

IMPACT ON FARMING PRACTICES OF PRODUCING PUMMELOS UNDER THE NAKORNCHAI SRI GEOGRAPHICAL INDICATION

by

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Abstract :

The Nakornpathom Provincial Chamber of Commerce submitted the application for GI registration of Nakornchaisri pummelos, and this was granted on 30 September 2005 in order to protect Nakornchaisri growers and prevent the deception of consumers. The unique geographical conditions and traditional farming systems of the Nakornchaisri zone have long been recognized as important factors in the production of quality pummelos. In addition, there are well-established distribution networks in the zone, especially for export. Nakornchaisri growers receive a premium price for their produce, and the price set in the area has been used by traders as a benchmark for pummelos from other sources.

The study compared the farming systems and production costs of GI-designated areas with those of neighbouring districts in Rachaburi Province, outside the GI area. There are very clear differences in farming concepts between the two zones, not as a reflection of GI registration but rather as a result of the social, cultural and economic contexts. Moreover, it is hard to assess the impact of GI registration because Nakornchaisri growers have always received premium farmgate prices and pummelo production has now expanded to many other regions of the country, putting in question the relevance of the current GI system (delimitation of area, limited involvement of producers, impact of GI registration on market demand etc.).

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The statistics given in this report were obtained from the Thai Office of Agricultural Economics.

1 USD = 33 Baht THB

1 rai = 0.16 hectare

Glossary

CV : Cultivar

GI : Geographical Indications

WTO : World Trade Organization

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Introduction

The present study was carried out to examine the impact on farming practices of producing pummelos under the Nakornchaisri geographical indication (GI). After presenting the product and reviewing the GI code of practice, the report examines farming practices and the marketing system for Nakornchaisri pummelos. The final section presents the lessons learned and draws conclusions from the study.

1. Nakornchaisri pummelos and their list of requirements (or code of practice)

Nakornchaisri pummelos

The pummelo is one of the main ancestors of the grapefruit. Botanically, it is identified as *Citrus maxima* Merr. (*C. grandis* Osback; *C. decumana* L.). The pummelo is tropical or near-tropical and is native to southeastern Asia. It flourished naturally at low altitudes close to the sea. Because of its restricted cultivation areas, it is often overshadowed by the grapefruit. Currently, it is much cultivated in southern China, Thailand, Taiwan, the far south of Japan, southern India, Malaysia, Indonesia, New Guinea and Tahiti. As a luscious fresh fruit, it is famous and even more popular than grapefruit in the Far East.

The pummelo is one of the most popular citrus fruit on Thailand's domestic market. It was first introduced into the country in Samphram District of Nakornpathom Province. Nakornpathom's main production areas today are in Nakornchaisri and surrounding districts, which lie in the low swampy plain along the river. Combined with the fact that salty sea-water filters into the land at high tide, this location produces fruit with a specific delicate flavour and texture. The pummelo is considered of potential interest in regional trade. Thailand started exporting pummelos some 30 years ago and is still the only country in the region with a mature and sustainable pummelo export trade. Ever since the start, this export trade has depended mainly on fruit (the CV Tongdee variety) grown in the Nakornpathom Province. Hong Kong is the main export market. It is claimed that the attributes of Nakornchaisri pummelos are a result not only of unique geographical conditions, but also of human factors, entailing specific farming traditions and production skills. Nakornchaisri pummelos have a reputation well-recognized in the market, and growers enjoy an almost guaranteed market and high price. GI registration to identify the produce, protect it and promote its marketing was thus initiated in 2005 by the Nakornpathom Chamber of Commerce and was expected to be welcomed by the various stakeholders along the supply chain.



Nakornchaisri pummelo

Registration and list of requirements for producing Nakornchaisri pummelos

In Thailand, the Ministry of Commerce's Department of Intellectual Property is in charge of the protection and approval of GIs. By 8 January 2010, there were 32 GIs registered with the Department of Intellectual Property: 26 Thai products and 6 foreign ones. Among the 26 Thai GIs, there are two for pummelos: one for Nakornchaisri pummelos and one for Chainat Khaotangkwa pummelos.

The application for GI registration for Nakornchaisri pummelos (application 47100002) was submitted by the Nakornpathom Provincial Chamber of Commerce on 29 September 2004 and granted on 29 September 2005 (registration 48100002).

The following requirements appeared with slight modifications in the GI registration filed with the Department of Intellectual Properties, to allow pummelo growers to carry the GI mark. The list of requirements covers production areas, characteristics of the fruit, production practices and processes, and management norms.

