BABY CORN PRODUCTION, PROCESSING AND MARKETING IN THAILAND

Report Submitted to

Field Fresh Foods Pvt. Ltd

Gurgaon

India

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INTRODUCTION

Baby corn is the ear of maize plant (Zea mays L.) harvested young, especially before or just after the silks has emerged and no fertilization has taken place. The de-husked ears can be eaten as a vegetable, whose delicate flavor and crispiness are much in demand in Thailand and abroad. Baby corn is free from pesticide and its nutritional value is comparable to cauliflower, cabbage, tomato, eggplant and cucumber. Its by-products, such as tassel, young husk, silk and green stalk, provide good cattle feed. Cattle manure can then be used, enabling organic recycling through the plant-animal chain. Baby corn provides many food benefits to people. Farmers can grow four to five crops a year. Thus production of baby corn generates employment among the rural poor of all ages. Brokers who buy from farmers, canneries, wholesale and retail merchants in Bangkok and exporters have already benefited from this crop in Thailand.

In the past two decades, baby corn production has proved a remarkable success for farmers and the nation as a whole and has lessons for replication elsewhere.

1. MARKET OVERVIEW

1.1 World Market Overview

Baby corn production and markets are expanding worldwide, especially in Asia, Africa and South America, although Asia has the highest baby corn consumption. Baby corn is usually consumed as fresh; however, frozen and canned baby corn also has a large market share particularly for export. Countries known as major exporters of baby corn include Thailand, Sri Lanka, Taiwan, China, Zimbabwe, Zambia, Indonesia, South Africa, Nicaragua, Costa Rica, Guatemala, and Honduras. Major baby corn markets are U.K., the U.S., Malaysia, Taiwan, Japan and Australia. However, statistical information on baby corn production is limited because many producing countries either neglect to make a report of baby corn production or barely include it in sweet corn production. The available information of world market situation of baby corn in each region is summarized as follows:

North America:

One of the largest baby corn markets is the U.S. Many countries in North America usually import fresh baby corn. However, fresh baby corn is rarely available in retail businesses such as supermarkets. It is usually used in high-end restaurants, which prefer unhusked baby corn. As for canned baby corn, the U.S. mostly imports it from Asia including Thailand, Taiwan, and Indonesia. Factories in the U.S. prefer to buy baby corn in can, and make it into brined baby corn in glass jars. Individually Quick Frozen (IQF) baby corn has the smallest market share in the U.S. market in comparison to other processed baby corn products because of its high price.

Europe:

European countries import fresh baby corn more than the U.S. Fresh Baby corn is in most demand here. Baby corn products are imported both in loose and pre-packed forms, though the later is more prevalent. U.K. is the largest fresh baby corn market in the Europe. In this country, fresh baby corn is normally distributed through retailers such as supermarkets. This contrasts with the U.S. market, where fresh baby corn is used primarily in restaurants. To European countries, Sri Lanka, Thailand, Zimbabwe, Zambia and Kenya are known as major exporting countries. The Netherlands is also considered an exporter to this region. But, it is not actually a producer because it imports baby corn from Asia and Africa, and re-exports baby corn to northern Europe as well as the Middle East.

Middle East:

The import volume of baby corn in Middle East countries is mainly accounted for by the Netherlands. However, baby corn from the Netherlands, in fact, comes from Asia and Africa. The country just imports baby corn from other producers, and re-exports it to many countries in this region. Buyers in the Middle East generally import baby corn in the pre-packed form like European importers. In the Middle East, Saudi Arabia is the largest importer of canned baby corn.

Asia:

World baby corn supplies mostly come from Asian countries. Therefore, they are regarded as producers rather than importers. However, there are some Asian countries that import a lot of baby corn. These are, for instance, Japan, Malaysia, which usually import canned baby corn.

1.2 Thai Market Overview

Baby corn for domestic and foreign consumption has become a significant contributor to the Thai economy. Baby corn fresh, frozen and canned becomes more and more popular both in Thailand and abroad. Out of 174,127 tons of baby corn production (2004), 61% was under domestic consumption, while 39% was exported to other countries. It earns the country more than 1 billion Baht (1 US$@39 Baht) each year. With a short period of cultivation, only 45-60 days, farmers can reap the crop and fetch 12,500-18,750 Baht per ha. Also, there are few pests to attack the plant. Moreover, parts of baby corn trees after harvest can be used as animal feed, especially for meat and milk cows.

In the global trade, Thailand is estimated to account for 80 percent of the world trade volume of baby corn. During 2002-2004, Thailand exported fresh baby corn to approximately 30 countries, and preserved baby corn products to almost 100 countries. Thailand dominates the world baby corn trade with both fresh and canned products, thus having earned about 1,700 million Baht each year (Table 1). Among the two products, canned baby corn was exported at a higher volume than fresh baby corn during the last three years. Thailand manufactures canned baby corn products in various package sizes, but a 1.5-kilogram can size conforms to industry standards, and is prevalently popular among food processors and the food-service industry. As for fresh baby corn

markets, Malaysia is the biggest importing countries with the share of around 51% of the export volume.

Table 1: Baby corn exports from Thailand during 2002-2004

	Canned baby corn (Tons)	Value (Baht)*	Fresh baby corn (Tons)	Value (Baht)
2002	61,413	1,643	3,954	173
2003	62,830	1,645	8,444	197
2004	63,473	1,675	3,853	244

Source: Department of Agricultural Extension, 2005 (*1 US$@39 Baht)

Many countries import baby corn from Thailand. In 2004, U.S.A was Thailand's largest export market for baby corn, accounting for 31.2 percent of Thailand's total export volume (Table 2). Food processors in the U.S. prefer to buy canned baby corn while countries in the European region prefer the fresh product. U.K. is the largest customer of Thailand for fresh baby corn, however, there are high competitors mostly from African countries such as Zimbabwe, Zambia, and Kenya while Sri Lanka is also one big exporter in the European market. This has resulted in a decrease in Thailand's market share.

The import volume of baby corn in Middle East countries is mainly accounted for the Netherlands. However, baby corn from the Netherlands, in fact, comes from Asia and Africa. The country imports baby corn from other producers, and re-exports it to many countries in this region. Buyers in the Middle East generally import baby corn in the pre-packed form like European importers. In the Middle East, Saudi Arabia is the largest importer of canned baby corn.

Within Asian countries, Malaysia is the largest importing country followed by Japan, Hong Kong and Singapore. Japan and Singapore imported fresh baby corn more than canned baby corn, while Hong Kong is high exporting country of Thai canned baby corn.

Table 2: Baby corn importing countries in 2004

Country	Export volume (tones)	Percent (%)
U.S.A.	21,029	31.2
Japan	4,820	7.2
England	4,229	6.3
The Netherlands	4,201	6.2
Canada	3,744	5.6
Australia	3,503	5.2
Germany	3,280	4.9
Others	22,520	33.5

Source: Department of Agricultural Extension, 2005

2. PRODUCTION AREA AND CROP ENVIRONMENT

Baby corn is one of the highly adapted crops which can be grown throughout the country. In Thailand, the estimated baby corn production over the country was 174, 127 tons in 2004. Its major producing areas are in the West and North and some provinces in the Northeast, which produced more than 90% of the total baby corn production of the country (Table 3). The major provinces of baby corn production are Kanchanaburi, Nakhon pathom, Ratchaburi, Nakhon sawan and Nakhon ratchasima.

Table 3: Regional production in Thailand in 2004

Region	Volume (tones)	Percent (%)
North	18,259	10.49
Northeast	962	0.55
Central	608	0.35
East	73	0.04
West	153,695	88.27
South	530	0.30
Total	174,127	100

Source: Department of Agricultural Extension, 2005

2.1 General Environmental Requirements

Baby corn grows well in a wide range of soil types but it thrives best in loose soil, which drains well. A suitable soil for baby corn has a wide pH range. It can also grow in very acid soil, but cannot grow in wetland with low drainage. As for temperature, the plant prefers full sunlight necessary to its growth. Consequently, successful growth requires a minimum average temperature of 24-35 °C. Nevertheless, the daytime temperature exceeds 35 °C; baby corn may be injured slow growth. Baby corn can be grown year-round, approximately 4-5 times a year. The resulting in schedule for baby corn production throughout the year is shown in Figure 1.

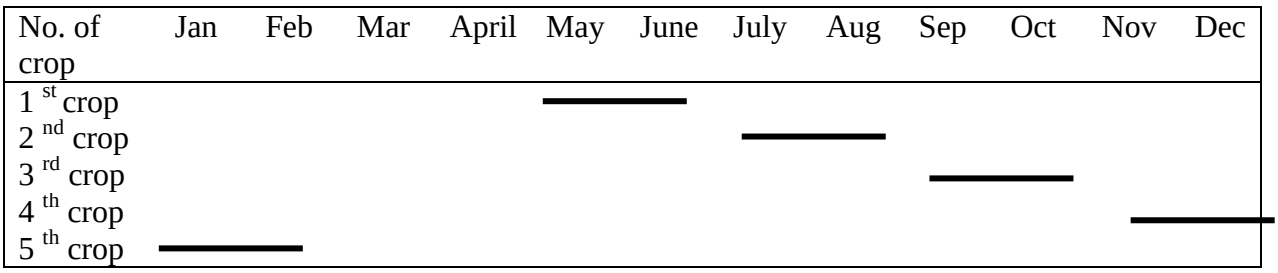

Figure 1: Production schedule for baby corn production from sowing and harvest dates

According to the Department of Agriculture, Thailand, the growing environments recommended for Good Agricultural Practices (GAP) in Thailand are as follows:

1. ***Topography***

- Can grow in every region of Thailand where there is water availability
- Flat plain area and slop less than 5%
- No water logging
- Far from pollution source
- Good transportation system, near collector, market and factory

2. ***Soil type***

- Loam, loamy clay mix with sand or loam mix with sand
- High fertility, organic matter should not be less than 1.5%, available phosphorus more than 10 mg/kg and exchangeable potassium not less than 40 mg/kg
- Loose soil, which drains well
- Soil surface depth 25-30 cm
- pH ~ 5.5-6.8

3. ***Climate***

- Year-round. Baby corn can be grown 4-5 times a year.
- Temperature between 24-35 ^{0}C
- Average rainfall distribution 1,000-1,200 mm/year
- Full sunlight

4. ***Water source***

- Water availability for the whole growing season
- Clean water without polluted organic or inorganic contamination

3. BABY CORN VARIETY AND AVAILABILITY

In Thailand, baby corn varietals improvement has been started since 1976 with the initial approach to develop open-pollinated variety (OPV). In 1981, researchers were able to release Rangsit-1, a composite variety that met desirable characteristics as high yield, yellow in ear color, good kernel arrangement, downy mildew resistance and wide environmental adaptation. This variety was widely used by farmers for some time before the introduction of a hybrid variety. The key progress for hybrid varietals development was the cooperative involvement of researchers from the public and private sectors in an integrated approach. International agencies also provided breeding materials, support for research and human resources, making sustained research and development. Nowadays, researchers have been more focused on various research aspects of hybrid variety. In their opinion, hybrid variety is superior to composite variety since it can produce ears with better quality in terms of flavor, texture and higher standard sizes. Thus, breeding of baby corn variety emphasize on the high quality of young cobs and downy mildew resistant cultivars. Large germ plasma collections of corn are maintained at the Kasetsart University, the Department of Agriculture and local seed companies.

There are differences in demand for baby corn varieties. The varietals preference is varied from place to place. Each of them has its own different suitability and advantage. In rain fed area, farmers prefer opened pollinated variety since it is more resistance to the unsuitable environment. However, hybrid varieties are more popular than open pollinated varieties in most areas because of uniformity of cob size, cob height, plant height, flowering and silking date, and maturity harvesting period. Besides, they produce higher and better quality yield than open-pollinated ones and get a good acceptance from the producing factories. Comparisons of significant characteristics of selected popular varieties in Thailand are shown in Table 4.

Table 4: Popular baby corn varieties and their characteristics

Characteristics	Variety							
	Hybrid						Open-pollinated	
	G 5414	SG 18 [1/]	Pacific-116	Pacific-283	Uniseeds B-65	Kasetsart2	Chieng-mai90	Suwan2
Yield with husks (ton/ha)	11.25-12.50	10.63-15.63	9.38-10	13.75-15	11.25-11.88	10-11.25	5.44-7.5	4.66
Yield without husk (kg/ha)	1687-2375	1875-2687	1,687-1,812	2,187-2,500	1,875-2,187	1,750-1,875	937-1,250	750
Exchange rate [2/]	6.5:1	6:1	5.5:1	6:1	6:1	5.5:1	6:1	6:1
No of cob/plant	2-3	2-3	3	3-4	2-3	2	2-3	2
Cob color	Light yellow	Light yellow	Yellow	Light yellow	Yellow	Light yellow	Yellow	Yellow
Uniformity of cob	Very good	Very good	Very good	Very good	Very good	Very good	Good	Fair
Detasselling (DAP)	44	-	46-48	45-47	52	-	40-42	40-43
Length of silk at harvesting (cm)	3-5	3-5	3-5	3-5	3-5	1-3	3-4	3-5
First harvesting age (DAP)	49	50-52	48-50	47-49	54	51	43-45	45-48
Harvesting period (day)	5-6	5-6	6-8	5-7	5-6	5	5-10	5-10
Downy mildew resistant	Good	Good	Good	Good	Good	Good	Good	Good
Strength of stem	Strong	Strong	Strong	Strong	Strong	Strong	Fair	Moderate
Releasing agency	Syngenta Seed Co. Ltd	Syngenta Seed Co. Ltd	Pacific Seed Co. Ltd	Pacific Seed Co. Ltd	Uniseed Co. Ltd	Kasetsart University	Department of Agriculture	Kasetsart University

[1/] No detasselling because it is sterilized
[2/] Ratio of yield with husk and yield without husk

4. DETERMINING LABOR AND TRAINING REQUIREMENTS

The majority of baby corn growers in Thailand have long experience in growing baby corn from their own parents; however, they are not familiar with Good Agricultural Practices (GAP). The training is necessary when the farmer want to adopt GAP. The department of Agriculture and Department of Agricultural Extension are responsible to train these farmers, 1-2 times at the beginning and some additional seasonal/critical growing period training if necessary. At the same time the officers have to monitor them in the field during every production process to make sure that the farmer can follow GAP properly. Besides, most companies also provide specific training to their contract farmers in some critical production stages.

