thanh Hoa, Thua Thien-Hue	39	16.6
South Central Coast	40	Quangnam Danang	14	6.0
Central Highlands	50	Danang Gai Lai	8	3.4
(NES)	60	HCMC, Dong Nia, Tay Ninh	29	12.3
Total			235	100

Source: End users Survey

Table 5.1.2—Enterprise types and their legal registration.

Enterprise type	% of sample	Legally registered	Not registered
Household	83.4	14	182
Vietnamese owned	8.5	20	0
Foreign owned	0.4	1	0
VN State owned	5.5	13	0
Joint venture with state enterprise	1.3	3	0
Cooperative	0.9	2	0
Total	100	53	182

Source: End users Survey

Table 5.1.3—Main Business Area for End users

	Number	Percent
Maltose	29	12.34
Noodles	130	55.32
Pharm.	8	3.40
Textiles	11	4.68
Adhesive	1	0.43
Plywood	1	0.43
Packaging Paper	6	2.55
Paper	6	2.55
Glucose	2	0.85
Fermentation Products	1	0.43
Starch Processing	2	0.85
Other Food	37	15.74
Other Non-food	1	0.43
Total	235	100.00

Source: End users Survey

Table 5.1.4—End user Business Area by Region

Business Area		Region						
		NMM	RRD	NCC	SCC	CH	NES	Viet Nam
Maltose	Number	1	25				3	29
	% within region	20.00	17.86				10.34	12.34
Noodles	Number		94	10	14	8	4	130
	% within region		67.14	25.64	100.00	100.00	13.79	55.32
Pharm.	Number	1	4				3	8
	% within region	20.00	2.86				10.34	3.40
Textiles	Number	1	5	1			4	11
	% within region	20.00	3.57	2.56			13.79	4.68
Adhesive	Number						1	1
	% within region						3.45	0.43
Plywood	Number			1				1
	% within region			2.56				0.43
Packaging Paper	Number	2	1				3	6
	% within region	40.00	0.71				10.34	2.55
Paper	Number		2				4	6
	% within region		1.43				13.79	2.55
Glucose	Number		2					2
	% within region		1.43					0.85
Fermentation Products	Number						1	1
	% within region						3.45	0.43
Starch Processing	Number			2				2
	% within region			5.13				0.85
Other Food	Number		6	25			6	37
	% within region		4.29	64.10			20.69	15.74
Other Non-food	Number		1					1
	% within region		0.71					0.43
Total	Number	5	140	39	14	8	29	235
	% within region	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: End users survey

Table 5.1.5—Enterprise Type by Business Area

Enterprise Type		Business Area													
		Maltose	Noodles	Pharm.	Textiles	Adhesive	Plywood	Packaging Paper	Paper	Glucose	Fermentation Products	Starch Processing	Other Food	Other Non-food	Total
Household	Number	27	130			1		2				2	34		196
	% within Business Area	93.10	100.00			100.00		33.33				100.00	91.89		83.40
VN Owned	Number			5	7		1	1	4	1			1		20
	% within Business Area			62.50	63.64		100.00	16.67	66.67	50.00			2.70		8.51
Foreign Owned	Number										1				1
	% within Business Area										100.00				0.43
VN State Owned	Number	1		3	3			3	1				1	1	13
	% within Business Area	3.45		37.50	27.27			50.00	16.67				2.70	100.00	5.53
Joint Venture/SOE	Number				1					1			1		3
	% within Business Area				9.09					50.00			2.70		1.28
Cooperative	Number	1							1						2
	% within Business Area	3.45							16.67						0.85
Total	Number	29	130	8	11	1	1	6	6	2	1	2	37	1	235
	% within Business Area	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: End users Survey

Table 5.1.6—Enterprise type by region

Enterprise Type		Region						
		NMM	RRD	NCC	SCC	CH	NES	Viet Nam
Household	Number		122	36	14	8	16	196
	% within Business Area		87.14	92.31	100.00	100.00	55.17	83.40
VN Owned	Number		7	3			10	20
	% within Business Area		5.00	7.69			34.48	8.51
Foreign Owned	Number						1	1
	% within Business Area						3.45	0.43
VN State Owned	Number	5	6				2	13
	% within Business Area	100.00	4.29				6.90	5.53
Joint Venture/SOE	Number		3					3
	% within Business Area		2.14					1.28
Cooperative	Number		2					2
	% within Business Area		1.43					0.85
Total	Number	5	140	39	14	8	29	235
	% within Business Area	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: End users Survey

Table 5.1.6—Number of years of operation of starch-using enterprises, by enterprise type and region.

Region	Enterprise type	Number of enterprises	Average year of start-up	Earliest year	Latest year
Northern Mountains	State owned	5	1971	1962	1990
Red River Delta	Household	122	1987	1965	1997
Red River Delta	VN owned	7	1971	1955	1988
Red River Delta	State owned	6	1971	1960	1991
Red River Delta	Joint venture	3	1970	1959	1992
Red River Delta	Cooperative	2	1993	1992	1994
North Central Coast	Household	36	1986	1945	1997
North Central Coast	VN owned	3	1992	1988	1997
South central Coast	Household	14	1991	1989	1995
Central highlands	Household	8	1991	1985	1995
NES	Household	16	1990	1980	1997
NES	VN owned	10	1979	1970	1989
NES	Foreign owned	1	1994		
NES	State owned	2	1980	1975	1984

Source: End users Survey

Table 5.1.7 —Average Year of Entry

Business Area	Year of Operation	Years Under Current Management
Maltose	1987.97	5.34
Noodles	1986.82	8.38
Pharm.	1968.50	8.88
Textiles	1973.55	8.64
Adhesive	1994.00	4.00
Plywood	1992.00	1.00
Packaging Paper	1984.50	5.67
Paper	1986.67	6.00
Glucose	1963.50	11.00
Fermentation Products	1994.00	4.00
Starch Processing	1986.00	12.00
Other Food	1987.68	8.84
Other Non-food	1960.00	12.00

Source: End user Survey

Table 5.1.8—Year of Entry by End users

	Number	Percent
Before 1988	99	42.13
1988	22	9.36
1989	10	4.26
1990	26	11.06
1991	11	4.68
1992	29	12.34
1993	11	4.68
1994	14	5.96
1995	6	2.55
1996	3	1.28
1997	4	1.70

Source: End user Survey

Table 5.1.9—Number of years under current management, by region and enterprise type

Region	Enterprise type	Number of enterprises	Number of years under current management		
			Average	Minimum	Maximum
Northern Mountains	State owned	5	9.6	2	32
Red River Delta	Household	122	7.7	1	30
Red River Delta	VN owned	7	6.7	2	16
Red River Delta	State owned	6	8.7	3	15
Red River Delta	Joint venture	3	8.7	6	12
Red River Delta	Cooperative	2	5	4	6
North Central Coast	Household	36	9.9	1	28
North Central Coast	VN owned	3	1.7	1	3
South central Coast	Household	14	7.4	5	13
Central highlands	Household	8	8.4	3	16
NES	Household	16	7.3	2	15
NES	VN owned	10	7.7	3	15
NES	Foreign owned	1	4		
NES	State owned	2	8	2	14

Source: End users Survey

Table 5.1.10—Number of years at current production capacity, by enterprise type and region