Definition. Nakornchaisri pummelos refer to two cultivars, Tongdee (brilliant gold pomelo) and Kao Nan Pueng (white honey pomelo) grown in Nakornchaisri, Samphram and Puttamonton Districts of Nakornpathom Province.

Physical characteristics of the fruit

Shape	CV Tongdee (brilliant gold pomelo)	Nearly round to oblate with slightly flat end, no neck
	CV Kao Nam Pueng (white honey pomelo)	Nearly round to oblate. Size larger than Tongdee
Peel	CV Tongdee (brilliant gold pomelo)	Thin peel, yellowish green lime in colour, dotted with small oil glands
	CV Kao Nam Pueng	Thin peel (slightly thicker than

	(white honey pomelo)	Tongdee), yellowish green in colour, rough, dotted with oil glands larger than Tongdee
Pulp	CV Tongdee (brilliant gold pomelo)	Pale-yellow to pink, pulp soft, firm but not hard, heavy feel, dry, not becoming watery even when fully ripe
	CV Kao Nam Pueng (white honey pomelo)	Whitish to pale yellow in colour, the source of its cultivar name of “honey”, pulp firm but not hard, heavy feel, dry, not becoming watery even when fully ripe
Taste	CV Tongdee (brilliant gold pomelo)	Sweet with faintly acidic flavour, no bitterness
	CV Kao Nam Pueng (white honey pomelo)	Sweet to sub-acid flavour, no bitterness



Physical characteristic of the fruits

Production practices. The tree flourishes naturally in the low-lying swampy plain near the coast in Nakornchaisri and surrounding areas. Farmers claim that salt contributes to the flavour and juiciness of the fruit. The prime growing region near Bangkok in central Thailand has a mean temperature of about 28 °C and mean rainfall of 143 centimetres, heaviest from May to October and scarce in January, February, March, November and December.

In the low-lying orchards of the region, farmers dig ditches and channels (2 to 2½ metres wide at the surface) for drainage and as routes for in-farm transportation. They also set up elevated beds (4 to 5 metres wide) in which trees are planted 3 to 4.5 metres apart (and 6 metres apart between channels). It is essential to dry out the elevated beds for one to two months before planting in order to prevent *Phytophthora* root rot. The ditches have to be constantly deepened and widened, and soil has to be added to the beds in order to counteract erosion.



Young orchard of Nakornchaisri pummelos (on dykes)

Harvesting. CV Tongdee usually flowers two to four times a year. The fruit ripens approximately six to seven months after flowering (although, according to a field interview, the fruit is harvested eight to nine months after flowering). Flowering has been adjusted by thinning, watering restrictions and fertilization so that the main crop is harvested in August to September when export demand is high. There may also be a small crop between February and April. CV Tongdee is the leading Thai cultivar and perhaps the only one exported in substantial quantities to Hong Kong. CV Kao Nam Pueng may flower four or more times a year, so that harvesting can become a year-round operation. The fruit ripens and can be harvested approximately six to six-and-a-half months after flowering (although, according to a field interview, the fruit is harvested seven to eight months after flowering). The fruit of this cultivar is some of the most popular on the domestic market and some has been exported to Shanghai, China, in the past two or three years.

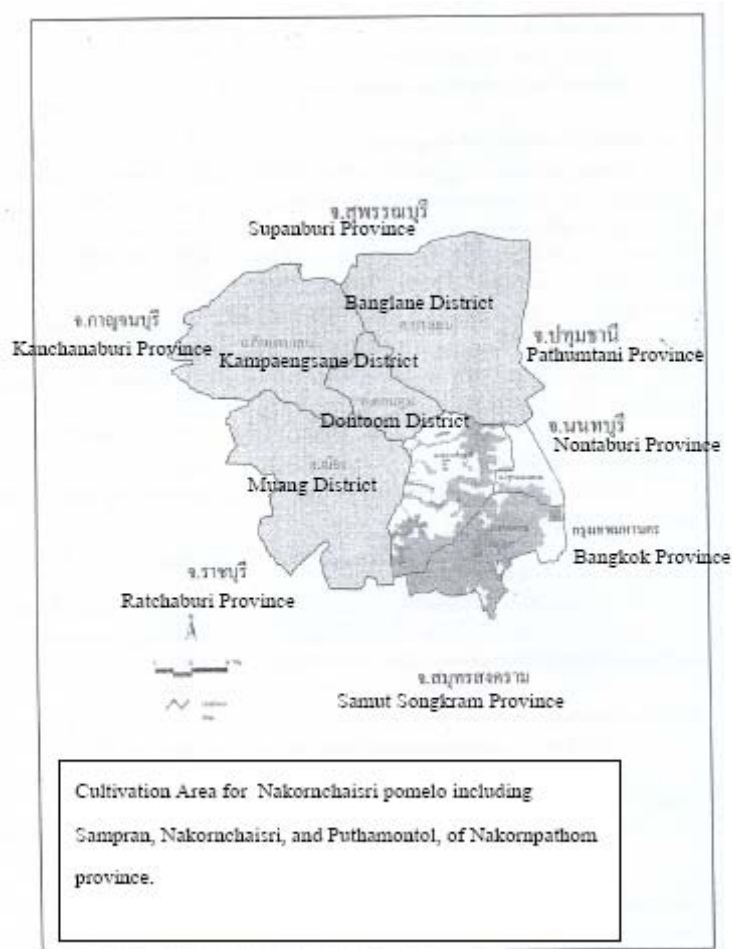
Packaging. The word “Nakornchaisri pummelo” should appear on the labelling of the package.