Although baby corn is well-adapted short period growing crop, it requires intensive labour for good production. The most critical periods for baby corn are during detasselling and harvesting. To avoid this problem the farmer are recommended to divide their area to small plots of 0.16-0.2 ha and delay growing period of each small plot 5-7 day as show in the Table 5.

Table 5: Example of production planning of baby corn for the expected product with husk not less than 2,000 kg/day in the area of 4 ha.[1]/

Planting date	Harvesting date (on February)													Harvesting date (on March)									
	20	21	22	23	24	25	26	27	28	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Jan	100	150	300	400	700	500	600	600	400	250													
2 Jan		100	150	300	400	700	500	600	600	400	250												
3 Jan			100	150	300	400	700	500	600	600	400	250											
4 Jan				100	150	300	400	700	500	600	600	400	250										
5 Jan					100	150	300	400	700	500	600	600	400	250									
10 Jan										100	150	300	400	700	500	600	600	400	250				
11 Jan											100	150	300	400	700	500	600	600	400	250			
12 Jan												100	150	300	400	700	500	600	600	400	250		
13 Jan													100	150	300	400	700	500	600	600	400	250	
14 Jan														100	150	300	400	700	500	600	600	400	250
Yield with husk (kg)	100	250	550	950	1650	2050	2500	2800	2800	2450	2100	1800	1600	1900	2050	2500	2800	2800	2350	1850	1250	650	250
Yield without husk (kg) [2]/	14	35	77	134	232	289	352	394	394	345	296	253	225	268	289	352	394	394	331	260	176	92	35

Remarks: [1]/ Assume that the first planting series is during 1-5 January and the second series is during 10-14 January, each day grown 0.8 ha. The delay of one series to another is 4 days (this period is used for seed, fertilizer and labor preparation)

Before start planning to meet yield with husk 2,000 kg/day in the area of 4 ha, the farmer should try with 0.16 ha with complete record from the first day till the last days of harvesting.

[2]/ Calculated from the exchange rate at 7.1:1

Source : Rakhakul, 2004

5. BABY CORN PRODUCTION COST, PRICE AND MARKETING IN THAILAND

5.1 Baby Corn Production Cost and Return

In comparison of baby corn production between year1997/1998 and 2003/2004, total production area of baby corn in Thailand was increased from 29,115 ha to 34,858 ha while the total production was increased from 215,122 tons to 249,303 tons or increased to 19.7% and 23.4% respectively as shown in Table 6. However the trend of average yield per ha was decreased may be due to deterioration of soil fertility since most of the farmers grow corn continuously the whole year round with very rare organic fertilizer application.

Major investment of baby corn is labor cost since it is labor intensive requirement crop. Although pesticide is not intensively used in baby corn due to short duration crop, investment of fertilizer and seed are considered high. Most of the farmers use hybrid seed from the company which require high dose of fertilizer application. In addition, with the new regulation of import, country also force the farmers to have many additional investments to improve their production process to meet the standard requirement of the consumer.

Table 6: Baby Corn growing area, production, yield, farm gate price and farm value, crop year 1997/98-2003-04

Year	Planted area	Harvested area	Production	Yield per ha (kg)		Farm gate price	Farm value
	(ha)	(ha)	1,000 (tons)	/(PA)	/(HA)	(Baht/kg)	(million Baht)
1997/98	29115.84	27991.2	215.122	7387.5	7687.5	20.62	4,435.816
1998/99	29168.48	28216.8	199.810	6850.0	7081.3	15.22	3,041.108
1999/00	26175.04	22813.6	189.624	7243.8	8312.5	19.05	3,612.337
2000/01	24623.2	22580.5	177.142	7193.8	7843.8	18.25	3,232.842
2001/02	37179.52	34852.6	284.130	7643.8	8150.0	17.21	4,889.877
2002/03	37380.8	36032.5	255.221	6825.0	7081.3	17.63	4,499.546
2003/04	34858.24	34556.5	249.303	7151.9	7214.4	18.69	4,659.473

Source : Department of Agricultural Extension, 2005
/PA = Planting Area
/HA = Harvesting Area

Table 7: Cost of baby corn production in 2004/2005 average from the whole country

Item	Without husk			With husk		
	Cash	None cash	Total	Cash	None cash	Total
	Baht					
1. Variable costs	15331.4	5027.5	20358.9	11784.4	2784.8	14569.1
1.1 Labor	7305.0	4824.8	12129.8	5049.4	2705.0	7754.4
Land preparation	2422.3	115.3	2537.6	1687.3	146.4	1833.6
Planting	464.1	416.8	880.9	294.8	181.1	475.9
Management	506.8	2607.4	3114.2	596.9	902.1	1498.9
Harvesting	3911.9	1685.3	5597.1	2470.6	1475.4	3946.0
1.2 Materials	7652.4	80.1	7732.6	6447.5	11.8	6459.3
Seed	2419.1	41.3	2460.3	2104.5	0.0	2104.5
Fertilizer	4182.6	0.0	4182.6	3608.9	0.0	3608.9
Pesticide + herbicide	575.3	0.0	575.3	303.3	0.0	303.3
Fuel	221.7	0.0	221.7	193.1	0.0	193.1
Agricultural equipments & other materials	247.5	36.3	283.8	219.0	11.1	230.1
Repair and maintenance	6.3	2.6	8.9	18.7	0.7	19.4
1.3 Capital opportunities cost	373.9	122.6	496.6	287.4	67.9	355.4
2. Fixed cost	0.0	2043.7	2043.7	0.0	1780.8	1780.8
Land rent	0.0	1943.9	1943.9	0.0	1649.3	1649.3
Equipment depreciation value	0.0	93.1	93.1	0.0	126.3	126.3
Equipment investment opportunities cost	0.0	6.6	6.6	0.0	5.2	5.2
3. Total cost/ha (Baht/ha)	15331.4	7071.2	22402.6	11784.4	4565.6	16349.9
4. Total cost/kg (Baht/kg)	7.3	0.0	10.6	1.5	0.0	2.1
5. Yield per hectare (kg/ha)	2110.1			7888.6		
6. Farmer price at the field (Baht/kg)	16.0			2.3		
7. Return per hectare (Baht)	33804.2			18380.4		
8. Net return per hectare (Baht)	18472.8	0.0	11401.6	6596.0	0.0	2030.4
9. Net return per kilogram (Baht)	8.8	0.0	5.4	0.8	0.0	0.3

Source: Office of Agricultural Economics, 2005

5.2 Baby Corn Prices

While the cost of investment of baby corn seems to increase every year, the price of baby corn is almost no different from the last ten years (Table 8 and 9). The price is high during rainy season since the supply is less and the farmers have to delay their planting due to difficulty of land preparation (Figure 2). However, nowadays, there are increasing number of livestock farms near baby corn production area, the farmer can have additional income from the sell of baby corn stems after harvesting about 4375-5000 Baht/ha and also husk after removing cob at the price of 0.5 Baht/kg.

Table 8: The prices of baby corn without husk during 1999-2005

Price of baby corn without husk, 1999-2005 (Baht/kg)								
Month/Year	1999	2000	2001	2002	2003	2004	2005	Average
Jan.	20.83	14.67	16.42	19.75	20.44	19.25	18.58	18.56
Feb.	20.8	13.25	17.21	18.55	18.04	19.92	20.58	18.34
March	21.67	12.25	17.91	18.42	14	19.8	20.67	17.82
April	23.72	13	18.33	17.21	17	19.89	20.78	18.56
May	19.48	18.2	18.33	16.23	18.83	20	20.34	18.77
June	19.35	24.5	15.71	17.48	19.73	20.33	20.67	19.68
July	20.25	20	15.82	16.8	17.08	20.37	20.67	18.71
Aug.	16.5	17.75	16.83	15.58	18.08	21.67	22	18.34
Sep.	17.87	16.37	17.54	17.12	20.67	22.25	23.58	19.34
Oct.	17.37	16.9	15.62	16.83	20.33	21.04	23.6	18.81
Nov.	17	15.57	19.04	18.29	19.35	20.04	24.42	19.10
Dec.	15	15.6	17.74	19.31	20.67	20.96	-	18.21
Average	19.16	16.51	17.21	17.63	18.69	20.46	21.44	18.73

Source: Office of Agricultural Economics, 2005

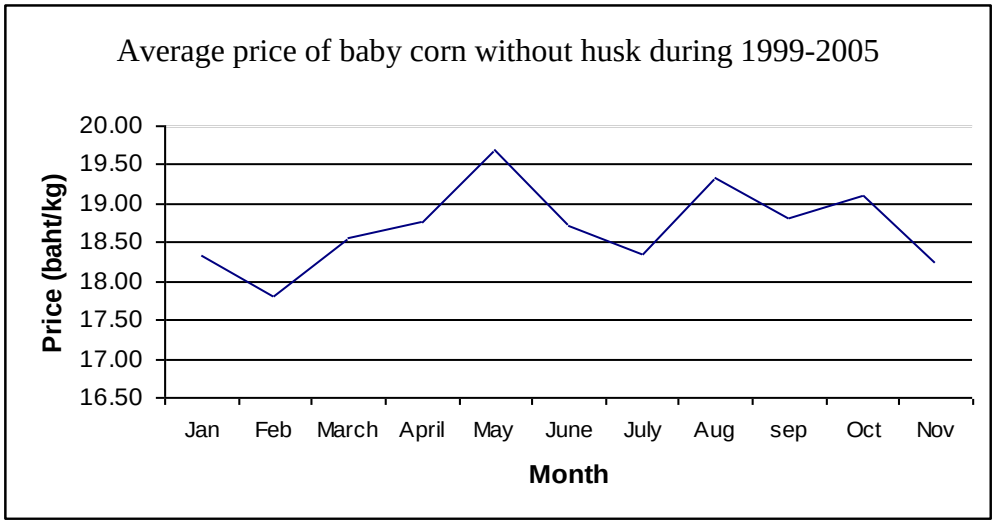

Figure 2: Monthly average wholesale price of baby corn without husk during 1999-2005

Table 9: The prices of baby corn with husk during 1999-2005

Price of baby corn with husk, 1999-2005 (Unit: Baht/kg)								
Month/Year	1999	2000	2001	2002	2003	2004	2005	Avg.
Jan	3.42	4.00	3.26	3.34	3.93	2.25	2.42	3.23
Feb	2.73	3.14	3.00	2.78	3.28	2.00	2.50	2.78
March	2.79	2.71	2.97	2.70	2.96	3.00	1.50	2.66
April	2.74	2.76	3.32	3.16	2.90	3.33	2.50	2.96
May	2.92	2.93	3.41	3.48	3.60	2.93	2.25	3.07
June	3.05	2.84	2.78	3.18	4.57	2.75	2.03	3.03
July	2.82	2.54	2.88	3.07	3.56	2.00	2.27	2.73
Aug	2.64	2.67	3.00	2.76	2.82	2.60	3.67	2.88
Sep	2.30	2.67	2.72	3.16	3.00	3.00	2.91	2.82
Oct	2.40	2.53	2.98	3.14	2.25	3.00	2.57	2.70
Nov	2.93	3.31	3.60	3.03	2.81	2.61	2.81	3.01
Dec	4.11	3.59	3.41	3.26	2.87	2.84	-	3.35
Average	2.90	2.97	3.11	3.09	3.21	2.69	2.49	2.93

Source: Office of Agricultural Economics, 2005

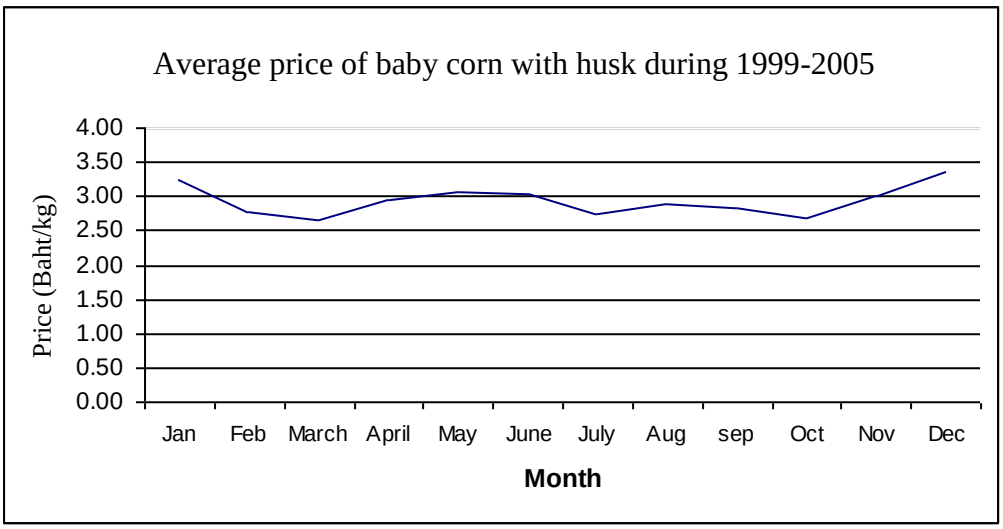

Figure 3: Monthly average wholesale price of baby corn with husk during 1999-2005

5.3 Baby Corn Marketing

Most of baby corn growers in Thailand sell their products to the local broker. One broker normally have farmers under his contract about 100-200 farmers. The broker will get the quota from the factory and distribute it to their contract farmers. They can control product's quantity by planning together with the farmer for the planting and harvesting period. After collecting the product the broker will sell the good quality products to the factory, and the sub standard products will be sold to local market or retailers which finally reach to the consumers (Figure 4).