Region	Enterprise type	Number of enterprises	Number of years at current capacity		
			Average	Minimum	Maximum
Northern Mountains	State owned	5	2	2	2
Red River Delta	Household	122	4.0	1	13
Red River Delta	VN owned	7	6.9	2	15
Red River Delta	State owned	6	9	3	30
Red River Delta	Joint venture	3	7	2	13
Red River Delta	Cooperative	2	3.5	3	4
North Central Coast	Household	36	5.6	1	22
North Central Coast	VN owned	3	3.7	1	6
South central Coast	Household	14	6	4	10
Central highlands	Household	8	5.6	3	10
NES	Household	16	4.1	2	6
NES	VN owned	10	3.8	2	7
NES	Foreign owned	1	4	-	-
NES	State owned	2	7.5	5	10

Source: End users survey

Table 5.1.11–Household workers

Number of Household Workers, of which:			Number of Hired Workers, of which:			Number of Permanent Workers:		Number of Temporary Workers	
Total HH workers	Female HH workers	HH workers under 16	Total Hired Workers	Female Hired Workers	Hired Workers under 16	Total	Female	Total	Female
2.85	1.30	0.04	0.92	0.00	0.00	600.00	400.00	215.00	140.00
3.90	1.87	0.25	1.08	0.66	0.01				
						281.88	205.00	16.86	12.00
						27758.64	17398.09	11.82	11.18
2.00	1.00	0.00	4.00	2.00	0.00				
						32.00	17.00	0.00	0.00
4.00	1.50	0.00	0.00			188.75	84.00	34.00	12.67
						3614.50	1220.83	0.00	0.00
						1215.00	900.00	100.00	90.00
2.50	2.00	0.00	0.00	0.00	0.00				
2.47	1.50	0.03	1.24	0.64	0.09	120.67	78.67	10.00	10.00
						670.00	400.00	0.00	0.00

Source: End users Survey

Table 5.2.1—Average starch procurement volumes (tons) for 1997, Vietnam (see appendix for regional procurement volumes broken down by end use).

	Cassava 1st class	Cassava 2nd class	Cassava modified	Cassava wet	Canna dry domestic	Canna wet domestic
Maltose	48.97	0.00	0.00	434.64	0.00	0.00
Noodles	3.23	0.00	0.00	7.07	5.99	26.45
Pharm.	731.35	1.88	3.75	0.00	0.00	0.00
Textiles	288.48	0.00	13.69	5.45	0.00	0.00
Adhesive	0.00	10.00	0.00	0.00	0.00	0.00
Plywood	0.00	2.70	0.00	0.00	0.00	0.00
Packaging Paper	30.00	14.17	0.00	0.00	0.00	0.00
Paper	414.00	0.00	0.00	0.00	0.00	0.00
Glucose	1500.00	0.00	0.00	1800.00	0.00	0.00
Fermentation Products	8000.00	0.00	0.00	61,000.00	0.00	0.00
Starch Processing	7.50	0.00	0.00	0.00	0.00	0.00
Other Food	4.94	0.00	0.00	13.58	0.00	0.00
Other Non-food	75.00	0.00	0.00	0.00	0.00	0.00
Viet Nam average	105.53	0.48	0.77	334.83	3.32	14.63

Source: End users survey

Table 5.2.2—Trends in average procurement of 1st class cassava starch in Vietnam 1996-2000.

	1996	1997	2000
Maltose	70.00	48.97	173.10
Noodles	2.45	3.23	3.32
Pharm.	591.00	731.35	896.73
Textiles	273.13	288.48	299.96
Packaging Paper	28.33	30.00	106.67
Paper	395.50	414.00	451.67
Glucose	1250.00	1500.00	3500.00
Fermentation Products	8000.00	8000.00	8000.00
Starch Processing	6.50	7.50	7.50
Other Food	4.91	4.94	6.24
Other Non-food	70.00	75.00	90.00
Viet Nam average	99.53	105.53	147.28

Source: End users survey

Table 5. 2. 3—Trends in average procurement of 2nd class cassava starch in Vietnam 1996-2000 (business areas not shown did not procure this starch).

	1996	1997	2000
Pharm.	1.88	1.88	2.50
Adhesive	8.00	10.00	15.00
Plywood	3.00	2.70	3.00
Packaging Paper	13.00	14.17	17.67
Viet Nam average	0.44	0.48	0.61

Source: End users survey

Table 5.2.4—Trends in average procurement of modified cassava starch in Vietnam 1996-2000. (business areas not shown did not procure this starch).

	1996	1997	2000
Pharm.	2.50	3.75	3.75
Textiles	13.56	13.69	14.35
Viet Nam average	0.72	0.77	0.80

Source: End users survey

Table 5.2.5—Trends in average procurement of wet cassava starch in Vietnam 1996-2000.

	1996	1997	2000
Maltose	372.02	434.64	503.93
Noodles	6.52	7.07	8.06
Textiles	5.45	5.45	5.45
Glucose	1800.00	1800.00	2550.00
Fermentation Products	48,000.00	61,000.00	-
Other Food	13.44	13.58	14.54
Viet Nam average (excluding MSG)	67.20	75.26	90.89
Vietnam average (including MSG)	271.5	334.8	-

Source: End users survey

Note: No projection for 2000 was obtained from the Fermentation Products sector. This was therefore excluded from the calculation of Vietnam average projections for 2000

Table 5.2.6–Trends in average procurement of dry and wet canna starch in Vietnam 1996-2000. (business areas not shown did not procure this starch).

	1996	1997	2000
Dry canna starch			
Noodles	5.98	5.99	7.53
Viet Nam average	3.31	3.32	4.17
Wet canna starch			
Noodles	23.50	26.45	28.56
Viet Nam average	13.00	14.63	15.80

Source: End user survey

Table 5.2.8—Total Procurement Volumes of Cassava Starch in 1997 (tons)

Business Area	Cassava 1st	Cassava 2nd	Cassava	Cassava
Maltose	1420.00	0.00	0.00	12604.50
Noodles	419.50	0.00	0.00	919.20
Pharm.	5850.80	15.00	30.00	0.00
Textiles	3173.30	0.00	150.60	60.00
Adhesive	0.00	10.00	0.00	0.00
Plywood	0.00	2.70	0.00	0.00
Packaging	180.00	85.00	0.00	0.00
Paper	2484.00	0.00	0.00	0.00
Glucose	3000.00	0.00	0.00	3600.00
Fermentation	8000.00	0.00	0.00	61000.00
Starch	15.00	0.00	0.00	0.00
Other Food	182.60	0.00	0.00	502.30
Other Non-	75.00	0.00	0.00	0.00
Total	24800.20	112.70	180.60	78,686.00

Source: End users survey

Table 5.2.9—Procurement by region and type of starch

Region	Cassava 1st Class Starch	Cassava 2nd Class Starch	Cassava Modified Starch	Cassava Wet Starch
NMM	1445.00	10.00	30.00	560.00
RRD	14640.30	0.00	5.60	16022.50
NCC	118.90	2.70	0.00	62.50
SCC	252.00	0.00	0.00	245.00
CH	41.00	0.00	0.00	10.00
NES	8303.00	100.00	145.00	61786.00
Vietnam total	24800.20	112.70	180.60	78686.00

Source: End users survey

Table 5.2.10—Total Procurement Volumes of Canna Starch in 1997

Business Area	Canna Dry Starch	Canna Wet Starch
Noodles	779.20	3438.70
Other	0.00	0.00
Total	779.20	3438.70

Source: End users

Table 5.2.11–Total Procurement Volumes of Canna Starch by region in 1997 (tons). All starch was used in the noodle business area only.