Specific links with the characteristics of the geographical area. Pummelos grow fairly well on mudflats overlying clay to loamy clay soil, characteristics of the swampy plains beside the Nakornchaisri and Tha Chin Rivers in the Nakornchaisri zone and the Rachaburi River in Rachaburi Province. The soil profile indicates a deposited top layer that is organically rich, a brownish middle layer of clay and a lower layer, approximately 2 metres deep, of sand and shell. The trees are highly tolerant of brackish water, the rich river silt and the salty water pushed inland at high tide. The soil is lightly acid to neutral, with a pH ranging from 6.5 to 8.

Origin and distribution history. The pummelo is believed to have originated at some unknown date in the Oomyai Subdistrict of Samphram District. After a severe flood in 1942, sweet oranges were introduced into the area, and one pummelo tree was accidentally included. Once planted, pummelos gradually expanded into other parts of Samphram District and then to Nakornchaisri District, where the fruit attained the best quality. Hence the name “Nakornchaisri pummelo”.

Geographical location. The trees are grown in the three adjacent districts of Nakornchaisri, Samphram and Puttamonton, which share similar geographical characteristics.

Map of the production area of Nakornchaisri pummelos



GI monitoring and certification. GI management norms include requirements for grower and trader registration, a monitoring and inspection system, traceability, a certificate of origin and clear labelling on the packaging. However, there is no specification as to what type of monitoring, inspection and traceability systems should be put in place.

Quality standards are not included in the GI registration. The following standards are found in the “Pummelo standards” published in December 2004 by the National Office of Agricultural and Food Standards.

Minimum quality requirements (national standards). Pummelos should be:

- sound: produce affected by rot or deterioration such as to make it unfit for consumption is excluded;
- clean, basically free of any foreign matter or taste/smell;
- surface blemishes caused by bruising and pests affecting the general appearance of the produce ranging from less than 10 to 30 percent of the surface depending on grade;

Quality grade	A	B	C	D
Surface blemish	<10%	10.1-20.0%	20.1-30.0%	>30%

- free of damage caused by sunburn or high temperature;

- free of any foreign smell and/or taste;
- carefully picked and having reached an appropriate degree of development and ripeness in accordance with criteria specific to the variety and the area in which they are grown;
- minimum total soluble solids content of no less than 8 percent for CV Tongdee and 7 percent for CV Kao Nam Pueng;
- colour and shape typical of the variety, with a uniform surface colour that is more green than yellow.

Size grade requirements and packaging

Variety	Grade	Circumference (inches)	Weight (kg)	Number of fruit per box	Net and gross weight (kg)	Market
CV Kao Nam Pueng						
	0	>21.0	>1.5			Domestic
	1	19.1-21.0	>1.3	9,12	#9:14.0-15.6 #12:16.0-17.6	Domestic and export
	2	18.1-19.0	>1.10	14	17.0-18.0	Domestic and export
	3	17.1-18.0	>0.9	16	-	Domestic and export
	4	16.1-17.0	>0.7	18	-	Domestic and export
CV Tongdee						
	0	>20	>1.2			Domestic
	1	17.1-20.0	>0.9	12,14,16	#12:17.1-18.5 #14:18.1-19.5 #16:17.1-18.5	Domestic and export
	2	16.1-17.0	>0.8	20	18.6-20.0	Domestic and export
	3	15.1-16.0	>0.7	22	16.6-18.0	Domestic and export
	4	14.0-15.0	>0.6	24,28,32	-	Domestic and export