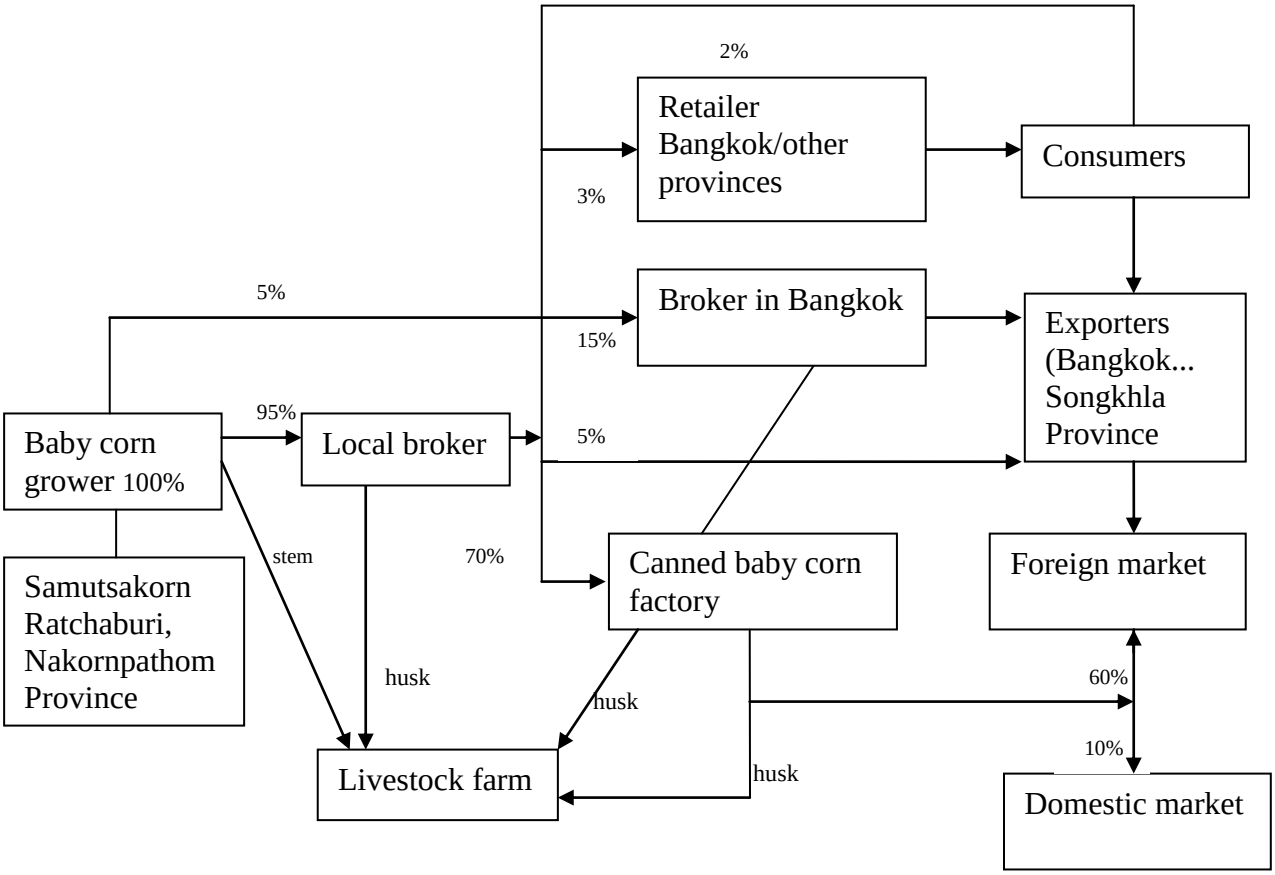

Figure 4: Marketing flow of baby corn in west region of Thailand

6. PRODUCTION PROCEDURES AND INPUTS

In intensive baby corn production, planning is the most important issue and requires in order to control production to meet both quantity and quality demand of the factory and market. Thus, prior contact with the factory or broker regarding production is highly recommended.

For general, production practices of baby corn in Thailand are similar only with some small differences according to the region. The Department of Agriculture, Thailand has developed the GAP for baby corn production manual for farmer adoptions as follow:

6.1 Land Preparations

- A seedbed which is deep, well pulverized yet fairly compact is excellent for corn.
- For the first plowing use 3 bottom disc plow tractor with the depth of 20-30 cm.
- Plowing is done when the field is at the right moisture.
- Dry the soil 7-10 days then plow again with 7 bottom disc plow tractor
- Harrowing is done at the time the soil has the right moisture content. It is done again within two days before planting to level the soil.
- A clayey and weedy field requires more plowing. In a weedy field where trash is plowed under, a second or third operation may be needed to obtain a clean seedbed.

6.2 Soil Analysis

- If the soil pH lower than 5.5, lime application is recommended with the rate of 1,250 kg/ha
- If soil organic matter lower than 1.5%, compost fertilizer and complete digested manure with the rate of 3,125-6,250 kg/ha is recommended

6.3 Planting Method

(1) Surface or flat-bed planting

Seeds are drilled or hill-planted on a level to slightly rolling topography at a desired depth and row spacing. It is suited for areas with abundant precipitation and heavy soil types. Plant spacing is 50x50 cm. 3-4 seeds /hill and thin out to retain only 2 plant/hill after 14 days.

(2) Listed planting

Seeds are placed at the bottom of the V-shaped furrow. A lister which is double mold board blade is used for opening furrow of this kind. It is practiced in areas where rainfall is a limiting factor, where soil is drainage is good and the soil is friable. Row spacing is 50 cm, plant spacing 25-30 cm, 2-3 seeds/hill and thin out to retain only 2 pant/hill after 14 days.

Figure 5: Ridged planting

The seeds are placed to a specified depth on top of the ridge. The conditions described in listed planting are also appropriate for this type.

If the soil contains considerable moisture at planting time, the seeds should be planted from 2 to 5 cm deep. On dry soil, the seeds should be planted 5 to 8 cm deep.

6.4 Seed Rate

Seed germination should be higher than 85%, application rate should be 28-38 kg/ha. Appropriate plant population will be 112,500- 125,000 plant/ha.

Figure 6: Planting tools of the farmer in Kanjana Buri Province, Thailand

6.5 Irrigation

Baby corn trees grow well and yield good quality produce, when planted in soil having humidity during all the cultivation period. If too much water is given to them, or a lack of water occurs for a time, the trees will suffer interruption in growth and consequently yield low quality produce. Defective ears result from a lack of water during corn ear producing time. In general, baby corn plants should be consistently watered from the beginning of cultivation to the end of harvest. When they are small, they should be watered every 2-3 days. As they reach the height of 50-60 centimeters, water should be given every 5-7 days. After that, every time soil gets dry, farmers have to water the trees

Figure 7: Furrowing irrigation

6.6 Fertilization

If soil has organic matter, available phosphorus and exchangeable potassium should be lower than 1.5%, 10 mg/kg, and 40 mg/kg, respectively. The recommended rate of fertilizer per hectare is 312 kg of 15-15-15 in sandy loam soil or 16-20-0 in loamy or loamy clay soil. It should be applied at the bottom of the hill and covered with 2 to 3 cm layer of soil before planting. When the plant age of 20 day, apply 46-0-0, rate 312 kg/ha or 21-0-0 rate, 625 kg/ha, by side dress application and reach the cover with soil.

Figure 8: Baby corn planting in Kanjana Buri Province, Thailand

6.7 Weeding

Weeds are the unwanted plant companion of crops. Besides serving as host to plant pest and diseases, weeds can reduce corn yield by as much as 50 to 80% if left uncontrolled.

Weeds are commonly controlled by hand weeding, hoeing within the rows and cultivation in between the rows or herbicide as shown in Table 10.

Table 10: Recommended herbicides for baby corn production

Weed	Herbicide	Application rate/ 20 lit of water [1/]	Application method
Annual weed	Metolachlor (40% EC)	150 – 200 ml	Spray pre-emergent when the is moist
	Alachlor (48% EC)	125-150 ml	
	Acetochlor (50% EC)	80-120 ml	
	Paraquat (27.6% SL)	75-100 ml	Spray 3-7 days before plowing or spray between row after planting 20 days when the weed have 2-3 leaves or before weed produce flower
Perennial weed	Glyphosate (48% SL)	120-160 ml	Spray before planting or before plowing 7-15 days
	Glufosinate-ammonium (15% SL)	300-400 ml	

[1/] Rate of water 500 lit/ha

6.8 Detasseling

Detasseling is achieved by removing all the tassels of corn plants. This is done as soon as the tassels emerge. After detasseling 2-5 days, the first cob harvesting can be started.

6.9 Crop Protection

Pest and Disease

Insect Pests: The common insect pest which are usually found in baby corn are Spodoptera exigue, corn stem borer. Details of each pest are as follows:

a). Spodoptera exigue This insect can destroy the crop by eating every young part during 1-2 week after planting. It is more violent during the dry period. To control this insect

b). Corn Stem Borer (Ostrinia furnacalis) Major damage caused by the borer occur at about 20 days up to harvesting stage by destroying the shoot, tassel and the stem causing poor quality of crop. This damage will be more serious during the dry period. To control this insect pest, monitoring the insect egg, worm, and damage on the crop regularly. If found during 20-30 days after planting, the damage should spray insecticide as shown in Table 11.

Table 11: Recommended insecticides for baby corn production

Insect Pest	Bio/chemical Pesticide	Application rate/ 20 lit of water	Caution	Stop using (day before harvesting)
Corn Stem Borer	Cypermethrin (15% EC)	10 ml	Spray when found 1 worm/plant or damaged of shoot leave 40-50% of total leave area	10
	triflumuron 50% WP	30 g		14
Spodoptera exigue	Nuclear polyhedrosis virus	20-30 ml	Spray in the evening when 2-3 insects /plant, 1-2 times every 5 days	1
	Beta-cyfluthrin (2.5 EC)	40 ml	Spray when found 2-3 insects/plant	14

Disease: Downy mildew (Peronosclerospora sorgh) is the only serious disease of corn in Thailand. The symptoms of the disease are yellowish stripes appearing on the leaves. Under moderate temperature and humidity conditions, a white downy, or a powdery mass appears on the leaves, particularly, under the surface. Affected plants are stunted and produced only small or unfilled ears. Recommended fungicides are shown in Table 12.

Table 12: Recommended fungicides for baby corn production

Disease	Chemical Pesticide	Application rate 1 kg	Caution	Stop using (day before harvesting)
Downy mildew	Metalaxyl (35% DS)	7 g	Mix with seed before planting	-

However, baby corn requires practically no application of pesticides because the crop has short growth duration thereby eliminating the residue factor and minimizing in production cost.

6.10 Harvesting and Storage

The most appropriate time for harvesting baby corn is after silking 2-3 days or when baby corn silk comes out 1-5 centimeters depending on varieties (Table 4) from the top end of ears, or when the plant is 45-50 days old depend on each variety. When possible, harvesting should be carried out in the morning, when the corn's moisture content is highest and product and ambient temperatures are low. Reap ears on top first, then those below. A baby corn plant produces 3-4 ears. When farmers pluck baby corn ears, the stem should be altogether plucked away so that farmers will know which trees are not reaped yet. Harvest crops every day and finish within 5-10 days in order to prevent baby corn from being overripe. In case of using unfamiliar baby corn varieties, farmers should get to know what length of silk indicates the most appropriate harvesting time by taking ears with different length of silk, and looking inside. Baby corn varieties have different lifetime ranging from 40 to 60 days. It is suggested that farmers reap 2 ears per tree. The third should be left as it is usually defective, and does not reach export standards. Timely harvesting is the most crucial thing in baby corn cultivation. Quality of produce largely depends on this stage of cultivation. For instance, late harvests illustrated by too long silk coming out from ears result in a too big baby corn size undesirable to processing plants and traders.

As for harvesting methods, farmers should twist or snap ears away. Next, put them in containers like baskets, bags, sacks. They should be kept in places with good ventilation, and should not be heaped or they will easily become rotten. Normally, a harvesting period lasts 10-12 days, except in the case of Golden Baby harvesting, which lasts 8 to 10 days. On average, there will 5000-6250 kilograms of baby corn in husk per hectare, or 625-1094 kilograms of husked baby corn per hectare. However, productivity is also influenced by different baby corn varieties, seasons, and ways of cultivation.

6.11 Yield and Recovery Yield

The total marketable weight of baby corn was measured with the husk and without the husk. On

average, the weight of the edible ear was 13% the weight of the ear with the husk. In conclusion, ten kilograms of harvested baby corn typically yield 1.5 to 1.8 kilograms of cob without husk, or about 15 to 20 percent of the harvested weight.

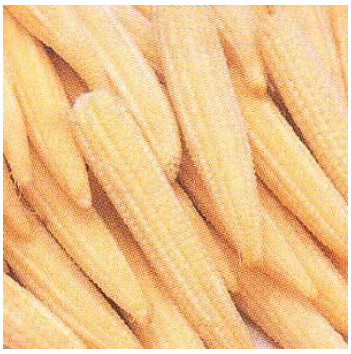

Figure 9: Baby corn products

Apart from consumption use, baby corn has another use. Its stalks and leaves amounting to 30,000 kilograms per hectare, husk and silk amounting to 5,562 kilograms per hectare, and masculine buds amounting to 3,125 kilograms per hectare can be used as animal feed, especially for cows raised for meat. Parts of the baby corn tree are rich in nutrients, especially protein found in the tree 6.4-13.8% and fiber found in the tree 28-30%. Cows fed with corn parts grow better than those fed with grass or rice straw. As a result, more and more cow farmers turn to use baby corn parts as animal feed instead of grass. The farmers can earn an additional income from selling baby corn parts. For instance, baby corn stalks can fetch between 1,250 and 6,250 baht per hectare according to seasons.

Milk cows also feed on baby corn waste well. Milk cow farmers buy fresh stalks at 1,875-2,500 baht per hectare, and masculine buds at 437-500 baht per hectare. Fresh stalks consisting of layers of bark are nutritionally rich, having 13.2% of protein and 34.8% of fiber. This nutritional fact is similar to that of fresh grass. Baby corn stalks help ease cows' digestion as well.

Nowadays, a large number of farmers grow baby corn together with raising cows feeding solely on baby corn waste. Income comes from sales of baby corn produce, cow milk and cows. However, growing baby corn together with raising cows entails a great deal of labor. Thus, farmers should group in planting baby corn every week so that stalks would be sufficient for feeding cows throughout the year. The following is a formula for calculating a number of growing areas.

Number of growing areas/week

$$= \frac{\text{Weight of crude food needed by cows/day (kg) x number of cows x 7}}{\text{Amount of baby corn stalks/rai (kg)}}$$

Figure 10: Baby corn husk for animal feeding

7. BABY CORN PRODUCTION CONSTRAINTS

7.1 Quality Problem

Quality of baby corn often fails to reach factory standards because farmers frequently use unqualified seeds and do not care for the plant well. The major problems are as follow:

7.1.1 Problems before harvesting which cause unqualified qualities and size

- Use of unqualified varieties, some varieties grows very fast, the farmer can not harvest in time.
- Use seeds from previous crops, causing none uniform plants.
- High plant population density as farmers want to increase number of cob/ha
- Application of too much fertilizer cause insect and disease infection
- Excess or deficit of water can cause twist cob and delay growing and lower yield

7.1.2 Problems from harvesting to the factory

- Harvesting
  - Shortage of labour due to baby corn is labour intensive crop the harvesting period is within 7-10 days only
  - Lack of experience of the farmer to consider suitable/mature cobs

- Collecting of products from field
  - The heat from sunshine can reduce the product qualities if the farmers leave their products out of shade while waiting for the broker to collect
  - Poor ventilated containers also can create high temperature and damage cobs during transport

- Transportation and removing husk
  - Loss of cob moisture during transportation can cause low weight and poor quality
  - Broken cobs, most of the cobs are broken during harvesting and transportation of cob without husk due to lack of experience of the farmer and carelessness.
  - None fresh products: The storage period of cob with husk is 3-5 days but after remove husk can be store only 1 day.