Region	Canna Dry Starch	Canna Wet Starch
NMM	0.00	0.00
RRD	613.70	3428.70
NCC	0.00	0.00
SCC	102.00	0.00
CH	59.50	10.00
NES	4.00	0.00
Viet Nam	779.20	3438.70

Source: End users survey

Table 5.2.12—Average procurement of starch by type and source in 1997

Business Area	Starch source				
	Own production	Starch enterprises	Traders	Urban wholesalers	Importers
1st class cassava starch					
Maltose	0.00	0.00	48.97	0.00	0.00
Noodles	0.00	0.18	0.98	2.07	0.00
Pharm.	0.00	0.00	730.10	1.25	0.00
Textiles	0.00	8.75	3.00	275.82	0.00
Packaging Paper	0.00	25.00	5.00	0.00	0.00
Paper	0.00	411.83	0.83	1.00	0.33
Glucose	0.00	0.00	1500.00	0.00	0.00
Fermentation Products	40000.00	0.00	8000.00	0.00	0.00
Starch Processing	6.00	0.00	1.50	0.00	0.00
Other Food	0.00	2.12	2.18	0.65	0.00
Other Non-food	75.00	0.00	0.00	0.00	0.00
Viet Nam average	170.58	11.99	78.89	14.22	0.01
Cassava Wet starch					
Maltose	0.00	412.26	21.55	0.00	0.00
Noodles	0.25	3.82	1.46	0.15	0.00
Textiles	0.00	0.00	5.45	0.00	0.00
Glucose	0.00	0.00	1800.00	0.00	0.00
Fermentation Products	0.00	0.00	61,000.00	0.00	0.00
Other Food	0.13	8.41	4.76	0.00	0.00
Viet Nam average, excluding VEDAN	0.16	54.31	19.79	0.09	0.00
Vietnam average including VEDAN	0.16	54.31	279.36	0.09	0.00
Canna dry starch					
Noodles	0.08	1.34	3.02	1.60	0.00
Viet Nam average	0.04	0.74	1.68	0.89	0.00
Canna wet starch					
Noodles	0.00	9.02	5.31	11.85	0.00
Viet Nam average	0.00	4.99	2.94	6.56	0.00

Source: End users survey

Table 5.2.13—Location and volume of starch purchases outside the home region of each enterprise, by business area, starch type and region

Region	Business Area	Starch type	Purchase location	No. of enterprises	Average volume
NM	Maltose	Cass, 1st, dry	Ha Tay	1	14,000
	Pharmaceutical	Cass, 1st, dry	Ha Tay	1	150
	Textiles	Cassava, wet	Ha Tay	1	480
	Packaging paper	Cass, 1st, dry	Ha Tay	1	300
	Packaging paper	Cass, 2nd, dry	Ha Tay	1	100
RRD	Noodle	Canna, dry,VN	Thanh Hoa	4	88
	Noodle	Canna, wet,VN	Thanh Hoa	1	480
	Noodle	Canna, wet,VN	Thanh Hoa	3	283
	Textile	Cass, 1st, dry	Vinh Phu	1	100
	Textile	Other	USA	1	650
	Textile	Other	China	1	650
	Glucose	Cassava, wet	Vinh Phu	1	10,000
NES	Various	Cassava	Ha Tay	8	Not recorded

Source: End users survey

Table 5.3.1—Average procurement prices (VNdong/kg) for cassava starch, by type and business area, 1996 and 1997

Business Area	1st class cassava starch		2nd class cassava starch		Modified cassava starch		Wet cassava starch	
	1996	1997	1996	1997	1996	1997	1996	1997
Maltose	1600.00	1750.00					1117.86	1087.93
Noodles	1723.33	1819.23					1136.84	1094.40
Pharm.	4283.33	4166.67	4500.00	4500.00	8000.00	8000.00		
Textiles	2350.00	2593.75			24250.00	13675.00	1500.00	1500.00
Adhesive			2200.00	2500.00				
Plywood			1700.00	1300.00				
Packaging Paper	2400.00	2300.00	2400.00	2500.00				
Paper	2166.67	2866.67						
Glucose	1900.00	1950.00					1375.00	1325.00
Fermentation Products							920.00	995.00
Starch Processing	2250.00	2300.00						
Other Food	2066.72	2150.00					1206.00	1202.38
Other Non-food	5000.00	5200.00						
Viet Nam average	2316.63	2441.94	2571.43	2614.29	18833.33	11783.33	1155.99	1130.44

Source: End users survey

Table 5.3.2—Average procurement prices (VNdong/kg) for domestic dry and wet canna starch, 1996 and 1997

	Dry canna		Wet canna	
	1996	1997	1996	1997
Noodles	5102.13	3837.27	3525.68	2363.10
Viet Nam average	5102.13	3837.27	3525.68	2363.10

Source: End users survey

Table 5.3.3— Relative prices of different starch types (wet cassava starch = 100) for 1996 and 1997

Starch type	1996	1997
Cassava 1st	194	199
Cassava 2nd	170	179
Modified cassava	1448	898
Cassava wet	100	100
Cassava other	85	89
Canna dry, VN	392	295
Canna dry, imported	366	305
Canna wet, VN	271	180
Canna wet, imported	285	191

Source: End users survey

Table 5.3.4—Variation in 1st class cassava starch price by region and end use.

Business Area	Cassava 1st class, dry starch price, 1997 (VN dong/kg)							
	Red River Delta				NES			
	No. enterprises	Av.	Min	Max	No. enterprises	Av.	Min	Max
Maltose					1	1500	1500	1500
Noodles	1	2000	2000	2000	2	1950	1600	2300
Pharmaceutical	3	4233	3200	5700	3	3667	3000	4500
Textiles	4	2463	2000	2650	3	2883	2000	3500
Packaging paper	1	2000	2000	2000				
Paper	2	2600	2600	2600	4	3000	3000	3000
Glucose	2	1950	1900	2000				
Other food	5	3100	1900	5200				

Source: End users survey

Table 5.3.5—Average Cassava wet starch price in 1997, by region

Business Area	Cassava 1st class dry starch, average price VN dong/kg, 1997, by region					
	NM	RRD	NCC	SCC	CH	NES
Maltose	1100	1088				1066
Noodles		1044	1566	988	1733	1150
Textiles	1500					
Glucose		1325				
Fermentation Products						995
Starch processing			2300			
Other food		1100	1579			1208

Source: End users Survey

Table 5.4.1—Type of Starch used in Products by End users

Type of Starch	Number	Percent
1st Class Dry Cassava Starch	65	28.63
2nd Class Dry Cassava Starch	4	1.76
Wet Starch	61	26.87
Other	1	0.44
Domestic Dry Canna Starch	74	32.60
Domestic Wet Canna Starch	21	9.25
Other	1	0.44

Source: End users survey

Table 5.4.2—Type of Starch used in each Product by Business Area (% within business area)

Type of Starch used in Product	Business Area											Total
	Maltose	Noodles	Pharm	Textiles	Adhesive	Packaging Paper	Paper	Glucose	Fermentation Products	Other Food	Other Non-food	
1st Class Dry Cassava Starch	3.45	11.72	100.00	81.82		40.00	100.00		100.00	63.89	100.00	28.63
2nd Class Dry Cassava Starch					100.00	60.00						1.76
Wet Starch	96.55	14.06		9.09				100.00		33.33		26.87
Domestic Dry Canna		57.81										32.60
Domestic Wet		16.41										9.25
Other				9.09						2.78		0.88

Source: End users Survey

Table 5.4.4–Starch as a proportion of total cost by business area (% within business area)