Quality grade requirements

Quality attribute	A	B	C	D
CV Kao Nam Pueng				
Total soluble solids (%)	>9.0%	8.1-9.0%	7.0-8.0%	<7%
Acidity (%)	0.4-0.9	0.4-0.9	0.4-0.9	>0.9
TSS/acid ratio	>18.0	12.1-18.0	8.0-12.0	<8.0
Puffiness (%)	0	<5%	5.1-10.0	>10%
CV Tongdee				
Total soluble solids (%)	>10.0	9.1-10.0	8.1-9.0	<8.0
Acidity (%)	0.4-0.9	0.4-0.9	0.4-0.9	>0.9
TSS/acid ratio	>18.0	12.1-18.0	8.0-12.0	<8.0
Puffiness (%)	0	<5%	5.1-10.0	>10%

2. Farming practices and Nakornchaisri pummelo markets

Production statistics, trends in the Thai pummelo sector and the proportion of pummelos produced in GI-designated areas

Table 1. Annual production, farmgate price and farm value of pummelos grown in Thailand, 1982-2006, and estimated production in 2007

Year	Total production					Production (Nakornpathom)		Production (Rachaburi)	
	Planted area (rai) (2)	Harvested area (rai) (3)	Production (tonnes)	Farm price (baht)	Farm value (million baht)	Planted area (rai)	Production (tonnes)	Planted area (rai)	Production (tonnes)
1982	67 962	59 466	32 956	11.36	374 377				
1987	94 248	66 714	44 850	11.79	528 787				
1992	91 172	59 015	75 688	13.33	1 008 924				
1993	98 290	63 412	82 395	13.25	1 081 737	10 623	16 939	1 081	753
1994	130 365	64 654	81 558	13.36	1 089 609	9 166	14 310	983	556
1995	162 740	72 030	87 589	14.12	1 236 763				
1996	177 288	71 263	89 544	15.46	1 384 345	7 849	12 355	1 569	818
1997	204 195	87 934	121 573	15.06	1 830 883	9 100	13 206	3 228	826
1998	225 561	94 739	127 478	16.36	2 085 538	9 871	23 189	3 464	1 309
1999	222 734	120 190	164 329	15.59	2 561 892	10 034	29 401	3 408	2 211
2000	242 828	145 446	183 930	15.5	3 034 845	10 034	29 401		
2001	264 256	189 726	224 579	16.58	3 723 520	10 778	18 262		
2002	283 826	202 013	267 288	16.88	4 506 476	11 012	18 437		
2003	229 920	165 490	265 750	9.69	2 575 117	9 140	13 464	2 721	3 064
2004	173 413	135 389	197 716	11.51	2 295 483	7 748	11 768	2 542	2 709
2005	227 915	192 103	276 288	7.84	2 168 745			628	1 503
2006	258 166	197 862	295 210	7.38	2 178 650	3 540	4 500	744	940
2007	NA	200 965	308 079	NA	NA	6 965	7 000	927	763

Total Thai pummelo production acreages and tonnages increased more than two-fold in five years, from about 100 000 rai and 75 000 tonnes in 1992 to 200 000 rai and 120 000 tonnes in 1997, and to 283 000 rai and 267 000 tonnes in 2002. Production in 2006 increased slightly to about 258 000 rai and 295 000 tonnes, while total production in 2007 is estimated at more than 300 000 tonnes. The difference between the planted area in column 2 and the harvested area in column 3 is accounted for by new pummelo plantations less than four years old. New areas under pummelo production increased rapidly in 1995 and continued to increase with years of high prices until production reached more than 250 000 tonnes in 2002-2003, when prices started to fall. The downward trend in farm prices continued until 2006.

The corresponding farm values for Thai pummelos also rose from 1 000 billion baht in 1992 to 1 830 billion baht in 1997 and 4 500 billion baht in 2002. After steadily rising for some years, farmgate prices started to fall in 2003 as production areas expanded and the tonnage exceeded 250 000 tonnes from a harvested area of 200 000 rai. As farmgate prices fell, farm value fell to 2 179 million baht in 2006. There are complicated reasons for the current downward trend in prices, one of the main ones being that new production areas may not be suitable for growing pummelos. The proportion of tradable fruit in some regions is as low as 20 percent. The fruit from these new regions is often of unreliable quality in terms of appearance, disease, pest infestation, sooty mould, surface blemishes of various sorts, thick peel, puffy fruit, variation in eating quality, underripe or overripe when harvested, and a bitter taste.