- Broker: Most of the store for collecting and peeling of the broker are located near the road and thus can not protect products from the dust. After collecting products, from the farmers have to pile up in a place with poor ventilation, created high temperature and thus damage to the cobs. Besides, during high production period may have labor shortage for peeling the husk.

- Collecting the products by the factory: During high production period, the broker may have to wait long queue for quality checking under open sunshine causing reduced product qualities. Besides, with the high quantity product, sampling method can not achieve good quality standard.

7.2 Price Fluctuation

Baby corn farmers always face a price drop. This is because of produce distribution through middlemen. They always offer low prices. Therefore, farmers cannot rest assured on prices. Worry about prices and markets results in uncertainty of produce volume.

7.3 Local Market Problem

7.3.1 Dividing

This is one of significant problems in baby corn trade. Factories are always strict about quality of raw materials. If they find unqualified corn ears, they will leave them out and subtract the weight of defective baby corn from the total weight of baby corn offered by middlemen for sale. If the number of defective baby corn is huge, they will lose considerable profits. However, middlemen or produce collectors usually manage to get compensation pay from farmers, claiming that some of produce they buy is low in quality and cannot be accepted by factories. In consequence, this entire burden rests on baby corn cultivators, who already suffer the low price of baby corn. Sometimes, the cultivators run out of morale in growing the plant despite high demand from markets and processing plants.

7.3.2 Delayed payment from factories

Sometimes, it takes about 2-3 months for factories to pay money to middlemen. Then, middlemen have to postpone payment to farmers when buying produce. This leads the farmers to a lack of capital for the next planting. They have to borrow money from many sources to carry on with baby corn cultivation. Therefore, they have to bear the burden of paying high interest rates.

7.4 Export Problem

7.4.1 Local competition

There is a lot of competition in terms of price cutting among local manufacturers due to a bright trend of canned baby corn import demand. It is getting higher every year. Some exporters offer prices lower than production costs so that they can seize more market shares from old exporters. Other exporters have to reduce product prices accordingly to remain competitive. Inevitably, prices, at which farmers sell their produce, weaken.

7.4.2 Competition with foreign producers

Especially Taiwan, one of Thailand's important competitors. Even though Thailand has very low-price products, those from Taiwan can trade in even lower prices than Thailand's. This is because of higher production costs in Thailand particularly the cost of canning, and also low efficiency of production. These factors effects Thailand's market share.

7.4.3 Inadequate gross tonnage

Both canned baby corn and fresh baby corn exports always face no availability of room in airplanes. Also, the cost for transporting goods in this way is very high. This is because most airline companies do not favor transportation of fruits and vegetables even though there is high demand from foreign countries. This makes Thai exporters lose opportunities to reach more markets worldwide. Moreover, many fresh products often decay while awaiting shipping at airports. It can be said that considerable income is lost each year.

7.4.4 Failing to reach standards

Both Thai canned baby corn and fresh baby corn do not meet world standards yet. Thai baby corn exports are often found to be broken, blended with corn silk, and have no consistency in sizes. Some are too big and some too old. Besides, the packaging, especially that of fresh baby corn, does not meet standards too.

8. STANDARD REQUIREMENTS FOR BABY CORN PRODUCT

There are three types of baby corn products available in the world market including fresh baby corn, canned and frozen. The general requirements for baby corn products are as follows:

- The most suitable cob size is 1.0-1.5 cm with the length of 4-9 cm; however, the length can be graded into three categories.
  - Big size 7-9 cm
  - Medium size 5-7 cm
  - Small size 4-5 cm
- Cob corn of excellent quality is straight and no damage or broken cob
- Cob color is light yellow or yellow
- Uniform ovary alignment
- Fresh cob storage should not be longer than 24 hours

8.1 Fresh Baby Corn

Most fresh baby corn is packed dehusked in perforated plastic clamshells or punnets for retail markets. Polystyrene or plastic trays wrapped with film can also be used. Ventilation is required in all four-side walls. These trays may weigh 125 grams, 150 grams, 170 grams, 200 grams, or 250 grams. Clamshells, punnets, or trays are typically packed 12 in a carton. Carton dimensions vary depending on net weight and market. Some wholesale markets use 5- to 10-pound waxed cartons containing corn with husks intact.

In Europe, importers prefer fresh baby corn to be completely free of wrapper leaves and silk, and laid neatly in clear plastic trays that are aligned next to each other so as to create a relatively level surface. Each layer must have the cob tips pointing in the same direction. Baby corn is usually shipped to Europe pre-packed in 250 gram, PVC-over wrapped trays and shipped eight trays per 2-kilogram carton, or in 6-ounce trays with six trays per carton. Labels must include the country

of origin, the words "baby corn" if the contents are not visible, the date of packing, and the weight.

8.2 Canned Baby Corn

The commonest type of canned baby corn is canned baby corn in brine (baby corn and brine as components). It is often packed in metal cans and glass jars. Baby corn preserved in brine and packed in glass jars is more expensive than canned baby corn, and consequently has higher quality. Baby corn in glass jars is a specialty item found mostly in gourmet supermarkets. Restaurants and other food industries usually do not purchase baby corn in glass jars because it entails difficulty in storing, is prone to damage, and more costly than canned baby corn. Generally, sizes of canned baby corn are divided into three categories as15, 20 and 108 Ounces.

Size 15 & 20 Ounces: The remaining 20 percent of total production is the manufacture of canned baby corn of the 15 and 20 Ounce sizes. Products of these two sizes are mostly domestically sold.

Size 108 Ounce: Factories produce canned baby corn of this size in the volume of 90 percent of total production. This size is especially for export.

8.3 Frozen Baby Corn

Frozen baby corn, which is mostly used as an ingredient for prepared foods, has possibly the smallest U.S. market in comparison with other processed baby corn products because of its high price.

Figure 11: Fresh baby corn production process

For baby product export, packages should bear all the labeling information required by the importing country. Carton labeling may include the following:

· • Country of origin
· • Product/variety
· • Net weight
· • Exporter name/importer name

9. BABY CORN POST HARVEST PROCEDURES

9.1 Buying Processes of Factory

9.1.1 Examination of raw materials before starting the work

The factories usually have other works to do such as seasoning vegetables and fruits, in the mean time the factory will go ahead with young corns for supplementation when they don't have other products to process. Some factories will process the young corns all year around.

From the information provided by the International Food Ltd. in Lumpang province, the young corns can be produced 3 times a year, early rainy season between April to July (about 45 days), late rainy season between August to December (45-50 days), and dry season between January to March (70 days). In some area although the farmers can grow throughout the year they grow corn only during part of the year as they grow rice as the main crop.

Collecting of baby corn products vary from factory to factory. Some factories make contract directly with the farmers. But some factories will buy the raw materials and set the quality and quantity of young corns through the broker. The factories will give the corn seeds to the farmers via brokers. The broker will also sell the fertilizer and insecticide to the farmers. The factories buy and sell baby corn through broker which will cut down the waiting time for sample checking of the factory. If the factories have too much of young corns, the factory will store the corns in the refrigerator, usually not more than a day.

9.1.2 Weighing process

The young corns are delivered to the factories by the broker, farmers or brought by the factories themselves. The corns are packed in the plastic baskets (belong to the factories). They will go through the process of weighing, quality selections, and then thru the separation of the silks from the cobs and removal of the damaged corns.

9.1.3 Selection of sizes and quality

If the factories buy from the broker, the broker will take the responsibility for the selection of sizes and quality of the young corns. The factories will randomly check the corns and pay the broker or the farmers. Usually the factories will reject the corns less than 5%. After going through the separation process, the corns are washed and send for canning. Generally, during January to April, about 45% of grade 'A' corns can be achieved because of ease of control and adequate water supply.

In Kanchanaburi province, one of the largest baby corn growing areas in Thailand, baby corn marketing process is via contract farming system between factory and farmers through brokers. The brokers collect product that meet the standard from their contract farmers and deliver to factory. The details of this system are shown in Figure 10. Brokers are responsible for initial grading and sizing the products. Baby corn products that meet factory standard are sent directly for processing. The other products that are lower than the standard requirement by factory are put into the local market for domestic consumption.

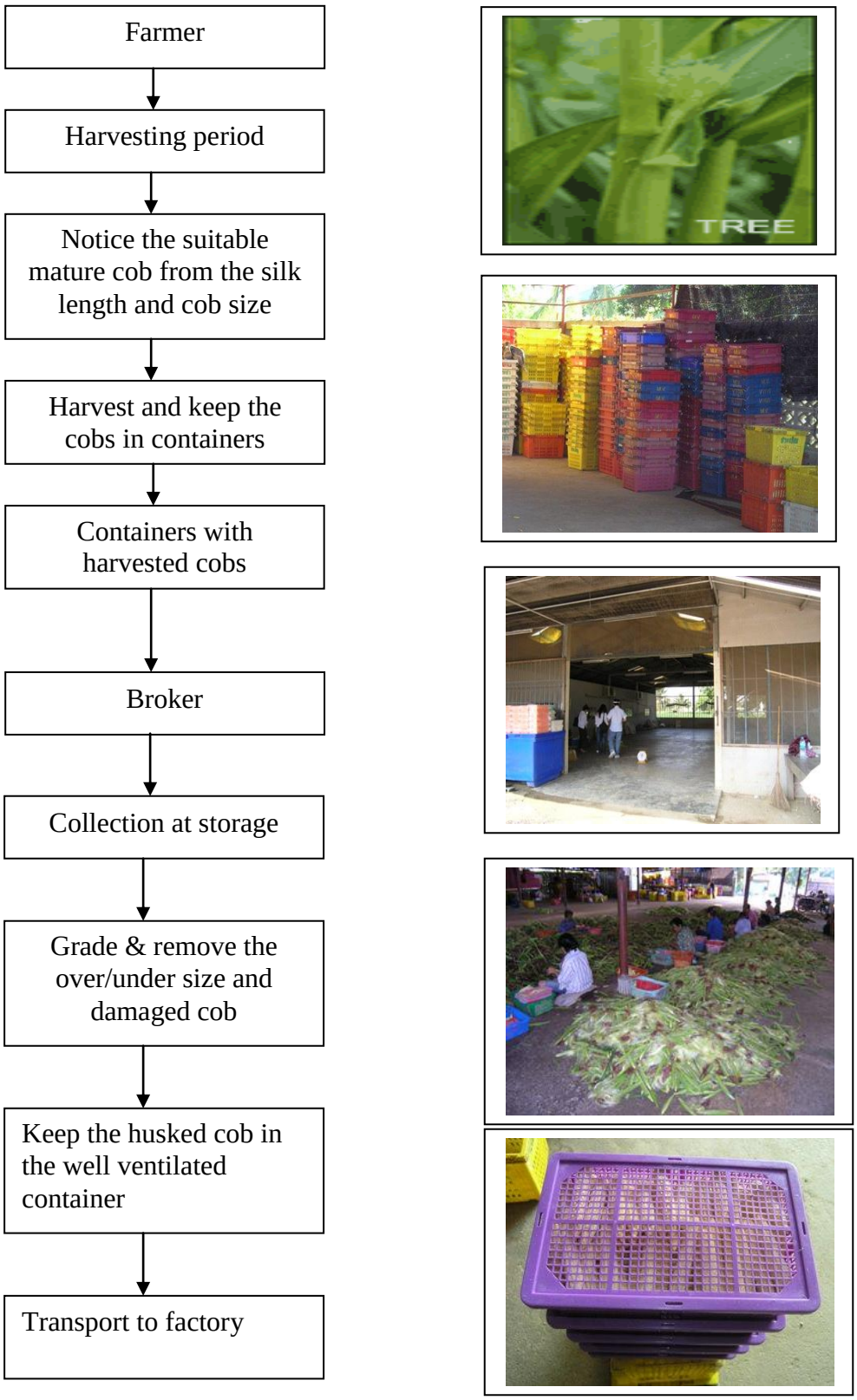

Figure 12: Baby corn selling processes from farmer to broker in Kanjanaburi Province

9.2 Processing of Canned Baby Corn

9.2.1 Baby corn raw materials

Baby corn has to be fresh, the length of the cob is between 4-10 centimeters, the diameter is between 1-1.5 centimeters, straiten cob, kernels in good alignment, no bitten by insects. The kernels should be in yellow color or cream color. If husk is removed from baby corn, the baby corn must not show any sign of cutting by knife and no silk attached.

9.2.2 Preparation of corn

1) Cleaning

Cleaning peeled baby corn, getting rid of silk and other dirty objects. After the husk is removed, the next step is shaking the corns to separate the silks from the corns, and remove the broken corns or damaged corns from the good. Then wash the corns in water and soak in 0.5% alum for 45-60 minutes to increase the crunch.

2) Boiling

Boiling baby corn in water mixed with citric acid 0.2% for approximately 10 minutes at temperature 90-100 ^{0} C until it is well cooked. The good quality boiled cob should produce clear color at the center of the cob and the cob should be able to bend without being broken.

3) Soaking

After boiling, the corns should be put in cold water immediately until the cob is cool.

4) Grading

The corns are graded by sizing. Generally, big corns should have 7-9 centimeters length and 1.4-1.5 centimeters diameter. Medium corns should have 5-7 centimeters length and 1.2-1.3 centimeters diameter. Small corns should have 4-5 centimeters length and 1.0-1.1 centimeters diameter.

5) Containers

Packing in cans or glass. In the companies studied under this project, the size of cans and bottles are as follows;

Can sizes 300 x 407 (height x diameter, in), net weight 225 grams, total weight 425 grams.
Can sizes 307 x 409(height x diameter, in), net weight 270 grams, total weight 540 grams.
Can sizes 603 x 700(height x diameter, in), net weight 1,500 grams, total weight 2900 grams.
8 oz. Bottle, net weight 100-120 grams, total weight 225 grams.
16 oz. Bottle, net weight 220-240 grams, total weight 450 grams.