Starch as a proportion of total cost	Business area									Total
	Maltose	Noodles	Pharm.	Textiles, paper, plywood, and other non-food	Adhesive	Packaging Paper	Glucose	Fermentation Products, Starch Processing	Other Food	
>75%	68.97	83.08					50.0		16.22	57.45
50-75%	31.03	2.31							16.22	7.66
25-50%		5.38			100.0		50.0		21.62	7.23
10-25%		9.23	12.50			16.67		100.00	18.92	10.21
5-10%			37.50						18.92	4.26
<5%			50.00	100.00		83.33			8.11	13.19

Source: End users survey

Table 5.5.2—Most Important Quality Criteria by Business Area (% within business area)

Criteria	Business Area										Total
	Maltose	Noodles	Pharm.	Textiles	Adhesive, other non-food	Plywood, Fermentation products	Packaging Paper	Paper, starch processing	Glucose	Other Food	
Color	96.55	95.31	37.50	66.67			33.33	100.00		85.71	87.28
Moisture				11.11	100.00		33.33				2.19
Purity	3.45	3.91	50.00	22.22		100.00	16.67			8.57	7.89
Sour Smell		0.78	12.50				16.67		100.00	5.71	2.63

Source: End user survey

Table 5.5.3—Method of Assessing Quality

Method	Percent
Visual Inspection	71.93
Experience	22.37
Dissolving in Water	0.44
Other	5.26

Source: End users survey

Table 5.5.4—Frequency of starch purification before processing, and average losses, by business area.

Business Area	% Purifying starch before processing	Reason for purification (no.)	Average % loss on purification
Maltose	57	Remove sand, off odor, make whiter (13)	1.5
Noodles	77	Purify (77) Cleaning (4) Remove impurities (10)	3.5
Pharmaceutical	25	Remove sand and odor, make white (2)	1.0
Textiles	38	Remove sand (3)	0.7
Adhesives	0		
Plywood	0		
Packaging paper	33	Remove sand, make whiter (2)	
Paper	40	Remove impurities (1)	3.0
Glucose	50	Remove sand, make whiter (1)	1.0
Fermentation Products	100	Remove impurities (1)	1.0
Starch processing	100	Purify (2)	1.0
Other food	68	Purify (24)	3.1
Total	67		

Source: End users survey

Table 5.6.1—Frequency of problems reported by the starch end users, by business area.

Business Area	Starch problems reported (no. enterprises)			
	Supply	Price	Quality	Other
Maltose		Unstable (6)	High moisture (1)	Lack credit (1) Poor market (2)
Noodles	Lack raw material (5) Lack capital (1) Need reserve wet starch (1)	Unstable (16) Stable (1)	Unstable quality (16)	Drying in rainy season (1) Lack of water (1) Techology and marketing (1)
Pharmaceutical		Unstable (2)		
Textiles			Unstable quality (4)	
Glucose			Unstable quality (1)	
Fermentation Products	Unstable, short harvest time (1)	High root price, low starch price (1)		
Other food	Shortage of starch off peak (3)	Unstable (2)		

Source: End users survey

Table 6.3.1— Baseline Scenario

Cassava Market

	AMOUNT
Production ('000 tons)	1999.86
Food Consumption ('000 tons)	300.04
Farm Price (Dong/kg)	279.95
Retail Price (Dong/kg)	347.95
Farm Income (mill USD)	25.8

Feed Market

	AMOUNT
Production ('000 tons)	304.74
Farm Price (Dong/kg)	1011
Retail Price (Dong/kg)	1256
Feed Consumption ('000 tons)	190.7
Exports ('000 tons)	114.04
Value Exports (mill USD)	11.52
Feed Income (mill USD)	4.24

Wet Starch Market

	AMOUNT
Retail Price (Dong/kg)	1199.9
Total Production ('000 tons)	40.8
Small Processor Production ('000 tons)	28.15
Large Processor Production ('000 tons)	12.65
Total Consumption ('000 tons)	40.8
Intermediate Consumption ('000 tons)	28.97
Maltose Consumption ('000 tons)	8.57
Noodle Consumption ('000 tons)	0.41
Glucose Consumption ('000 tons)	2.45
Other Food Consumption ('000 tons)	0.41
Processor Price (Dong/kg)	1104.9
Total Income (mill USD)	0.7
Small Processor Income (mill USD)	0.41
Large Processor Income (mill USD)	0.29

Dry Starch Market

	AMOUNT
Retail Price (Dong/kg)	2442
Total Production ('000 tons)	136.82
Small Processor Production ('000 tons)	12.31
Large Processor Production ('000 tons)	124.51
Total Consumption ('000 tons)	114.8
Maltose Consumption ('000 tons)	2.3
Noodle Consumption ('000 tons)	1.15
Glucose Consumption ('000 tons)	4.59
Other Food Consumption ('000 tons)	1.15
Total Income (mill USD)	6.14
Small Processor Income (mill USD)	0.36
Large Processor Income (mill USD)	5.78
Textile Consumption ('000 tons)	5.74
Pharmaceutical Consumption ('000 tons)	10.33
MSG Consumption ('000 tons)	84.95
Paper Consumption ('000 tons)	4.59
Processor Price (Dong/kg)	1990

Starch Exports

	AMOUNT
Value Exports (mill USD)	6.61
Total Export Income (mill USD)	1.53
Quantity Exports ('000 tons)	22.02

Production Shares (%)

	AMOUNT
Cassava for Food	15
Cassava for Feed	55.01
Cassava for Wet Starch	1.48
Cassava for Dry Starch	28.51

Income Shares (%)

	AMOUNT
Farm Income	69.96
Feed Income	11.5
Processing Income	18.54
Wet Starch Income	1.89
Dry Starch Income	16.64
Small Processor Income	2.07
Large Processor Income	16.47

Total Income

	AMOUNT
Total Income (mill USD)	36.88

Source: Computed by the authors using SIMV

Table 6.4.1—Effects of Improvements in Cassava Productivity on Starch Subsector

Cassava Market		10% Increase in Cassava Yield	
	AMOUNT	CHANGE	PCT CHANGE
Production ('000 tons)	2132.89	133.03	6.65
Food Consumption ('000 tons)	319.14	19.09	6.36
Farm Price (Dong/kg)	259.13	-20.82	-7.44
Retail Price (Dong/kg)	327.13	-20.82	-5.98
Farm Income (mill USD)	25.47	-0.33	-1.28

Feed Market		10% Increase in Cassava Yield	
	AMOUNT	CHANGE	PCT CHANGE
Production ('000 tons)	324.13	19.39	6.36
Farm Price (Dong/kg)	1011	0	0
Retail Price (Dong/kg)	1256	0	0
Feed Consumption ('000 tons)	190.7	0	0
Exports ('000 tons)	133.43	19.39	17
Value Exports (mill USD)	13.48	1.96	17.01
Feed Income (mill USD)	4.54	0.29	6.94

Wet Starch Market		10% Increase in Cassava Yield	
	AMOUNT	CHANGE	PCT CHANGE
Retail Price (Dong/kg)	1156.39	-43.51	-3.63
Total Production ('000 tons)	42.03	1.22	3
Small Processor Production ('000 tons)	29	0.84	3
Large Processor Production ('000 tons)	13.03	0.38	3
Total Consumption ('000 tons)	42.03	1.22	3
Intermediate Consumption ('000 tons)	29.84	0.87	3
Maltose Consumption ('000 tons)	8.83	0.26	2.99
Noodle Consumption ('000 tons)	0.42	0.01	3.01
Glucose Consumption ('000 tons)	2.52	0.07	3.01
Other Food Consumption ('000 tons)	0.42	0.01	3.01
Processor Price (Dong/kg)	1061.39	-43.51	-3.94
Total Income (mill USD)	0.69	-0.01	-1
Small Processor Income (mill USD)	0.4	0	-1.12
Large Processor Income (mill USD)	0.29	0	-1.17