Despite the increase in total production in the country, production in Nakornpathom Province decreased as a result of high land prices and increasing commercial and housing activities, falling

from 10 000 rai and 17 000 tonnes in 1993 to 9 100 rai and 13 000 tonnes in 1997, and 6 600 rai and 12 000 tonnes in 2004. In 2006/07, the area under pummelos in Nakornpathom remained stable at about 7 000 rai. Current pummelo production in the province accounts for less than 5 percent of total production and comes mainly from the GI-designated areas in Nakornchaisri District (1 300 rai), Samphram District (4 500 rai) and Phuthamonton District (250 rai). The pummelo production acreage decreased significantly in GI-designated areas in Samphram and Nakornchaisri Districts, while production in Phuttamonton District is insignificant.

Table 2. Production of pummelos grown in GI-designated districts, 2001-2006

Year	Nakornchaisri		Samphram		Phuttamonton	
	Area (rai)	Production (tonnes)	Area (rai)	Production (tonnes)	Area (rai)	Production (tonnes)
2001	2 111	3 026	6 705	13 891	181	362
2002	1 898	2 814	6 653	13 777	255	765
2003	1 825	3 413	5 928	12 087	255	765
2004	1 524	1 910	4 539	8 773	237	339
2005	1 524	1 910	4 539	8 773	237	339
2006	1 300		4 500		250	

Thai pummelo exports and the proportion of GI pummelos in the export trade

Table 3. Total exports of pummelos from Thailand and exports to major markets in Hong Kong and China, 1992-2006

Year	Tonnes	Value (thousand baht)	Export to Hong Kong		Export to China	
			Tonnes	Value (thousand baht)	Tonnes	Value (thousand baht)
1992	5 889	71 854				
1993	5 083	53 159				
1994	3 985	67 813				
1995	4 776	56 122				
1996	6 182	66 907	5 221	48 557	-	
1997	3,247	44 375	2 660	34 078	-	
1998	4 496	66 317	4 168	56 783	-	
1999	6 432	103 468	4 278	70 925	1 208	13 940
2000	6 209	100 410	3 947	53 603	1 572	34 893
2001	6 574	101 531				
2002	7 518	101 388	5 068	55 508	1 341	19 494
2003	7 607	114 125	3 685	37 215	2 069	32 912
2004	7 313	102 039	2 901	29 800	541	14 711
2005	6 293	99 673	2 648	14 970	1 390	21 385
2006	9 386	132 904	3 660	33 074	2 928	30 309

Hong Kong and China are the most important export markets for Thai pummelos. Hong Kong accounts for some 70 percent of the country's total exports. Historically, Hong Kong was the port of entry for the re-export of Thai fruit to China, and direct export to China is fairly recent. Reliable sources indicate that a large quantity of pummelo exports consigned to China was actually channelled to Hong Kong markets. The reversion of routing from China to Hong Kong was the result of China's entry into WTO and its consequent reduction in its tariff rate for fresh fruit. China has its own pummelo production in the south of the country with production costs that are a fraction of the cost of Thai pummelos. However, the quality is very poor, so that the demand from China may increase. It should be noted that China has recently been putting major effort into pummelo variety improvement. CV Tongdee accounted for more than 95 percent of exports to Hong Kong. The main aim of the Nakornchaisri pummelo GI registration is therefore to protect

Thai growers and maintain the Hong Kong export market long enjoyed by Thailand, rather than to expand into Chinese markets.

The Nakornchaisri name has been recognized since the early years of pummelo exports to Hong Kong and continues to enjoy a good reputation even today among a group of loyal, enthusiastic consumers. Some 70 percent of the pummelos produced in Nakornchaisri are CV Tongdee, a preferred variety in the Hong Kong market. After long years of experience, the exportable rate has reached an average of about 80 percent to as high as 90 percent on some farms, and growers are easily able to adjust their harvest season to meet peak export demand in August and September during the Chinese mid-autumn festival. Nakornchaisri and the surrounding areas have been and continue to be indispensable as the main export supply base. Traders and exporters have been exploring supply sources from other regions of the country with reasonable success. The quality of fruit from some of the new regions is almost equal to that of Nakornchaisri pummelos. However, other pummelo-growing regions in the country are not yet able to provide high-quality fruit ready for harvesting during the peak export season. The trees grow well in lighter types of soil such as loam or sandy loam in other growing regions in the country. They can apparently monopolize large quantities of nitrogen for development of their fruit because roots grown in such soil tend to produce long, profuse systems. An excessive nitrogen nutrient uptake results in puffy fruit, thick peel and unreliable quality, especially during the first two years of harvesting.