6) Adding brine

After filling baby corn in containers, water and brine are added in cans in the proportion of 2:98 (brine 2%, water 98%) together with citric acid 0.05%-0.1%.

The temperature of added brine is about 40-60 ^{0}C. It should have the space above the content about 3/16 inches for 8 oz bottle, 4/16 inches for 300 can and 16 oz bottle, 5/16 inches for 307 can, and 6/16 inches for 603 can.

7) Exhaust process

To exhaust air until the beginning temperature of 70-75 ^{0}C for small can is achieved 75-80 ^{0}C for 603 can, and 68-72 ^{0}C for bottle.

8) Seaming

9) Heating

Sterilization process, temperature 250 ^{0}F, pressure 15 pounds/sq. inch, takes 25 minutes for 300x407 can and 8 oz. bottle, 30 minutes for 307 × 409 grams and 16 oz. bottle, 50 minutes for 603x700 can at temperature 240 ^{0}F and pressure 10 pounds/sq. inch.

10) Cooling process

Cooling is done until temperature in the can is 35-40 ^{0}C or 95-105 ^{0}F. Cut out pH 5.2-5.6.

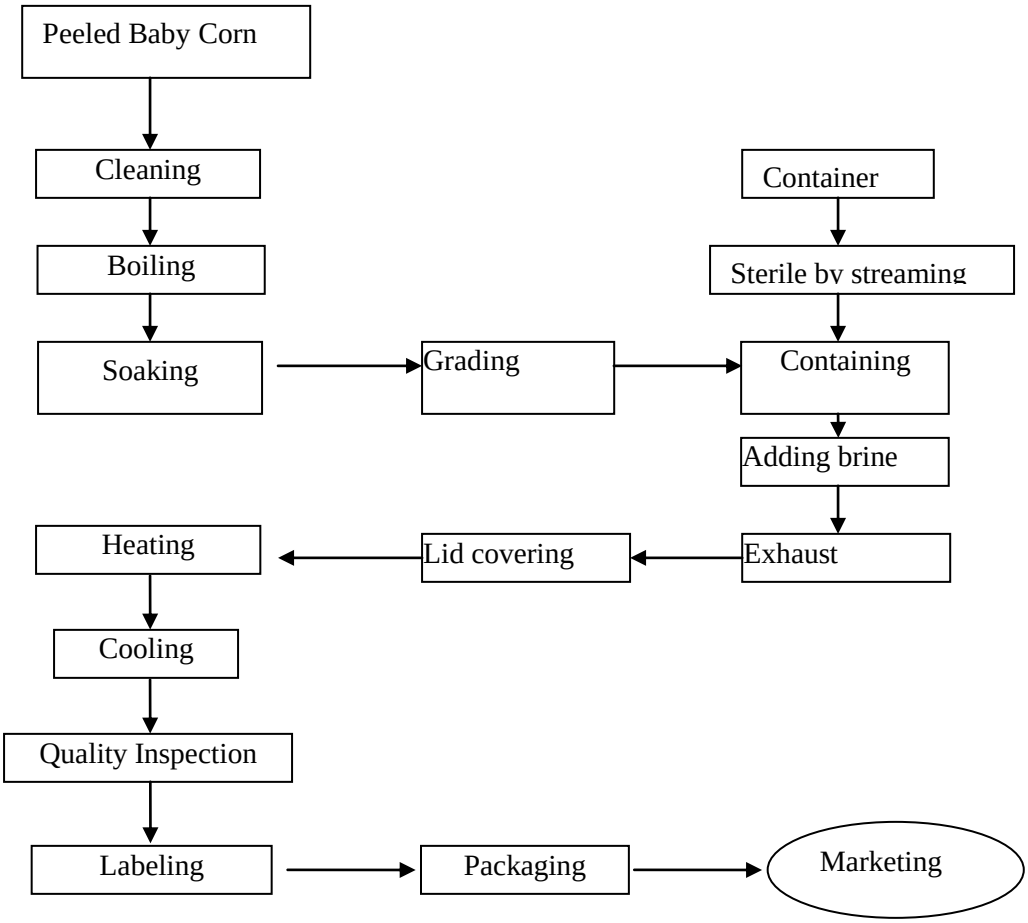

Figure 13: Production process diagram of canned baby corn

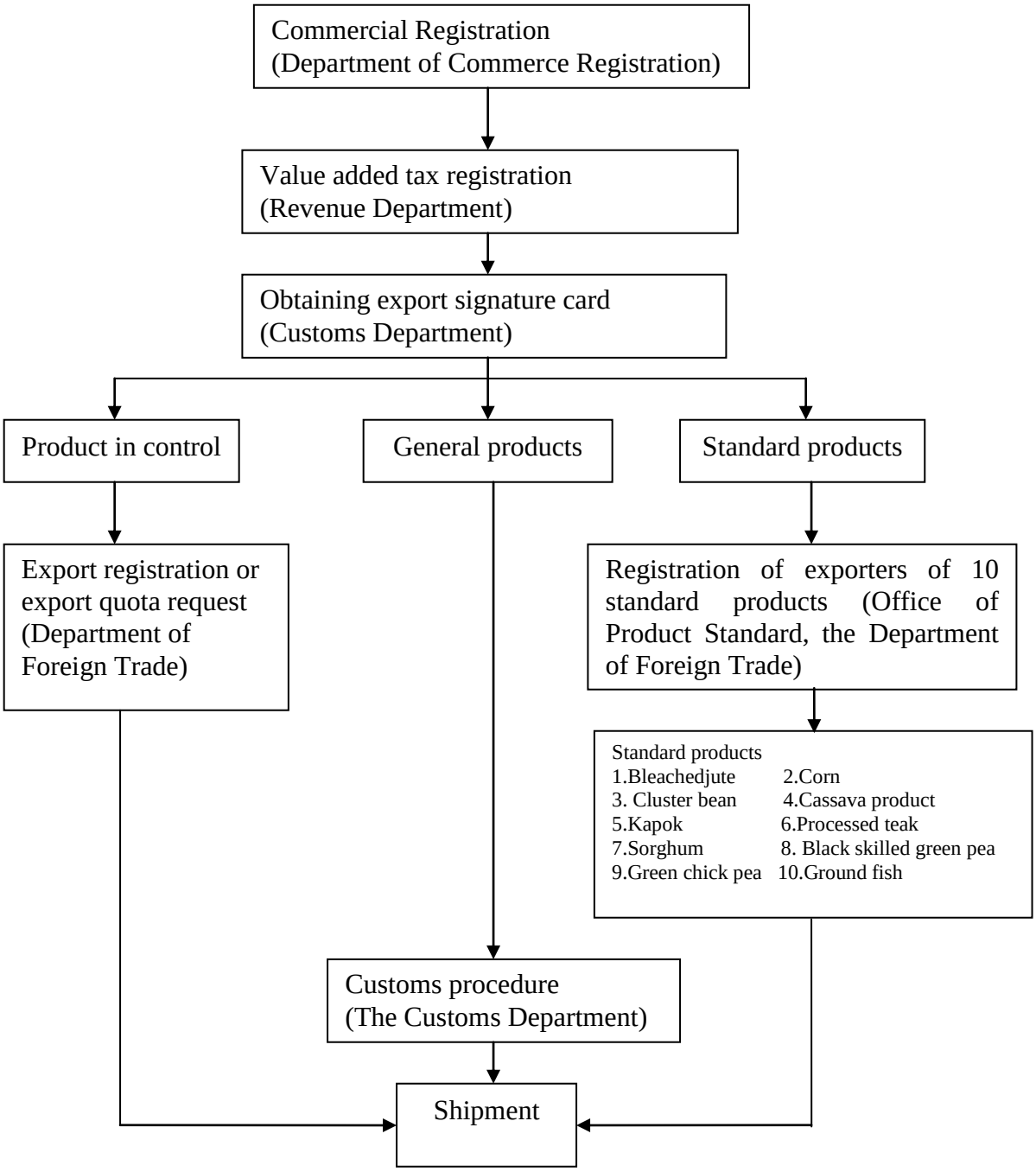

Figure 14: Export procedures for baby corn from Thailand

10. IMPLEMENTATION OF GLOBAL GOOD AGRICULTURAL PRACTICE (GAP)

10.1 Good Agricultural Practice Standard

Protection of the health of consumers requires effective food safety control systems. These systems must be implemented on the entire chain of food production from farm to table. The control and inspection of the food safety implementation in Thailand is carried out by two parties, including both the official governmental sector and non-governmental parties associated with the chain of food production. The governmental sector is responsible for legislating the legal framework relating to food production as well as the augmentation of the other sponsoring programs for the food producers.

Food safety control can be achieved through the implementation of a safety and appropriate food production system, of which there are principles or guidelines for taking caution in each step of the food production. These frameworks include Good Agricultural Practice (GAP), Good Hygienic Practice (GHP), Good Manufacturing Practice (GMP), and Hazard Analysis Critical Control Points (HACCP). These guidelines are then to be used as a basis for practice for the voluntary non-official fresh food producers participating in the program and for the government authority to monitor and enact necessary legal action. The food safety control for fresh produce in Thailand is divided into four major categories including farm, grading/packing establishment, exporting and retailing. The details of those categories in both official and non-official control aspects are discussed below.

10.1.1 Farm

a) Official control

Since 1992, Thailand has enacted and enforced the Hazardous Substance Act which regulates the authorization and registration of pesticides, declaration of pesticides prohibited for registration, importing or selling. The purpose of this Hazardous Substance Act is to provide safety in the application of pesticides for both farmers and consumers. The enforcement of this Act is carried out during the pesticide registration process, which is a step before the pesticide can be distributed or sold. Moreover, this Act empowers governmental officials to control and inspect pesticide at ports of entry, manufacturing plants, and retailers. Thus, allowing governmental officials to control the quality of pesticides sold to the farmers while providing safety to the agricultural products and the farmers who use the pesticide.

To protect the health of consumer in Thailand, the Thai government enacted the Food Act in the year 1979. By the Food Act, the Ministry of Public Health (MOPH) established the Maximum Residue Limits (MRLs) for pesticide residues on each type of food and agricultural produce. The purpose of the enactment of this regulation is to protect the consumer. However, the investigation and the legal action based upon this Act have been directed toward the trading of food rather than the farm which is less pragmatic.

b) Non-official control

The safety of fresh produce production results from the appropriate agricultural practice by the farmers at the farming level. The non-official control is therefore essential for the safety of fresh produce production. Any of the programs and frameworks that would aid farmers to understand and implement a good agricultural practice is deemed necessary. In this light, Thailand's Ministry of Agriculture and Cooperatives (MOAC) has begun to promote and encourage farmers to comply with GAP guidelines for several years. In the year 2003, the MOAC declared the standards of GAP for Food Crops. The farmers are, then, able to use these criteria in the cultivation to ensure the safety and quality of the food crop. Additionally, the government authority is able to use the GAP for Food Crops as a basis to evaluate the agricultural farm before awarding certification. To enhance the precision of the criteria, the MOAC will declare the standardized GAP for specific economically significant fresh produce such as durian, mango, longan, asparagus, chilli peppers etc.

Thailand's MOAC is in the process of promoting the standardized GAP to farmers all over the country. A large number of farmers have been persuaded to join the GAP. Those who are ready to join the GAP system will then be registered with the MOAC. The GAP system is planned, at present, to target 27 Food Crops. It is expected that there will be registered 325,000 farmers by the end of the year 2004. Since the increase of the auditing program for the farmers' standardized GAP, report in June 2004 indicated that 5,225 farmers have been certified. It is projected that the number of certified farmers will reach 56,000 by the end of the year 2004. Hence, the certification process will generate greater number of farmers who engage in appropriate and safe agricultural practices as well as help increase the amount of safe food crop in the market. This, in turn, will further benefit both the consumers and those who engage in business ventures dealing with agricultural products.

10.1.2 Grading/packing establishment

a) Official control

The grading and packing of fresh produce can be done at the farm level, by the farmer, under GAP system or at the manufacturing level under GMP system. According to Thailand's Food Act (1979), any grading/packing establishment categorized as a food industry must receive a permit from the Ministry of Public Health (MOPH) prior to the beginning of the production process. To be eligible for the permit, the grading/packing establishment must pass a hygiene inspection performed by an MOPH's officer.

b) Non-official control

The most important non-official food safety control measure at the manufacturing level is the promotion of GMP and HACCP system. The implementation of these two systems is based on the Codex standards, particularly the Codex General Principle of Food Hygiene and Codex Code of Hygiene Practice for Production and Handling of Fresh Fruits and Vegetables. Accordingly, Thailand's Ministry of Agriculture and Cooperatives has initiated a certification program for fresh produce grading establishment. Any certified fresh produce grading/packing establishment that

passes inspection will receive GMP certification. To further assure the promotion of the total food safety control, the MOAC has encouraged fresh produce grading/packing establishments to create a network between grading/packing establishment and GAP certified farms. This programme also entails the inspection and evaluation of both farms and the grading/packing establishments. There is the collection of samples from both farms and the grading/packing plants for laboratory analysis. Those who pass the standardized evaluation will be certified and allowed to show the mark "Q" Food Safety. Since the augmentation of the program, 35 fresh produce businesses are certified so far.

10.1.3 Exporting

a) Official control

On April 11, 2004, Thailand's Ministry of Commerce, in accordance with the "Exporting and Importing Goods into the Kingdom of Thailand Act," declared that 12 economically significant fresh fruits and vegetables must be inspected for pesticide residues prior to exportation to the United States, Japan, the European Community, the Republic of China, Hong Kong, Malaysia, and Singapore. These fresh fruits and vegetables include mangosteen, durian, mango, tamarind, lychee, longan, pomelo, baby corn, okra, ginger, and chilli peppers. The Department of Agriculture (DOA) is designated as the responsible party for inspecting the pesticide residue in the aforementioned fresh produce. The fresh produce exporter is allowed to proceed with the exportation only if the produce passes the inspection by being tested against the standard, and then receives a certification awarded by the DOA. According to regulation, the exporter must contact and inform the DOA prior to exportation. The DOA's officer will collect samples from the exporter's packing house. The collected samples will then be analyzed for pesticide residues. In the past year alone, the DOA has analyzed more than 20,000 fresh produce samples. The results indicate a trend for the overall decrease in contamination levels of samples. The number of fresh produce samples with residues over maximum residue limit (MRL) has declined from nine percent in the year 2003 to approximately four percent in the year 2004. Up until August 2004, none of the exports that passed inspection have been rejected by the destination country. This policy also promotes awareness among both producers and exporters about food safety at all stages of fresh produce production particularly on the control of food safety at the farm level. While this policy has boosted the importing countries' confidence, the cost for residue analysis is substantial and imposes difficulties for exporters. Therefore, the MOAC has decided to employ the non-official control, for exporting, to alleviate the burden of both the government and exporters.

b) Non-official control

The MOAC's food safety programme for the entire chain of fresh produce production has increased the confidence of importing countries and domestic market in both the chemical and microbiological safety of Thailand's fresh produce. The MOAC has set criteria that, in effect, lessen the burden of residue analysis before exporting the fresh produce; 100% inspection will be truncated to only 10% random sampling inspection for any food safety certified exporter.