Dry Starch Market		10% Increase in Cassava Yield	
	AMOUNT	CHANGE	PCT CHANGE
Retail Price (Dong/kg)	2442	0	0
Total Production ('000 tons)	147.15	10.33	7.55
Small Processor Production ('000 tons)	13.24	0.93	7.55
Large Processor Production ('000 tons)	133.91	9.4	7.55
Total Consumption ('000 tons)	114.7	-0.1	-0.09
Maltose Consumption ('000 tons)	2.27	-0.03	-1.1
Noodle Consumption ('000 tons)	1.14	-0.01	-1.1
Glucose Consumption ('000 tons)	4.54	-0.05	-1.1
Other Food Consumption ('000 tons)	1.14	-0.01	-1.1
Total Income (mill USD)	6.86	0.72	11.75
Small Processor Income (mill USD)	0.4	0.04	11.87
Large Processor Income (mill USD)	6.46	0.68	11.76
Textile Consumption ('000 tons)	5.74	0	0
Pharmaceutical Consumption ('000 tons)	10.33	0	0
MSG Consumption ('000 tons)	84.95	0	0
Paper Consumption ('000 tons)	4.59	0	0
Processor Price (Dong/kg)	1990	0	0

Starch Exports		10% Increase in Cassava Yield	
	AMOUNT	CHANGE	PCT CHANGE
Value Exports (mill USD)	9.74	3.13	47.35
Total Export Income (mill USD)	2.26	0.73	47.37
Quantity Exports ('000 tons)	32.45	10.43	47.36

Production Shares (%)		10% Increase in Cassava Yield	
	AMOUNT	CHANGE	PCT CHANGE
Cassava for Food	14.96	-0.04	-0.27
Cassava for Feed	54.86	-0.15	-0.27
Cassava for Wet Starch	1.43	-0.05	-3.41
Cassava for Dry Starch	28.75	0.24	0.84

Income Shares (%)		10% Increase in Cassava Yield	
	AMOUNT	CHANGE	PCT CHANGE
Farm Income	67.82	-2.14	-3.06
Feed Income	12.08	0.57	5
Processing Income	20.1	1.57	8.45
Wet Starch Income	1.84	-0.05	-2.84
Dry Starch Income	18.27	1.62	9.74
Small Processor Income	2.13	0.06	3.05
Large Processor Income	17.97	1.5	9.13

Total Income		10% Increase in Cassava Yield	
	AMOUNT	CHANGE	PCT CHANGE
Total Income (mill USD)	37.56	0.68	1.84

Source: Computed by the authors using SIMV

Table 6.4.2—Effects of Increase in End-product demand

Cassava Market	Increase in Final Demand, No Change in Cassava Supply			Increase in Final Demand + 10% increase in Cassava Supply		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Production ('000 tons)	1996.52	-3.35	-0.17	2129.26	129.39	6.47
Food Consumption ('000 tons)	301.05	1.01	0.34	320.22	20.17	6.72
Farm Price (Dong/kg)	278.78	-1.17	-0.42	258.03	-21.92	-7.83
Retail Price (Dong/kg)	346.78	-1.17	-0.34	326.03	-21.92	-6.3
Farm Income (mill USD)	25.65	-0.15	-0.59	25.32	-0.48	-1.87

Feed Market	Increase in Final Demand, No Change in Cassava Supply			Increase in Final Demand + 10% increase in Cassava Supply		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Production ('000 tons)	305.77	1.03	0.34	325.23	20.49	6.72
Farm Price (Dong/kg)	1011	0	0	1011	0	0
Retail Price (Dong/kg)	1256	0	0	1256	0	0
Feed Consumption ('000 tons)	190.7	0	0	190.7	0	0
Exports ('000 tons)	115.07	1.03	0.9	134.53	20.49	17.97
Value Exports (mill USD)	11.62	0.1	0.9	13.59	2.07	17.97
Feed Income (mill USD)	4.26	0.02	0.38	4.55	0.31	7.33

Wet Starch Market	Increase in Final Demand, No Change in Cassava Supply			Increase in Final Demand + 10% increase in Cassava Supply		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Retail Price (Dong/kg)	1276.17	76.27	6.36	1229.76	29.86	2.49
Total Production ('000 tons)	43.19	2.38	5.84	44.49	3.68	9.02
Small Processor Production ('000 tons)	29.8	1.64	5.84	30.69	2.54	9.02
Large Processor Production ('000 tons)	13.39	0.74	5.84	13.79	1.14	9.02
Total Consumption ('000 tons)	43.19	2.38	5.84	44.49	3.68	9.02
Intermediate Consumption ('000 tons)	31.16	2.19	7.56	32.1	3.13	10.8
Maltose Consumption ('000 tons)	8.56	0	-0.06	8.82	0.25	2.95
Noodle Consumption ('000 tons)	0.41	0	-0.04	0.42	0.01	2.96
Glucose Consumption ('000 tons)	2.66	0.21	8.52	2.74	0.29	11.79
Other Food Consumption ('000 tons)	0.4	-0.01	-2.9	0.41	0	0.02
Processor Price (Dong/kg)	1181.17	76.27	6.9	1134.76	29.86	2.7
Total Income (mill USD)	0.79	0.09	13.21	0.78	0.08	12.04
Small Processor Income (mill USD)	0.46	0.05	13.08	0.45	0.05	11.9
Large Processor Income (mill USD)	0.33	0.04	13.02	0.33	0.03	11.84

Dry Starch Market	Increase in Final Demand, No Change in Cassava Supply			Increase in Final Demand + 10% increase in Cassava Supply		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Retail Price (Dong/kg)	2442	0	0	2442	0	0
Total Production ('000 tons)	134.77	-2.05	-1.5	144.95	8.13	5.94
Small Processor Production ('000 tons)	12.13	-0.18	-1.5	13.05	0.73	5.94
Large Processor Production ('000 tons)	122.64	-1.87	-1.5	131.9	7.4	5.94
Total Consumption ('000 tons)	122.62	7.82	6.81	122.49	7.69	6.7
Maltose Consumption ('000 tons)	2.46	0.16	6.96	2.43	0.13	5.77
Noodle Consumption ('000 tons)	1.18	0.03	2.88	1.17	0.02	1.75
Glucose Consumption ('000 tons)	6.55	1.96	42.61	6.48	1.88	41.03
Other Food Consumption ('000 tons)	1.27	0.13	11.03	1.26	0.11	9.8
Total Income (mill USD)	5.77	-0.37	-6.08	6.48	0.34	5.52
Small Processor Income (mill USD)	0.34	-0.02	-5.98	0.38	0.02	5.63
Large Processor Income (mill USD)	5.43	-0.35	-6.07	6.1	0.32	5.53
Textile Consumption ('000 tons)	5.8	0.06	1	5.8	0.06	1
Pharmaceutical Consumption ('000 tons)	11.16	0.83	8	11.16	0.83	8
MSG Consumption ('000 tons)	89.2	4.25	5	89.2	4.25	5
Paper Consumption ('000 tons)	5.01	0.41	9	5.01	0.41	9
Processor Price (Dong/kg)	1990	0	0	1990	0	0