Production costs of a pummelo farm (trees aged 5 to 25 years)

The farming approach in the GI-designated area around Nakornchaisri (the three districts of Nakornchaisri, Samphram and Puttamonton) is very different from that found in Rachaburi Province.

Traditionally, Nakornchaisri is famous as the land of pummelos, with a long history and excellent reputation. Farms are usually small, with an average size of less than 10 rai. Most farms grow mainly CV Tongdee, which is the preferred variety for export. Despite their small size, farms in the area are more export-focused than farms elsewhere. The area also has two major packing plants. With a relatively stable market, Nakornchaisri growers have improved their skills in order to maximize profits and receive higher prices by adjusting their harvest season to meet peak export demand in August and September. Lastly, based on their traditional farming systems, Nakornchaisri growers grow a cultivar that meets consumers' variety preference. Their experience enables them to improve their farming techniques in order to adjust the harvest season and attract traders or exporters so as to form effective sourcing networks, thus receiving higher prices for their produce and maximizing profits.

Rachaburi, where the average farm size is even smaller than in Nakornchaisri, is marked by the wide range of crops grown: coconuts, grapes, citrus and cash crops such as papayas, bananas and orchids. The most common companion crop for pummelos is coconuts. Farming is based on a greener, more sustainable approach with fewer applications of fertilizer and chemical sprays. The yield per rai is much less for farms in the Rachaburi area, where growers manage risks based on the traditional low-input farming system, growing a range of crops.



Pummelos grown on dykes, in association with other trees

The very different farming systems in the two areas surveyed are based purely on traditional practices, the regional culture and the economic background. The information indicates that the farmers' production methods, decision-making processes and success and failure factors are not related to GI registration. The differences in farming systems are reflected in the difference in production costs in the two regions, as seen in the following table.

Table 4. Comparison of the average cost (baht/rai) of pummelo production in various regions of Thailand, 2006

Item	Central region (include Nakornpathom)	Rachaburi	Whole country (average)
1. Variable cost	6 525.11	3 433.39	7 253.99
1.1 Labour cost	3 217.78	1 573.64	2 975.75
Land preparation	(236.50 for 1 st year)	(176.00 for 1 st year)	(400.18 for 1 st year)
Planting	(193.30 for 1 st year)	(62.00 for 1 st year)	(164.33 for 1 st year)
Farm care (pruning, water level adjustment, flood prevention)	2 369.84	1 259.41	1 747.44
Harvesting	847.94	314.23	1 228.31
1.2. Material input cost	2 852.09	1 620.21	3 772.15
Planting materials	(709.29 for 1 st year)	(1,095.00 for 1 st year)	(930.05 for 1 st year)
Fertilizer	1 345.51	1 019.41	1 899.41
Pesticides and herbicides	464.19	242.08	763.89
Fuel/electricity	412.27	221.18	370.05
Equipment/machinery	580.49	137.00	705.83
Maintenance	49.63	0.54	32.97
1.3 Opportunity cost*	455.24	239.54	506.09
2. Fixed cost	1 924.79	1 546.72	2 015.21
Land (rent)	561.62	473.20	505.07
Depreciation	402.74	106.72	444.93
Opportunity cost	61.72	15.44	59.45
Pre-harvest cost (up to the 4 th year)	898.71	951.36	1 005.76

3. Total cost (baht per rai)	8 449.90	4 989.11	9 269.20
4. Cost (baht per kg)	6.59	8.41	4.24
5. Yield (kg per rai)	1 282.81	592.13	2 188.32

* Opportunity cost = the money (variable cost) if it is put in the bank at a 7 percent interest rate.

The subsections below summarize general farm information for three cases surveyed in GI-designated areas in Nakornchaisri and surrounding districts in order to analyse factors affecting farming systems and production costs, and the various reasons why growers make their particular decisions. The sizes of the farms surveyed ranged from 8 to 30 rai. A size of more than 10 rai is considered fairly large and probably quite wealthy.

Farming system in Nakornchaisri GI area:

Land and soil preparation. The soil in Nakornchaisri District is marked by organic deposits in the top layer, with clay or clay-loam subsoil – considered ideal for pummelos. Farms in the Nakornchaisri GI areas that lie along Nakornchaisri and Tha Chin Rivers are mainly old-established orchards with similar requirements for land preparation. Unlike farms in other regions of the country, these need dykes around them. Growers dig ditches or channels for drainage and build raised beds on which to plant trees. After preparation, the land should be allowed to dry, preferably for two weeks, before pummelos are planted in the raised beds. The water-level in the beds, sometimes at a depth of only 50 to 70 centimetres for root development, is maintained by high raised dykes and water gates with pumps to prevent flooding at high tide and allow water to come in during the dry season. Maintenance of the dykes, continual deepening and widening of the ditches, and the addition of soil from the ditches to the beds are needed every two to four years to counteract flooding and erosion. One of the farms recently had this job carried out at a cost of 10 000 baht. Yearly flooding during the rainy season, lasting one to three months or even longer, is becoming a routine occurrence. Sand-bagging the dykes, maintaining the water-level and flood prevention activities are other major items of expenditure for farms.