10.1.4 Retailing

a) Official control

The hygienic and sanitary practice codes for fresh markets, retailers, restaurants, street food vendors are indicated in the Thai's Public Health Act (1992). Moreover, the Thai's Food Act (1979) has provided regulations which specify that the food, including fresh fruits and vegetables, sold in the fresh markets or other retailers must be safe from chemical or microbiological contamination that may cause diseases or health risks to the consumers. The Ministry of Public Health (MOPH) is in charge of the investigation, inspection, and enforcing the fresh markets, retailers, street vendors to comply with the hygienic and sanitary codes. The MOPH also has authority to close down, issue an order, or punish by law any business venture that violates the law. Additionally, the MOPH is authorized to randomly collect samples of food from these businesses to analyze for food contamination that may be harmful to the consumers. Nonetheless, the implementation of these laws rather focuses on the promotion and increase the awareness of the businesses to be cautious of the sanitary and hygienic practice than taking a legal action or pursuing a punishment stated by law.

b) Non-official control

The MOPH has augmented programs to encourage retailers, restaurants and other food services to take more caution on the practice of food safety and hygiene. The program include the inspection and certification to elevate the status of food service business such as:

- "Clean Food Good Taste" program: This program started in the year 1999. It includes all over the country inspection of food services and street vendors on the hygienic and sanitary standards. Since the augmentation of the "Clean Food Good Taste" program, the MOPH has certified and awarded the "Clean Food Good Taste" mark to more than 30,000 food services, which is almost 30% of the overall food service business.

Most international Good Agricultural Practice (GAP) manuals that have been published have concentrated heavily on the food safety component of GAP. Some have only addressed the microbiological contamination issue. The reason for this is that chemical contamination is covered extensively by Codex requirements. Food safety is an important component of GAP and some consider it the minimum basis for GAP recognition. A number of relevant GAP documents are included in this section as examples of what has been produced by a range of countries.

10.2 QA System

In practice, Thailand has developed a GAP based QA system (Q system). A modified manual is called Inspection Procedures for Certification Quality Management System: Good Agricultural Practice (GAP), Department of Agriculture, Ministry of Agriculture and Cooperatives.

10.2.1 Objective

To set standards for the inspection for Certification of Quality Management System: Good Agricultural Practice (GAP), Department of Agriculture.

10.2.2 Scope of quality management system: Good Agricultural Practice, Department of Agriculture

This is to apply to the systemic management of production processes for safe, pest-free, consumer-satisfying quality agricultural products.

10.2.3 Inspection for certification of quality management system: Good Agricultural Practice

Farmers in Quality Management System: Good Agricultural Practice, Department of Agriculture, will be assessed at the following three levels, namely production processes for safe products, processes for safe and pest-free products and processes for safe, pest-free and consumer-satisfying quality products.

The inspection for Certification of Quality Management System: Good Agricultural Practice for agricultural products in 3.1, 3.2 and 3.3 must follow the Principles, Criteria, and Assessment items 1−5, 1−6 and 1−8 respectively as shown in Table 13.

Table 13: Principles, criteria and assessments for quality management system: Good Agricultural Practice

Principles	Criteria	Assessments
1. Water source	Water source not contaminated with hazardous substances and microbes	Assess the environment – If possible risks exist, conduct water analysis.
2. Cultivation site	Land with no hazardous substances and microbes that may cause residues or contamination	Assess the environment – If possible risks exist, conduct soil analysis.
3. Use of agricultural hazardous substances	• If chemicals are used in production processes, instructions on labels, or instructions or recommendations by the Department of Agriculture must be followed. • Chemicals must be used in accordance with the list of chemicals allowed by trading counterpart countries. • Banned chemicals must not be used.	• Check the storage of agricultural hazardous substances. • Check the record of usage of agricultural hazardous substances, and, if in doubt, collect samples for residue analysis.
4. Product storage	• The storage must be clean, well-	• Check premises,

Principles	Criteria	Assessments
and on-site transportation	ventilated and protect products from contamination with foreign or hazardous substances, or disease carriers. • Equipment and transportation vehicles must be clean, and not contaminated with hazardous substances. • Product transportation must be carried out with care.	equipment, containers and product transportation methods
5. Data record	• Use of any hazardous substances must be recorded. • Investigation of and termination of plant diseases or pests must be recorded. • Management for quality agricultural production must be recorded.	• Check data records and forms.
6. Production for plant disease- and pest-free products	• Damage caused by plant diseases and pests must be investigated and must be treated if the damage at economic level is found. • Harvested products must be free plant diseases and pets. Those with plant diseases or pests must be isolated.	• Check the records of investigation and treatment of plant diseases and pests • Examine the isolation results
7. Management of quality agricultural production	• Practicing and managing according to the production control system • Non-conforming products must be isolated.	• Check the records of practice and management. • Examine the isolation results.
8. Harvesting and post harvest handling	• Harvesting at the appropriate period according to the production control system. • Harvesting equipment and containers must be clean. The harvesting method must not affect the product quality, or cause any contamination and make the products unsafe for consumption.	• Check the records of harvesting and post-harvest handling. • Examine the equipment, container, procedures and methods.

10.2.4 Inspection methods and procedures

Planning the inspection

The Inspection Team sets out the inspection plan, time frame and scope of the inspection and assessment criteria for Quality Management System: Good Agricultural Practice. These are to be recorded in the GAP Inspection Form.

Scheduling the inspection

- The Inspection Team leader liaises with relevant internal and external officers to schedule the inspection.
- Notify the farmers about the inspection plan and schedule 7 days prior to the inspection.
- In the event that there is a reason to believe that advanced notification of the inspection may lead to the false information or there may be a cover up, the Inspection Team may proceed without advanced notification. This must be recorded in the GAP Inspection Form.

Conducting the inspection

- The Inspection Team must introduce themselves and produce their identification cards to the farmer or the appointee each time they arrive for inspection at the production site.

- The farmer or the appointee is to be informed of the objectives and scope, as well as the procedures and duration, of the inspection.

- In case of insufficient information required for inspection, the Inspection Team may request additional information from the farmer or the appointee.

- Examine the corrective actions made to non-compliant items reported in the previous inspection.

- Carry out the inspection with the presence of the farmer or the appointee at all time.

- Record the assessment results and non-compliant items in the GAP Inspection Form

- At the end of inspection, the Inspection Team must arrange a meeting in which the assessment results are presented to the farmer or the appointee. The farmer can clarify the non-compliant items and seek advice for improvement, and discuss the schedule for corrective actions.

- The Inspection Team is to list out the non-compliant items and summarize them in the *GAP Non-Compliant Form*, and to report the inspection results in the *Preliminary GAP Inspection Form*. Both forms are complete when they are signed by both the Inspection Team and the farm owner. Copies of the documents are to be given to the farm owner for record.

Notification of Inspection Results

The farmer must be notified the results of inspection for GAP Certification in writing within 15 working days after completion of the inspection. The farmer is required to provide the details about how the corrective actions will be taken to the Office of Research and Development within 15 days of receipt of inspection results. If the farmer does not provide the corrective action details within the specified period, it is considered that the farmer agrees to make the required corrective actions indicated by the Inspection Team.

Frequency and number of inspections

The frequency and the number of inspections for GAP Certification depends on the inspection issues and the non-compliant items requiring corrective actions. The Inspection Team must follow the procedures listed in 4.3 for each inspection.

Types of Inspection

There are 4 types of inspections that can be chosen, depending on each situation, by the Inspection Team.

(1) Full Inspection − The Inspection Team must assess the farm for all principles. This is to be used with the farms that have never been certified or to be re-certified or their certification is revoked.

(2) Partial Inspection − this type of inspection is used with the farms that have been continually certified. The Inspection Team is to examine some indicators of Quality Management System: Good Agricultural Practice. But if any breach of regulations is found, the Inspection Team may use a full inspection.

(3) Follow-up Inspection − this type of inspection is used to follow up the corrective actions for non-compliant items reported in the previous inspection.

(4) Special Case Inspection − The Inspection Team can conduct an inspection if there is any problem or any complaint. The inspection will emphasize on the problematic principle(s). The Inspection Team can conduct a special case inspection without advanced notification.

10.2.5 GAP inspection reports

Preliminary GAP Inspection Report Information to be included

1) The name and address of the farmer
2) The farm identification number
3) The date of the previous and current inspections
4) The name and position of the inspectors
5) The name of the farmer or the person appointed by the farm owner

6) The purposes of the inspection
7) The scope of the inspection
8) The sampling (if applicable)
9) The farm's good practice in Quality Management System: Good Agricultural Practice
10) The corrective actions for previous non-compliant items
11) The non-compliant items reported in the previous inspection that have not been corrected, and the schedule for corrections
12) The non-compliant items reported in the current inspection and the schedule for corrections

- The Preliminary Inspection Report is to be prepared for the farmer.
- The Report must be truthful, clear and concise.
- Comments on the draft report are to be sought from all the members of the Inspection Team.
- The Report is to be signed by the Inspection Team.
- An official letter notifying the inspection results, along with the Inspection
- Report is to be sent to the farmer within 15 working days after the inspection is complete.
- Final GAP Inspection Report

When the Inspection Team has completed the inspection,

- The Inspection Team is to fill out the Summary GAP Form. The results must be in detail including the major and minor items requiring corrective actions.
- The summary of results and recommendations, along with the inspection documentation, is to be sent to the Inspection Unit within 3 days after the final inspection.

10.2.6 Submission of final GAP inspection report

The Inspection Unit is to compile and submit the information about the farmer and the inspection results received from the Inspection Team, to the GAP Certification Unit (CB) within 3 days after receipt of report from the Inspection Team.

10.2.7 Document and data control

Document control is essential in the Quality Management System: Good Agricultural Practice because the documents can be used as evidence, and it indicates the reliability of the Quality Management System: Good Agricultural Practice. Document control is useful for searching and tracing of data. Document control must be carried out as following.

- Farm identification system is to be set up, and coding system (alphabets or combinations of alphabets and numbers) used for document classification.

- Permission must be granted before the documents in the Quality Management System: Good Agricultural Practice, are used.

- The document content is to be revised and updated, if necessary, prior to seeking permission for use of the documents.

- Standard operating procedures must be established for document revision.

- The distribution of documents must be recorded as to, to whom and when the documents are distributed, the reasons and the quantity.

10.3 Criteria and Conditions for Farm Certification Quality Management System

10.3.1 Objectives

1.1 To describe the eligibility criteria for farms and farmers to apply for Farm Certification for Quality Management System: Good Agricultural Practice (GAP).

1.2 To describe duties, responsibilities of farmers and procedures in the Quality Management Program: Good Agricultural Practice

10.3.2 Scope

The document describes qualifications, duties, responsibilities and practice of farmers in applying for farm certification. It also outlines the management and improvement of production processes in the farm, in compliance with Quality Management System: Good Agricultural Practice. The eligibility criteria for farms are also described.

10.3.3 Eligibility criteria for farmers to apply for farm certification

- Must be the owner or the holder of production right, or the person authorized by the owner or the right holder.

- Must be listed in the Thai Citizen Register, Department of Provincial Administration, Ministry of Interior

- Be knowledgeable, competent and understand the production processes as specified in the GAP Application Form

- Agree with policy and requirements as specified in Quality Management System: Good Agricultural Practice documents.

- Must attend the training course for Quality Management System: Good Agricultural Practice, as indicated by the Department of Agriculture

10.3.4 Duties and responsibilities

- Farmers must carry out the production procedures and improve the farm and production processes, in compliance with the Quality Management System: Good Agricultural Practice.

- Farmers must manage the farm and oversee the production processes, in compliance with the Quality Management System: Good Agricultural Practice.

- If there are any changes in the farm, e.g. change of operators at any point of processes, etc, much attention must be paid to that point. If in doubt, the farmer can seek advice from the Advisory or the Inspection Team.

10.3.5 Application procedures for certification of quality management system: Good Agricultural Practice

- The office to lodge the GAP Application Form.

- Documents required for the GAP Application Form

- Copy of Personal Identification Card of the applicant or authorized person

- Copy of House Registration Certificate

- The farmer fills out the GAP Application Form and lodges it along with the required documents

- The officer receives the application along with required documents, gathers and sends the list the eligible farmers to 1) the Certification Unit (CB) for Quality Management System: Good Agricultural Practice, 2) the Advisory Board and the Inspection Team in the region for further action

- The farmer is notified of the schedule for advice (if any) and for inspection, and waits for advice and for inspection.

10.3.6 Eligibility criteria for farms to apply for certification

Eligible farms must be

- The site with no hazardous substances that could cause residues or contamination in agricultural products. Water supply must come from the non-contaminated sources.

- Single cultural plantation or farm - plantation or farm with one type of plant or,

- Combined-cultural plantation or farm - plantation or farm with more than two types of plant, and one type of plant comprises more than 50% of total plants. If the certification is applied for one type of plant, the farmer must have strategies to ensure that the procedures in Quality Management System: Good Agricultural Practice for this plant will not be affected by any treatment to the other type of plant.

- Mixed cultural plantation or farm - plantation or farm with many types of plant, and one type of plant comprises less than 50% of total plants in a field. If the certification is applied for one type

of plant, the farmer must have strategies to ensure that the procedures in Quality Management System: Good Agricultural Practice for this plant will not be affected by any treatment to other types of plant.