Starch Exports	Increase in Final Demand, No Change in Cassava Supply			Increase in Final Demand + 10% increase in Cassava Supply		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Value Exports (mill USD)	3.64	-2.96	-44.84	6.74	0.13	1.96
Total Export Income (mill USD)	0.85	-0.69	-44.83	1.56	0.03	1.97
Quantity Exports ('000 tons)	12.15	-9.87	-44.84	22.45	0.43	1.96

Production Shares (%)	Increase in Final Demand, No Change in Cassava Supply			Increase in Final Demand + 10% increase in Cassava Supply		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Cassava for Food	15.08	0.08	0.51	15.04	0.04	0.24
Cassava for Feed	55.29	0.28	0.51	55.14	0.13	0.24
Cassava for Wet Starch	1.51	0.03	1.81	1.45	-0.02	-1.67
Cassava for Dry Starch	28.13	-0.38	-1.34	28.36	-0.14	-0.5

Income Shares (%)	Increase in Final Demand, No Change in Cassava Supply			Increase in Final Demand + 10% increase in Cassava Supply		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Farm Income	70.35	0.39	0.55	68.19	-1.77	-2.53
Feed Income	11.68	0.17	1.51	12.26	0.76	6.59
Processing Income	17.98	-0.56	-3.02	19.55	1.01	5.46
Wet Starch Income	2.16	0.27	14.44	2.1	0.21	11.21
Dry Starch Income	15.81	-0.83	-5	17.44	0.8	4.81
Small Processor Income	2.18	0.11	5.34	2.24	0.17	8.22
Large Processor Income	15.8	-0.67	-4.07	17.31	0.84	5.11

Total Income	Increase in Final Demand, No Change in Cassava Supply			Increase in Final Demand + 10% increase in Cassava Supply		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Total Income (mill USD)	36.46	-0.42	-1.13	37.13	0.25	0.68

Source: Computed by the authors using SIMV

Table 6.4.3— Effects of Quality Improvements in Dry Starch

Cassava Market	10% Reduction in Export Marketing Margin		
	AMOUNT	CHANGE	PCT CHANGE
Production ('000 tons)	2009.99	10.12	0.51
Food Consumption ('000 tons)	297.01	-3.04	-1.01
Farm Price (Dong/kg)	283.51	3.56	1.27
Retail Price (Dong/kg)	351.51	3.56	1.02
Farm Income (mill USD)	26.26	0.46	1.78

Feed Market	10% Reduction in Export Marketing Margin		
	AMOUNT	CHANGE	PCT CHANGE
Production ('000 tons)	301.66	-3.08	-1.01
Farm Price (Dong/kg)	1011	0	0
Retail Price (Dong/kg)	1256	0	0
Feed Consumption ('000 tons)	190.7	0	0
Exports ('000 tons)	110.96	-3.08	-2.7
Value Exports (mill USD)	11.21	-0.31	-2.7
Feed Income (mill USD)	4.2	-0.05	-1.09

Wet Starch Market	10% Reduction in Export Marketing Margin		
	AMOUNT	CHANGE	PCT CHANGE
Retail Price (Dong/kg)	1219.91	20.01	1.67
Total Production ('000 tons)	40.97	0.17	0.42
Small Processor Production ('000 tons)	28.27	0.12	0.42
Large Processor Production ('000 tons)	12.7	0.05	0.42
Total Consumption ('000 tons)	40.97	0.17	0.42
Intermediate Consumption ('000 tons)	29.09	0.12	0.42
Maltose Consumption ('000 tons)	8.6	0.04	0.41
Noodle Consumption ('000 tons)	0.41	0	0.43
Glucose Consumption ('000 tons)	2.46	0.01	0.43
Other Food Consumption ('000 tons)	0.41	0	0.43
Processor Price (Dong/kg)	1124.91	20.01	1.81
Total Income (mill USD)	0.71	0.02	2.3
Small Processor Income (mill USD)	0.41	0.01	2.17
Large Processor Income (mill USD)	0.3	0.01	2.12

Dry Starch Market	10% Reduction in Export Marketing Margin		
	AMOUNT	CHANGE	PCT CHANGE
Retail Price (Dong/kg)	2588	146	5.98
Total Production ('000 tons)	142.62	5.8	4.24
Small Processor Production ('000 tons)	12.84	0.52	4.24
Large Processor Production ('000 tons)	129.79	5.28	4.24
Total Consumption ('000 tons)	111.64	-3.16	-2.75
Maltose Consumption ('000 tons)	2.2	-0.09	-4.07
Noodle Consumption ('000 tons)	1.1	-0.05	-4.07
Glucose Consumption ('000 tons)	4.41	-0.19	-4.07
Other Food Consumption ('000 tons)	1.1	-0.05	-4.07
Total Income (mill USD)	6.96	0.83	13.44
Small Processor Income (mill USD)	0.41	0.05	13.56
Large Processor Income (mill USD)	6.56	0.78	13.45
Textile Consumption ('000 tons)	5.64	-0.1	-1.73
Pharmaceutical Consumption ('000 tons)	10.15	-0.18	-1.73
MSG Consumption ('000 tons)	82.52	-2.43	-2.86
Paper Consumption ('000 tons)	4.51	-0.08	-1.73
Processor Price (Dong/kg)	2136	146	7.34

Starch Exports	10% Reduction in Export Marketing Margin		
	AMOUNT	CHANGE	PCT CHANGE
Value Exports (mill USD)	9.29	2.69	40.68
Total Export Income (mill USD)	2.16	0.62	40.7
Quantity Exports ('000 tons)	30.98	8.96	40.69

Production Shares (%)	10% Reduction in Export Marketing Margin		
	AMOUNT	CHANGE	PCT CHANGE
Cassava for Food	14.78	-0.23	-1.51
Cassava for Feed	54.18	-0.83	-1.51
Cassava for Wet Starch	1.48	0	-0.07
Cassava for Dry Starch	29.57	1.06	3.71

Income Shares (%)	10% Reduction in Export Marketing Margin		
	AMOUNT	CHANGE	PCT CHANGE
Farm Income	68.87	-1.09	-1.56
Feed Income	11	-0.5	-4.35
Processing Income	20.13	1.6	8.61
Wet Starch Income	1.87	-0.02	-1.13
Dry Starch Income	18.26	1.62	9.71
Small Processor Income	2.15	0.08	3.96
Large Processor Income	17.98	1.51	9.19

Total Income	10% Reduction in Export Marketing Margin		
	AMOUNT	CHANGE	PCT CHANGE
Total Income (mill USD)	38.14	1.25	3.4

Source: computed by the authors using SIMV

Table 6.4.4—Effects of Increasing Access to Capital

Cassava Market	10% Injection of Capital to Small & Large Processors			Injection of 10% Value of Total Capital to Small Processors Only			Injection of 10% Value of Total Capital to Large Processors Only		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Production ('000 tons)	2007.87	8	0.4	2055.91	56.05	2.8	2006.53	6.66	0.33
Food Consumption ('000 tons)	297.64	-2.4	-0.8	283.71	-16.33	-5.44	298.04	-2	-0.67
Farm Price (Dong/kg)	282.76	2.81	1	299.98	20.03	7.15	282.29	2.34	0.83
Retail Price (Dong/kg)	350.76	2.81	0.81	367.98	20.03	5.76	350.29	2.34	0.67
Farm Income (mill USD)	26.17	0.36	1.41	28.42	2.62	10.16	26.1	0.3	1.17