Planting and cultivation. Trees are planted in flat raised beds in two rows, with a spacing of 3 × 3 or 4½ metres or 4 × 4 or 5 metres between rows and about 6 metres between beds. The space taken up by ditches or channels means that there are fewer trees per hectare – which accounts for the lower yield per rai than the national average. Planting density ranges from 40 to 90 trees per rai, with 50 being a fairly standard rate for CV Tongdee. *Phytophthora* root rot is a major problem, and individual diseased trees are removed, burned and replaced. Pummelo decline is caused by a virus (tristeza) and a bacteria-like agent (greening), which set in after three to four years or six to eight years depending on the variety, the severity of the strain, and general farm care. Growers are reluctant to use disease-free planting materials because of the higher cost – 70 baht as against 20 to 25 baht per tree – and farm decline would still be a problem without routine control measures. Growers set a portion of their land aside for new planting once the decline sets in, leading to low productivity. Tree age on a farm will range from three or four to twelve years.

Varieties. CV Tongdee (brilliant gold Pomelo) and CV Kao Nan Pueng (white honey pomelo) differ in the time taken to ripen and in their appearance, yield, quality and resistance to adverse environmental conditions, disease and insects. Most farms grow both varieties, in a proportion of about 60 to 70 percent of the pink-fleshed CV Tongdee, which is hardier and a preferred variety for export, to 30 to 40 percent of the larger, white-fleshed CV Kao Nam Pueng, which is a preferred variety on the domestic market and is more highly priced.

Fruit are thinned when they are the size of a small lime, so that the remaining fruit on the tree can reach a larger size for the market. The number of fruit left per tree differs depending on variety. In the case of CV Tongdee, an average of 40 to 60 fruits is left per tree, inasmuch as fruit size is significantly smaller when more than 100 fruits are allowed to ripen per tree. In the case of CV Kao Nam Pueng, an average of 20 to 40 fruits is left per tree (but certainly fewer than 50). CV Tongdee

fruit grown in Nakornchaisri relies mainly on export. CV Kao Nan Pueng has lower yields and is less hardy.

Farm care and material inputs. With reasonably good farming practices, pummelo orchards require replanting about every 12 to 15 years, depending on the cultivars used and general orchard management. Replanting is a major additional cost. In general, CV Tongdee is more tolerant under adverse growing conditions. A well-managed farm planted to CV Tongdee may maintain its productivity for 20 years or even longer.

Chemical fertilizer is used extensively, but organic manure (from cows) is also used on all the farms surveyed. A simplified chemical fertilizer application is 1 kilogram for a one-year-old tree, 2 kilograms for a two-year-old tree and 3 kilograms for a three-year-old or older tree. The time of application is very important in order to regulate flowering, the subsequent setting of fruit, the various stages in fruit development and post-harvesting. Various chemical fertilizer formulae are used during different stages of development. When nitrogen is abundant, vegetative growth is vigorous and unfruitful. Fruit starts to form with fertilizer application and the foliar spray of nutrients after a dry spell when vegetative growth is low. After the fruit sets and during its development, the complete 1:1:1 fertilizer formula is used. The supply of nutrients to the fruit eventually checks or stops vegetative growth. After harvesting, the complete fertilizer formula is used again. An excessive supply of nitrogen is seldom a problem in the Nakornchaisri zone, since root systems tend to be restricted because of the high water-level in the beds. A sudden increase in the supply of nitrogen, either from the application of fertilizer or from rainfall during fruit development, is likely to result in fruit with thick peel or puffiness – one of the problems affecting pummelo quality in other growing regions in the country.

Copper compounds, particularly copper oxychloride, are the most commonly used fungicides for citrus fruit, supplemented with other insecticides and fungicides in one spray mixture. The most popular pesticides used are abametin, lannat, dimethoate, dichlorate and cypermetrim, and a range of fungicides and bactericides, normally mixed together in one application. Many types of sprayer are in use, from small hand equipment to a specially designed multiple-head sprayer installed on a small boat and sprayed into the trees as the boat travels along the channels.