- For fruit tree, the cultivation site must not be less than 3 rai, and for annual or perennial plants, the site must not be less than 1 rai (*Rai = unit of area, 1 rai equivalent to 1,600 square metres, or 0.4 acre or 1ha = 6.25rai).*

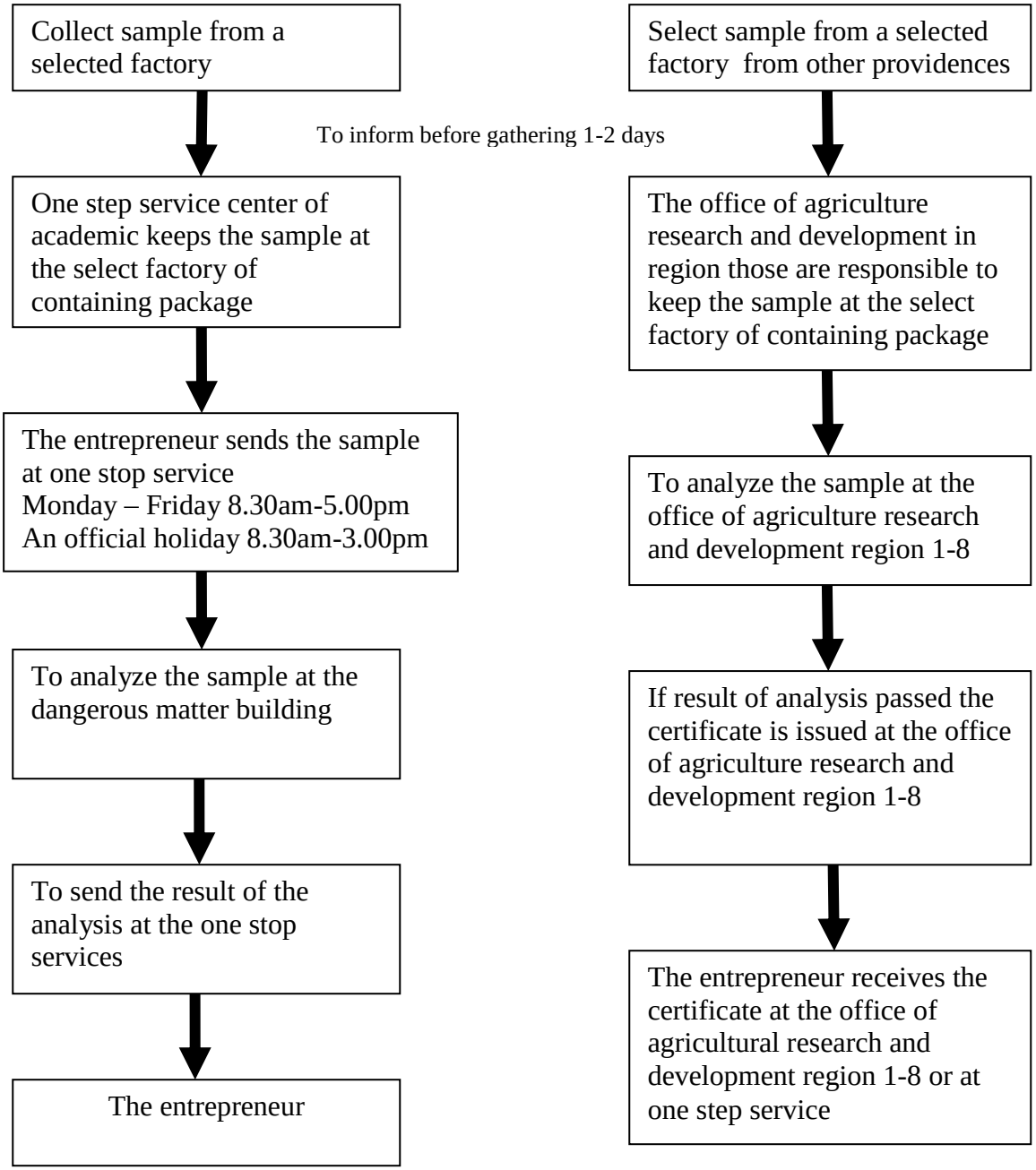

Figure 15: Processes of checking on toxic in vegetables for export

Lists of the prohibited toxic chemicals in baby corn

1. Aldrin
2. Amonicorb
3. 4-aminodiphenyl
4. Amitrole
5. Aramite
6. Asbestos-amosite
7. Azinphos-ethyl
8. Azinphos-methyl
9. Benzidine
10. Beta-HCH (1,3,5,/2,4,6-hexachloro-cyclohexane)
11. BHC or HCH (1,2,3,4,5,6-hexachloro-cyclohexane)
12. Binapacryl
13. Bis (chloromethyl) ether
14. Bromophos
15. Bromophos-ethyl
16. Cadmium and cadmium compounds
17. Calcium arsenate
18. Captofol
19. Carbon tetrachloride
20. Chlordane
21. Chlordecone
22. Chlordimeform
23. Chlorobenzilate
24. Chlorophonols
25. Chlorthiophos
26. Copper arsenate hydroxide
27. Cycloheximide
28. Cyhexatin
29. Daminozide
30. DBCP (1,2 –dibromo-3-chloropropane)
31. DDT (1,1,1-trichloro-2,2-bis (4-chlorophenyl ethane))
32. Demephion
33. Demeton
34. o-dichlorobenzene
35. Dieldrin
36. Dimefox
37. Dinoseb
38. Dinoterb
39. Disulfoton
40. DNOC (4,6-dinitro-o-cresol)
41. EDB (1,2-dibromoethane)
42. Endrin
43. Ethyl hexyleneglyneglycol (ethyl hexane diol)
44. Ethylene dichloride
45. Ethylene oxide (1,2-epoxyethane)

46. Fensulfothion
47. Fentin
48. Fluoroacetamide
49. Fluoroacetate sodium
50. Fonofos
51. Heptachlor
52. Hexachlorobenzene
53. Lead arsenate
54. Leptophos
55. Lindane (>99% gamma-HCH or gamma-BHC)
56. MCPB (4-(4-chloro-o-tolyloxy)butyric acid)
57. Mecoprop
58. Mephosfolan
59. Mercury compounds
60. Methamidophos
61. Mevinphos
62. MGK repellent-11
63. Mirex
64. Monocrotophos
65. Napthylamine
66. 4-nitro diphenyl
67. Nitrofen
68. Parathion
69. Paris green
70. Pentachlorophenate sodium or Pentachlorophenoxide sodium
71. Pentachlorophenol
72. Phenothiol
73. Phorate
74. Phosphamidon
75. Phosphorus
76. Polybrominated biphenyls, PBBs
77. Polychlorinated triphenyls, PCTs
78. Prothoate
79. Pyrinuron (piriminil)
80. Safrole
81. Schradan
82. Sodium arsenite
83. Sodium chlorate
84. Strobane polychloroterpenes
85. Sulfotep
86. 2,4,5-T ((2,4,5-trichlorophenoxy) acetic acid)
87. 2,4,5-TCP (2,4,5-trichlorophenol
88. TDE or DDD (1,1-dichloro-2,2-bis (4-chloropheny) ethane)
89. TEPP (tetraethyl pyrophosphate)
90. 2,4,5-TP ((±) -2-(2,4,5-trichlorophenoxyl propionic acid)
91. Thallium sulfate

92. Toxaphene or camphechlor
93. Tri (2,3-dibromopropyl) phosphate)
94. Vinyl chloride monomer (monochloroethene)

10.4 CODEX Standard for Baby Corn (CODEX STAN 188-1993)

10.4.1 Definition of produce

This standard applies to the cobs, without the silk and anthers, of commercial varieties of baby corn (corn inflorescence) grown from *Zea mays* L. of the *Gramineae* family, separated from silk, husk and anthers, to be supplied fresh to the consumer, after preparation and packaging. Baby corn for industrial processing is excluded.

10.4.2 Provisions concerning quality

In all classes, subject to the special provisions for each class and the tolerances allowed, the cobs of the baby corn must be:

- whole;
- fresh in appearance;
- sound, produce affected by rotting or deterioration such as to make it unfit for consumption is excluded;
- clean, practically free of any visible foreign matter;
- free of abnormal external moisture, excluding condensation following removal from cold storage;
- free of any foreign smell and/or taste;
- practically free of damage caused by pests;
- practically free of silk.

The cut that is made on the base of the cobs should be clean and well defined. A slight discoloration of the cut surface due to storage is acceptable.

The development and condition of the baby corn must be such as to enable it:

- to withstand transport and handling, and
- to arrive in satisfactory condition at the place of destination.

Governments, when indicating the acceptance of the Codex Standard for Baby Corn, should notify the Commission which provisions of the Standard would be accepted for application at the point of import, and which provisions would be accepted for application at the point of export.

10.4.3 Classification

The cobs of baby corn are classified in three classes defined below:

"Extra" Class

The cobs of baby corn in this class must be well trimmed, free of husk, stalk and silk, intact and of superior quality. They must be characteristic of the variety and/or commercial type. They must be free of defects, with the exception of very slight superficial defects, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

Class-I

The cobs of baby corn in this class must be well trimmed, free of husk and stalk and of good quality. They must be characteristic of the variety and/or commercial type. The following slight defects, however, may be allowed, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package:

- slight defects in shape, colour and texture;
- slight defects in irregular arrangement of undeveloped kernels (ovules);
- slight defects on the surface due to bruising, scratches or other mechanical damage. The total area affected shall not exceed 5 per cent per cob;
- silk attached to and/or broken from the cob shall be minimal without affecting the appearance.

Class-II

This class includes the cobs of baby corn which do not qualify for inclusion in the higher classes, but satisfy the minimum requirements specified in Section 2.1 earlier. The following defects may be allowed, provided the cobs of baby corn retain their essential characteristics as regards the quality, the keeping quality and presentation:

- defects in shape, colour and texture;
- defects in irregular arrangement of undeveloped kernels (ovules);
- defects on the surface due to bruising, scratches or other mechanical damage. The total area affected shall not exceed 10 per cent per cob;
- silk attached to and/or broken from the cob shall be minimal without affecting the appearance.

10.4.4 Provisions concerning sizing

Size is determined by the length of the cob of baby corn. The length for A size is 5.0-7.0 cm, B is 7.0-9.0 cm. and C is 9.0-12.0 cm. For all sizes, the minimum width should not be less than 1.0 cm and the maximum width not more than 2.0 cm.

10.4.5 Provision concerning tolerances

Tolerances in respect of quality and size shall be allowed in each package for produce not satisfying the requirements of the class indicated.

Quality tolerances

"Extra" Class Five per cent by number or weight of cobs of baby corn not satisfying the requirements of the class, but meeting those of Class I or, exceptionally, coming within the tolerances of that class.

Class-I Ten per cent by number or weight of cobs of baby corn not satisfying the requirements of the class, but meeting those of Class II or, exceptionally, coming within the tolerances of that class. In the case of cobs of baby corn with incompletely removed husk and stalk, only 5 per cent by number or weight of 0.5 cm long of the husk and stalk is allowed.

Class-II Ten percent by number or weight of cobs of baby corn satisfying neither the requirements of the class nor the minimum requirements, with the exception of produce affected by rotting or any other deterioration rendering it unfit for consumption.

In the case of cobs of baby corn with incompletely removed husk and stalk, only 5 per cent by number or weight of 0.5 cm long of the husk and stalk is allowed.

Size tolerances

For "Extra" Class, 5 per cent; and for Class I or Class II 10 per cent; by number or weight, of cobs of baby corn not satisfying the requirements as regards sizing, but falling within the class immediately above and/or below those indicated in Section 3.

10.4.6 Provisions concerning presentation

Uniformity

The contents of each package must be uniform and contain only cobs of baby corn of the same origin, quality and size. The visible part of the contents of the package must be representative of the entire contents.

Packaging

The cobs of baby corn must be packed in such a way as to protect the produce properly. The materials used inside the package must be new, clean, and of a quality such as to avoid causing any external or internal damage to the produce. The use of materials, particularly of paper or stamps bearing trade specifications is allowed, provided the printing or labeling has been done with non-toxic ink or glue. The cobs of baby corn shall be packed in each container in compliance with the Recommended International Code of

Practice for Packaging and Transport of Tropical Fresh Fruit and Vegetables (CAC/RCP 44-1995).

Description of containers

The containers shall meet the quality, hygiene, ventilation and resistance characteristics to ensure suitable handling, shipping and preserving of the cobs of baby corn. Packages must be free of all foreign matter and smell.

Marking or labeling

Consumers packages

For the purposes of this Standard, this includes recycled material of food-grade quality. In addition to the requirements of the Codex General Standard for the Labeling of Pre-packaged

Foods (CODEX STAN 1-1985, Rev. 2-1999), the following specific provisions apply:

Nature of produce

If the produce is not visible from the outside, each package shall be labeled as to the name of the produce and may be labeled as to the name of the variety.

Non-retail containers

Each package must bear the following particulars, in letters grouped on the same side, legibly and indelibly marked, and visible from the outside, or in the documents accompanying the shipment. For produce transported in bulk these particulars must appear on a document accompanying the goods.

Identification

Name and address of Exporter, Packer and/or Dispatcher. Identification code (optional).

Nature of produce

Name of produce if the contents are not visible from the outside. Name of variety and/or commercial type (optional).

Origin of produce

Country of origin and, optionally, district where grown or national, regional or local place name.

Commercial identification

- Class;
- Size (size code);
- Net weight (optional).

Official inspection mark (optional)

10.4.7 Contaminants

Heavy metals

The cobs of baby corn shall comply with those maximum levels for heavy metals established by the Codex Alimentarius Commission for this commodity.

Pesticide residues

The cobs of baby corn shall comply with those maximum residue limits established by the Codex Alimentarius Commission for this commodity.

Hygiene

It is recommended that the produce covered by the provisions of this Standard be prepared and handled in accordance with the appropriate sections of the Recommended International Code of Practice - General Principles of Food Hygiene (CAC/RCP 1-1969, Rev. 3-1997), and other relevant Codex texts such as Codes of Hygienic Practice and Codes of Practice. The produce should comply with any microbiological criteria established in accordance with the Principles for the Establishment and Application of Microbiological Criteria for Foods (CAC/GL 21-1997).

11. BABY CORN FARMING/BUSINESS STRUCTURE

Most baby corn productions for export are under contract farming system. This involves factory, broker and farmers. The details of this system given below are one of the baby corn company, selected by the Ministry of Agriculture as an outstanding company in supporting and developing farm communities.

11.1 Farm operation

- Organizing groups of growers in selected areas to grow and supply premium fresh produces to Swift's pack-houses.
- Risk assessments are carried out on all major factors from history of land use to soil and water condition and to any possibility of cross contamination.
- Three types of farming practices by members are:
    - Conventional farming under EUREP GAP;
    - Agro-chemical free farming;
    - Organic farming.