Feed Market	10% Injection of Capital to Small & Large Processors			Injection of 10% Value of Total Capital to Small Processors Only			Injection of 10% Value of Total Capital to Large Processors Only		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Production ('000 tons)	302.3	-2.44	-0.8	288.15	-16.59	-5.44	302.71	-2.03	-0.67
Farm Price (Dong/kg)	1011	0	0	1011	0	0	1011	0	0
Retail Price (Dong/kg)	1256	0	0	1256	0	0	1256	0	0
Feed Consumption ('000 tons)	190.7	0	0	190.7	0	0	190.7	0	0
Exports ('000 tons)	111.6	-2.44	-2.14	97.45	-16.59	-14.55	112.01	-2.03	-1.78
Value Exports (mill USD)	11.27	-0.25	-2.14	9.84	-1.68	-14.54	11.31	-0.21	-1.78
Feed Income (mill USD)	4.21	-0.04	-0.86	3.99	-0.25	-5.91	4.21	-0.03	-0.71

Wet Starch Market	10% Injection of Capital to Small & Large Processors			Injection of 10% Value of Total Capital to Small Processors Only			Injection of 10% Value of Total Capital to Large Processors Only		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Retail Price (Dong/kg)	1181.82	-18.08	-1.51	807.27	-392.63	-32.72	1196.45	-3.45	-0.29
Total Production ('000 tons)	41.3	0.5	1.22	56.03	15.22	37.31	40.9	0.09	0.23
Small Processor Production ('000 tons)	28.46	0.31	1.08	47.61	19.45	69.1	27.9	-0.26	-0.92
Large Processor Production ('000 tons)	12.84	0.19	1.53	8.42	-4.23	-33.45	13	0.35	2.78
Total Consumption ('000 tons)	41.3	0.5	1.22	56.03	15.22	37.31	40.9	0.09	0.23
Intermediate Consumption ('000 tons)	29.32	0.35	1.22	39.78	10.81	37.31	29.04	0.07	0.23
Maltose Consumption ('000 tons)	8.67	0.1	1.22	11.77	3.2	37.3	8.59	0.02	0.23
Noodle Consumption ('000 tons)	0.41	0.01	1.23	0.56	0.15	37.32	0.41	0	0.24
Glucose Consumption ('000 tons)	2.48	0.03	1.23	3.36	0.91	37.32	2.45	0.01	0.24
Other Food Consumption ('000 tons)	0.41	0.01	1.23	0.56	0.15	37.32	0.41	0	0.24
Processor Price (Dong/kg)	1086.82	-18.08	-1.64	712.27	-392.63	-35.54	1101.45	-3.45	-0.31
Total Income (mill USD)	0.69	0	-0.33	0.57	-0.13	-18.59	0.7	0	0.38
Small Processor Income (mill USD)	0.4	0	-0.63	0.44	0.04	8.94	0.4	-0.01	-1.29
Large Processor Income (mill USD)	0.29	0	-0.25	0.13	-0.17	-57.15	0.3	0.01	2.34

Dry Starch Market	10% Injection of Capital to Small & Large Processors	Injection of 10% Value of Total Capital to Small Processors Only	Injection of 10% Value of Total Capital to Large Processors Only

	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Retail Price (Dong/kg)	2442	0	0	2442	0	0	2442	0	0
Total Production ('000 tons)	141.35	4.52	3.31	165.92	29.09	21.26	140.65	3.82	2.8
Small Processor Production ('000 tons)	12.67	0.36	2.89	33.32	21.01	170.59	12.24	-0.07	-0.58
Large Processor Production ('000 tons)	128.68	4.17	3.35	132.6	8.09	6.5	128.4	3.9	3.13
Total Consumption ('000 tons)	114.76	-0.04	-0.04	113.77	-1.03	-0.9	114.79	-0.01	-0.01
Maltose Consumption ('000 tons)	2.29	-0.01	-0.46	2.04	-0.26	-11.21	2.29	0	-0.09
Noodle Consumption ('000 tons)	1.14	-0.01	-0.46	1.02	-0.13	-11.21	1.15	0	-0.09
Glucose Consumption ('000 tons)	4.57	-0.02	-0.46	4.08	-0.51	-11.21	4.59	0	-0.09
Other Food Consumption ('000 tons)	1.14	-0.01	-0.46	1.02	-0.13	-11.21	1.15	0	-0.09
Total Income (mill USD)	6.46	0.32	5.16	7.91	1.77	28.8	6.41	0.27	4.44
Small Processor Income (mill USD)	0.37	0.02	4.89	0.95	0.6	167.3	0.36	0.01	1.42
Large Processor Income (mill USD)	6.08	0.3	5.19	6.95	1.17	20.27	6.05	0.27	4.65
Textile Consumption ('000 tons)	5.74	0	0	5.74	0	0	5.74	0	0
Pharmaceutical Consumption ('000 tons)	10.33	0	0	10.33	0	0	10.33	0	0
MSG Consumption ('000 tons)	84.95	0	0	84.95	0	0	84.95	0	0
Paper Consumption ('000 tons)	4.59	0	0	4.59	0	0	4.59	0	0
Processor Price (Dong/kg)	1990	0	0	1990	0	0	1990	0	0

Starch Exports	10% Injection of Capital to Small & Large Processors			Injection of 10% Value of Total Capital to Small Processors Only			Injection of 10% Value of Total Capital to Large Processors Only		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Value Exports (mill USD)	7.98	1.37	20.73	15.64	9.04	136.78	7.76	1.15	17.4
Total Export Income (mill USD)	1.85	0.32	20.74	3.63	2.1	136.8	1.8	0.27	17.41
Quantity Exports ('000 tons)	26.59	4.57	20.73	52.15	30.12	136.79	25.85	3.83	17.4

Production Shares (%)	10% Injection of Capital to Small & Large Processors			Injection of 10% Value of Total Capital to Small Processors Only			Injection of 10% Value of Total Capital to Large Processors Only		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Cassava for Food	14.82	-0.18	-1.2	13.8	-1.2	-8.02	14.85	-0.15	-1
Cassava for Feed	54.35	-0.66	-1.2	50.6	-4.41	-8.02	54.46	-0.55	-1
Cassava for Wet Starch	1.49	0.01	0.83	1.98	0.5	33.58	1.48	0	-0.09
Cassava for Dry Starch	29.33	0.82	2.89	33.63	5.12	17.96	29.21	0.7	2.45

Income Shares (%)	10% Injection of Capital to Small & Large Processors			Injection of 10% Value of Total Capital to Small Processors Only			Injection of 10% Value of Total Capital to Large Processors Only		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Farm Income	69.74	-0.23	-0.32	69.51	-0.45	-0.64	69.75	-0.21	-0.31
Feed Income	11.21	-0.29	-2.56	9.76	-1.74	-15.14	11.25	-0.25	-2.17
Processing Income	19.06	0.52	2.81	20.73	2.19	11.81	19	0.46	2.5
Wet Starch Income	1.85	-0.04	-2.09	1.39	-0.5	-26.61	1.87	-0.02	-1.15
Dry Starch Income	17.21	0.56	3.37	19.34	2.69	16.18	17.13	0.49	2.92
Small Processor Income	2.07	0	0.2	3.42	1.35	65.08	2.04	-0.03	-1.49
Large Processor Income	16.98	0.52	3.14	17.31	0.84	5.12	16.96	0.49	3