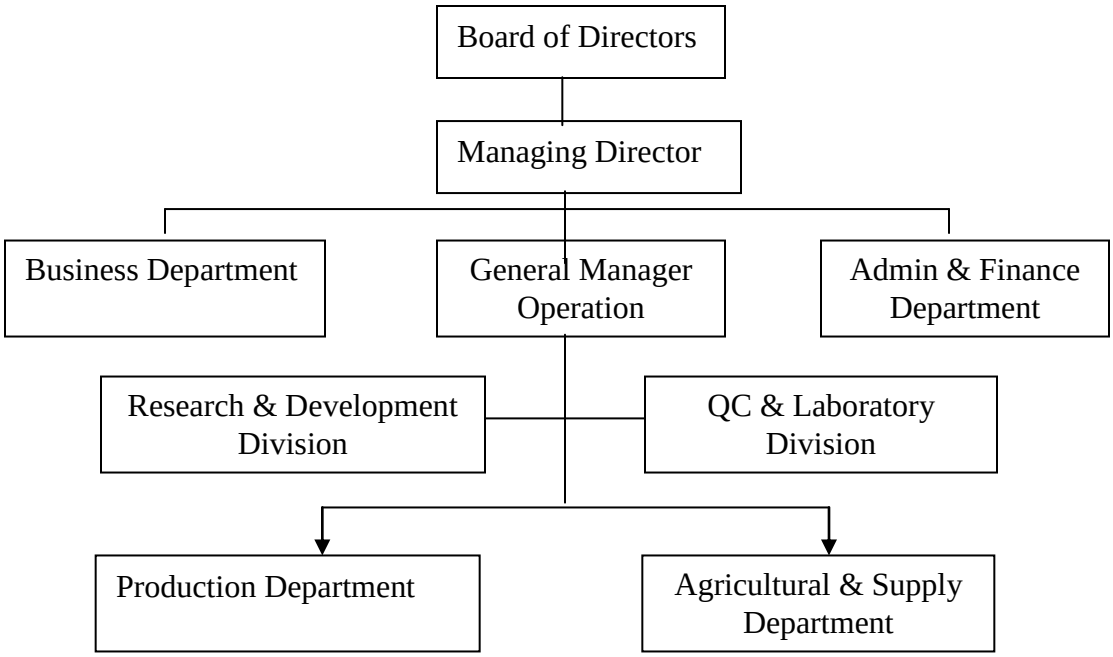

Figure 16: Business structure for fresh and frozen baby corn factory

11.2 Farm auditing

- Company's agronomists conduct regular internal auditing of members' farms.
- Independent internal auditing is carried out by other agronomists from head office
- They are trained and certified on HACCP system and EUREP GAP auditing.
- Yearly certification on EUREP GAP and organic farming practices are carried out by licensed CB.

11.3 Collection and grading

- Collection stations of the company are set right in the growing areas.
- Weighing and grading are transparently carried out at the stations.
- Labeling of plot-codes and growers' names is part of the company's traceability system.

11.4 Pack-house and processing

- They are purposed built pack-houses with GMP certification.
- Different types of facilities are designed to accommodate different processing.
- Processing of fresh produce is under the *HACCP* and *BRC Higher Level* systems.
- Processing of organic and conventional produce is separated.

11.5 Community development

- The operation of the company generates direct income of over Baht 300 millions to farm communities per year.
- Pricing policy reduces risk to their growers to the minimum. Their guaranteed price is much higher than the market price.
- Financial support and transfer of technology from the company help in improving yields and incomes of our growers.
- The company has actively participated in development programmes with local community, temples, schools.

11.6 Environment

- This company acquires supply only from members' farms and cooperatives. The farming practices of the company ensure that environment and ecology are protected.

- Price incentive, interest free loans, and other financial supports are provided in assisting growers to change to EUREP GAP and ORGANIC farming practices.

- Pilot farms have been set up in different areas with Agricultural University and with the Ministry of Agriculture to promote organic and GAP farming.

11.7 Ethical trading

- The company has develop a "Win-Win" policy that all parties, from growers to workers to consumers and to the company, have their fair shares from the operation
- Under age worker or "child labour" is not allowed in their company.
- Free medication, social security, are provided to all workers. The company goes beyond what is required by law to provide better welfare to all workers such as longer period with full pay on maternity leave.
- On over time, one and a half time normal wage is paid on normal working day. On holiday two times is paid
- Free vacation and free transportation to and from work are provided

- Interest free loans are provided for employees who are in need
- All growers get guarantee prices for their produces on long term contracts. Interest free loans are provided to improve their farms
- Scholarship are provided to children of the company's workers
- All workers, growers, and other suppliers are paid exactly on time

12. COMMERCIAL THAI COMPANIES

There are numbers of companies involve in baby corn production are processing. The list below given names and contact addresses of some of the commercial companies.

Company: River Kwai International Food Industry Co., Ltd.
Address: 21st floor, Thaniya plaza, 52 Silom Rd., Suriywongse, Bangrak, Bangkok, 10500, Thailand
Tel: (662) 231-2934
Fax: (662) 231-2944
E-mail: info@rkifood.com

Company: THAI AGRI FOODS PUBLIC CO., LTD.
Address: 155/1 MOO 1, THEPARAK RD., BANGSAOTHING KING A. BANGSAOTHONG, SAMUTPRAKARN, THAILAND
Tel: (662) 02-3154171-6
Fax: (662) 02-315469,315-4188
E-mail: marketing@thaiagri.com

Company: AMPRO INTERTRADE CO., LTD.
Address: 328 CHAROENNAKORN 40, CHAROENNAKORN RD. BANGLUMPOOLANG, KLONGSAN, BANGKOK 10600, Thailand
Tel: (662) 437 6708
Fax: (662) 437 5957
E-mail: sales@ampro.co.th, ampro@ksc.th.com

Company: SUPER J. INTERNATIONAL CO., LTD.
Address: 77/139, SINN SATHORN TOWER, 33rd FLOOR, KRUNGTHONBURI ROAD, KLONGTHONSAI, KLONGSARN, BANGKOK 10600, Thailand
Tel: (662)440-0891-4
Fax: (662) 440-0890
E-mail:jtanking@ksc.th.com

Company: ERAWAN FOODS COMPANY LIMITED
Address: 127/21 PANJATHANI TOWER, FLOOR 16, NONSEE, YANNAWA, BANGKOK 10120, Thailand
Tel: (662) 681-0251-9
Fax : (662) 681-0250
E-mail: contact@erawanfoods.com

Company: ABC PRODUCTS CO., LTD.
Address: 89 CHAROENNAKORN, CHAROENNAKORN ROAD, BANGLUMPULANG, KLONGSARN, BANGKOK, 10600, Thailand
Tel: (662) 8624841-5
Fax : (662) 862-4847

E-mail: greatco@abc.co.th

Company: NORTHERN FOOD CO.,LTD.
Address: 60/38 MOO 7, SOI MITRUNGROENGVILLA,BOROMRAJCHONNEE RD., TALINGCHAN BANGKOK 10170, Thailand
Tel: (662) 880-7284-6
Fax : (662) 880-7287
E-mail: northern@ksc.th.com

Company: M-PATHY INTERTRADE CO., LTD.
Address: 50/28 MOO 5, BANGSITHONG, BANGKRUAY, NONTHABURI 11130, Thailand
Tel: (662) 886-3066-7
Fax : (662) 866-3065
E-mail: mpathy@loxinfo.co.th

Company: Pan Asia (1981) Co Ltd.
Address: 814 Soi Sukhumvit 50, Prakhanong, Bangkok 10250, THAILAND
Tel: (66) 2 332-0023-36
Fax : (66) 2 331-1971, 331-1972

Company: Thai Wei-Chuan Co., Ltd.
Address: 52/6 F3 Silom Condominium, Soi Saladaeng 2, Silom Road, Bangkok 10500, Thailand.
Tel: (662) 2665877-8
Fax : (662) 2665879

Company: Pan Asia (1981) Co Ltd.
Address: 814 Soi Sukhumvit 50, Prakhanong, Bangkok 10250, THAILAND
Tel: (66) 2 332-0023-36
Fax : (66) 2 331-1971, 331-1972

Company: Siam Growth Co., Ltd.
Address: 3 Soi Charansanitwong Road, Bangbamru, Bangkok, Thailand 10700
Tel: 66 2 9772000
Fax : 66 2 9772002

Company: Fresh Partners (Thailand)
Address: 87 Wireless Road, Bangkok, Thailand
Tel: 66 18204658
Fax : 66 2 654 0 326
Company: Asia Exotic Corporation Ltd.
Address: 600/775 Moo 14, Mooban Sewali Soi 2/1, Paholyothin Rd., Kukot, Lamlookka, Pathumtani, Thailand 12130
Tel: 66 2 9221210
Fax : 66 2 9221211

Company: CK Interbiz Co. Ltd.
Address: 394/752 Rm. 852, Moo 3, Phetkasem Rd., Bangkae, Bangkok, Thailand 10160
Tel: 66 2 8039265
Fax : 66 2 8039153

Company: Vachamon Food Limited
Address: 1332/1-2 Prachachum, In Front Soi 39, Bangsua, Bangsua, Bangkok, Thailand 10800
Tel: 66 2 9517641
Fax : 66 2 9517571

Company: PechSiam Daily Foods Company Limited
Address : 110/49 Moo 7, Bang Na Trad Roadd, Bangchalong,, Bangplee, Samutprakan, Thailand
Tel: 66 1 2788812
Fax: 66 2 7522775
Website: http://www.pechsiam.com

Company: Liberty Fruits Co., Ltd
Address : Worachak, Bangkok, Bangkok, Thailand 10100
Tel: 66 2 6215949
Fax: 66 2 6215949

Company: R. S. Foods Tech (Thailand) Co., Ltd.
Address : 54 Soi Petkasem 4, Petkasem Road, Watta, Bangkok, Thailand 10600
Tel: 66 2 8925535
Fax: 66 2 8925535
Website: http://www.rsfoodstech.thailand.com

Company: New Lamthong Foods Industries Co., Ltd.
Address : 12/9 Arunamarin Rd., Bangkoknoi, Bangkok, Thailand 10700
Tel: 66 2 4334370
Fax: 66 2 8834880
Website: http://www.newlamthong.thailand.com

Company: Universal Food Public Company Limited
Address : 947/157, Moo 12, Bangna-Trad Road, Bangna, Bangkok
10260, Thailand
Tel: +66 (0) 2 398 8555, 2 361 8954-57
Fax: +66 (0) 2 744 0860-2
Company: V.A.S. ORIENTIAL THAILAND 1999 CO., LTD.
Address : 31/3 MOO 3, SOI PINYO, SONGPRAPHA ROAD, SEEGUN DONMUANG BANGKOK, 10210 ,Thailand
Tel: (662) 5662186
Fax: (662) 5662451

E-mail: vasorient@yahoo.com

Company: GREAT ORIENTAL FOOD PRODUCTS CO., LTD
Address : 888/127 SOI THANAPHOL 2, PANUCH VILLAGE, PHACHARATBUMPHEN RD., SAMSEN-NOK HUAYKWANG, BANGKOK 10310, Thailand
Tel:(662) 691-6821-2
Fax: (662) 691-6824
E-mail: food@greatoriental.com
Website: www.greatoriental.com

Company: SUN SWEET CO., LTD.
Address : NO. 9 MOO 1, SANPATONG-BANKAD RD. ,TOONGSATOK SANPATONG, CHIANGMAI 50120 ,Thailand
Tel: (66-53) 830-555
Fax: (66-53) 830-563, 311-992
E-mail : kcfood@cscoms.com
Website: www.kc.co.th ,www.sunsweethai.com

Company: O.V. INTERNATIONAL IMPORT-EXPORT CO., LTD.
Address : 15 SOI TAKSIN 5, TAKSIN STREET, KLONGTONSAI KLONGSAN, BANGKOK 10600, Thailand
Tel: (662)438-1546, 438-2585
Fax: (662) 437-8275
E-mail: info@ovinterfoods.com
Website: www.ovinterfoods.com

Company: NORTHERN FOOD CO.,LTD.
Address : 60/38 MOO 7, SOI MITRUNGROENGVILLA BOROMRAJCHONNEE RD., TALINGCHAN, BANGKOK 10170, Thailand
Tel: (662) 880-7284-6
Fax: (662) 880-7287
E-mail: northern@ksc.th.com
Website: northernfood.co.th

Company: VITA FOOD FACTORY (1989) CO., LTD.
Address : 89 ARUNAMARIN RD., BANGYIKHAN BANGPLAD, BANGKOK 10700, Thailand
Tel: (662) 433 6018-19
Fax: (662) 433 7333
E-mail:: vitafood@infonews.co.th; **Website:** www.vitafood.co.th

Company: MALEE SAMPRAN PUBLIC CO.,LTD.
Address : 401/1 MOO 8, PHAHOLYOTHIN RD., Koo Kod LUMLUKKA, Prathumthani 12130, Thailand
Tel: (662) 992- 5800

Fax: (662) 992- 5839
E-mail:: rungroj@malee.co.th
Website: www.malee.co.th

Company: GREAT ORIENTAL FOOD PRODUCTS CO., LTD
Address : 888/127 SOI THANAPHOL 2, PANUCH VILLAGE, PHACHARATBUMPHEN RD. ,SAMSEN-NOK HUAYKWANG ,BANGKOK 10310, Thailand
Tel: (662) 691-6821-2
Fax: (662) 691-6824
E-mail: food@greatoriental.com
Website: www.greatoriental.com

Company: FANG AGRI FOODS PRODUCTS CO., LTD.
Address : 211 MOO 17, WIANG FANG, CHIANG MAI 50110 Thailand
Tel: (66-53) 452 074-5
Fax: (66-53) 452 425
E-mail: yutasak@fangagrifoods.co.th
Website: www.fangagrifoods.co.th

Company: GRAND ASIA FOOD INDUSTRY CO., LTD.
Address : 5/127 Soi Udomsab, Boromrajchonnanee Road – Bangkoknoi, Bangkok 10700, Thailand
Tel: (662) 433 6450 To 5
Fax: (662) 433 4255
E-mail: granda@asiaaccess.net.th
Website: www.grandasiafoods.com

Company: ASA Bangkok Ltd.
Address: 86 Ekamai 10 Sukhumvit 63, Bangkok 10110, THAILAND
Tel: (66) 2 381-9696, 381-9697