Total Income	10% Injection of Capital to Small & Large Processors			Injection of 10% Value of Total Capital to Small Processors Only			Injection of 10% Value of Total Capital to Large Processors Only		
	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE	AMOUNT	CHANGE	PCT CHANGE
Total Income (mill USD)	37.52	0.64	1.74	40.89	4.01	10.87	37.43	0.55	1.48

Source: Computed by authors using SIMV

Table 6.5.1—Summary of Policy Options

Policy	Farmer Income (million USD)	Processor Income (million USD)	Feed Exports ('000 tons)	Dry Starch Exports ('000 tons)
Baseline	25.8	6.8	114	22
Increase Cassava Yield	25.5	7.55	133	32.5
Increase Starch Quality	26.3	7.67	111	30.98
Credit to Small Enterprises	28.4	8.48	97.5	52.15

Source: Computed by the authors using SIMV

FIG 6.1 DEMAND SHIFTS

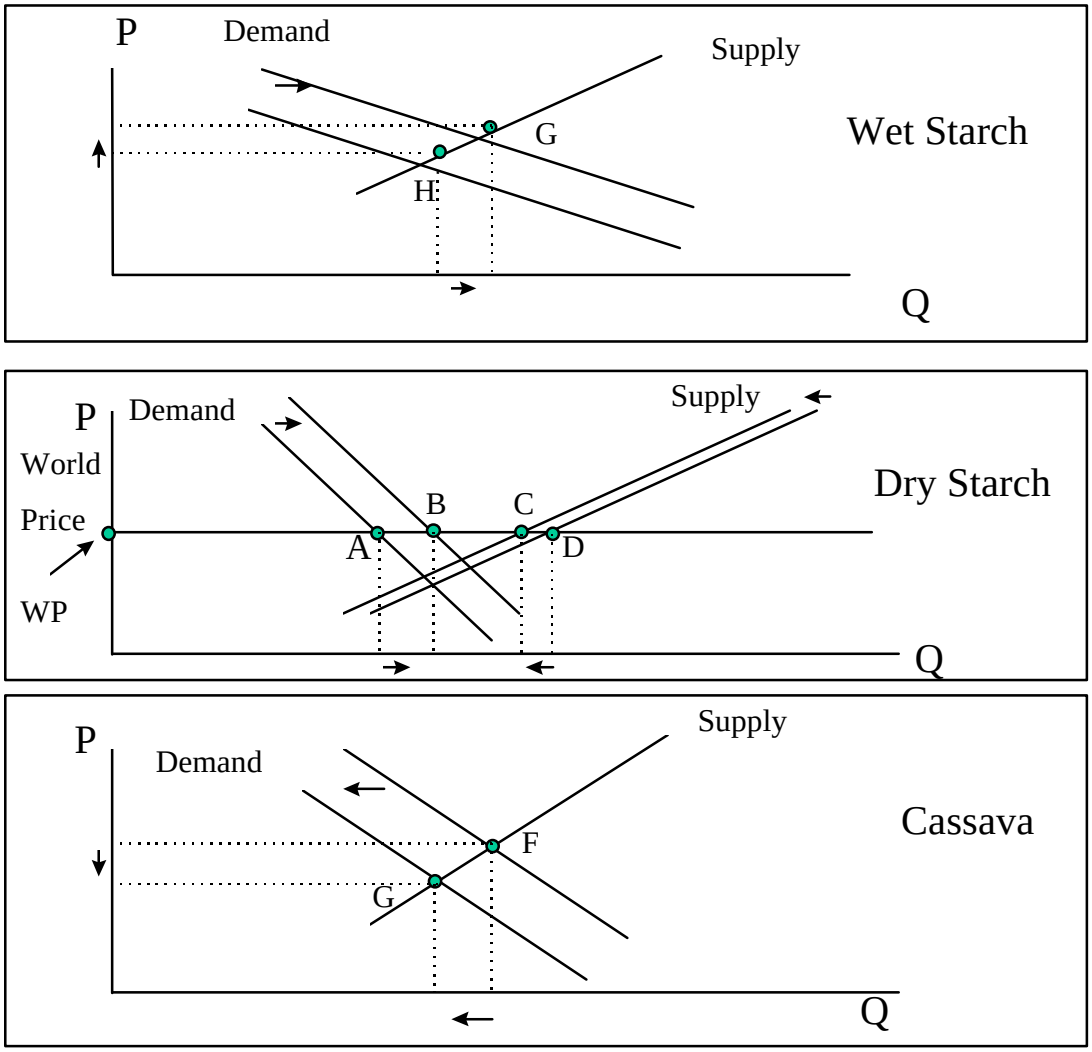


Table A.1—Conversion Rates for Feed and Starch

Commodity	Tons of Cassava Roots required to generate one ton of Commodity
Feed	3.61
Wet Starch	2.5
Dry Starch	4.17

Source: Processor survey for Starch, Hai (1997) for feed.

Table A.2—Matrix of Elasticities in Model

Elasticity of Cassava Supply with respect to Price of:

	FOOD	FEED	WS	DS
ROOTS	0.4	0	0	0

Elasticity of Cassava Demand with respect to Price of:

	FOOD	FEED	WS	DS
ROOTS	-1	0	0	0

Elasticity of Feed Supply with respect to Price of:

	FOOD	FEED	WS	DS
FEED	-1	0.3	0	0

Elasticity of Feed Demand with respect to Price of:

	FOOD	FEED	WS	DS
FEED	0	-0.1	0	0

Elasticity of Wet Starch Supply with respect to Price of:

	FOOD	FEED	WS	DS
WS.SMALL	-1	0	0.8	0
WS.LARGE	-1	0	0.8	0

Elasticity of Wet Starch Supply with respect to Capital

	CAP
WS.SMALL	0.336
WS.LARGE	0.382

Elasticity of Dry Starch Supply with respect to Price of:

	FOOD	FEED	WS	DS
DS.SMALL	-1	0	-0.3	0.8
DS.LARGE	-1	0	-0.3	0.8

Elasticity of Dry Starch Supply with respect to Capital

	CAP
DS.SMALL	0.336
DS.LARGE	0.382

Elasticity of Wet Starch Demand with respect to Price of:

	FOOD	FEED	WS	DS
WS.INTERM	0	0	-0.8	-0.3
WS.NOODLE	0	0	-0.8	-0.3
WS.MALTOSE	0	0	-0.8	-0.3
WS.GLUCOSE	0	0	-0.8	-0.3
WS.OTHFOOD	0	0	-0.8	-0.3

Elasticity of Dry Starch with respect to Price of:

	FOOD	FEED	WS	DS
DS.NOODLE	0	0	-0.3	-0.8
DS.MALTOSE	0	0	-0.3	-0.8
DS.GLUCOSE	0	0	-0.3	-0.8
DS.OTHFOOD	0	0	-0.3	-0.8
DS.TEXTILES	0	0	0	-0.3
DS.PHARM	0	0	0	-0.3
DS.MSG	0	0	0	-0.5
DS.PAPER	0	0	0	-0.3

Source: Author's Assumption

Table A.3—Regression Results for Investment by Small Processors

	Beta	Std. Error	t	Sig.
(Constant)	1.573	0.452	3.479	0.001
LOGINV	0.336	0.059	5.670	0.000

Source: Based on data from processor survey

Table A.1—Conversion Rates for Feed and Starch 368
Table A.2—Matrix of Elasticities in Model 369
Table A.3—Regression Results for Investment by Small Processors 370