Harvest maturity. CV Tongdee should be harvested eight to nine months after flowering, when the oil glands on the peel become more prominent and less dense at the blossom end and before the flesh becomes dry and corky at the stem end. CV Kao Nam Pueng is harvested seven to eight months after flowering.

Harvest season. In the case of CV Tongdee, there is often a small crop in February to March, with the main crop in August to September. For a fairly good-sized farm of about 10 rai, harvesting lasts from a few days to no more than two weeks. Kao Nam Pueng flowers repeatedly, so that fruit are selectively harvested throughout the year.

In the Nakornchaisri GI zone, land prices are becoming prohibitive and are one of the main constraints on expansion of production in the area. The national average rent for farmland is about 500 baht per year, but in the GI zone the rate can be as high as 1 000 baht per rai or even 2 000 baht for prime land. Leases are often for three years, with an option to renew for up to ten years. Most growers who seek to rent farms to grow pummelos once worked as hired hands on established farms. They therefore have only basic farming skills, but lack experience in farm management and in marketing. Taking advantage of lower land rent and cheaper labour in other regions of the country, increasing numbers of Nakornchaisri growers are migrating to new regions to grow pummelos or are making contracts with existing pummelo farms to grow and sell pummelos.

Most farms rely on family labour because of the small farm size and also because routine care for pummelos is not very labour intensive. As and when needed, extra help can be arranged through labour sharing with neighbours or contracting labour for initial land preparation, erosion and flood

prevention, scheduled spraying, weeding or harvesting. The present cost of labour is 300 to 400 baht per day, well above the average of 150 to 175 baht in other regions.

Seasonal variations in farmgate prices

Seasonal variations in farmgate prices for CV Tongdee and CV Kao Nan Pueng of various sizes (baht/kg) are shown in the two tables below. Pummelo prices have fewer seasonal variations than other more perishable seasonal fresh fruit. The farmgate prices for Nakornchaisri pummelos would be at least 20 to 30 percent higher than those listed in the table. At the time of the interviews (May 2007), the farmgate price for a 17-inch fruit was 25 to 27 baht. The average farmgate price paid by exporters in 2006 was 23 baht per piece.

Table 5. Seasonal variations in farmgate prices (baht) of CV Tongdee of various sizes, 2001-2005

Year	Size	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
2001	Large						12.00	12.00	12.00	12.50	11.50	10.00	10.00
2003	Large	8.0	10.0	15.67	18.22	18.50	12.20	16.25	19.33	13.00	14.58	15.08	
2005	Large	11.70	12.42	10.84	8.66	11.23	13.68	13.37	12.52	11.37	11.94	12.04	10.51
2001	Small						8.00	5.00	6.00	6.00	6.00	6.00	6.00
2003	Small	6.00	6.66	10.00	12.00			8.00			11.00		
2005	Small		4.00	4.66	5.66	7.60	7.50	6.50	5.00	6.00	6.00	6.13	7.37
2005	Mixed	8.81	8.62	8.37		10.00			5.46	7.00	7.00	5.00	

Table 6. Seasonal variations in farmgate prices (baht) of CV Kao Nam Pueng of large and mixed sizes, 2004-2005

Year	Size	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
2004	Large		14.37	14.75	14.00	13.00	13.00	16.58	17.45	15.34	15.29	15.10	15.81
2004	Mixed	12.87	12.50	12.75	12.67	11.95	12.87	13.19	15.66	13.83	12.00	14.00	13.25
2005	Large		19.17	16.00	14.33	17.00	15.00	15.00					16.67
2005	Mixed	14.50	16.37	15.25		16.00		7.00	7.00	5.00	5.00	5.00	

Bangkok wholesale market prices are not affected by farmgate prices, as can be seen from the following table on seasonal variations in Bangkok wholesale prices of CV Tongdee pummelos between 1999 and 2007.

Table 7. Seasonal variations in Bangkok wholesale prices of large and small fruit, 1999-2007

Year	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Large fruit												
1999	40.25	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50
2001	24.40	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50
2003	33.41	40.00	40.00	40.00	38.16	33.33	30.00	30.00	30.00	25.67	22.65	21.21
2005	24.00	30.17	32.50	32.50	32.50	32.50	32.50	32.50	32.50	28.50	26.14	22.50
2007												
Small fruit												
1999	17.80	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
2001	13.48	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50
2003	23.32	27.50	27.50	27.50	25.66	20.83	17.50	17.50	17.50	13.89	11.15	9.29
2005		20.61	22.50	22.50	22.50	22.50		22.50		18.25		
2007												

Supply chain and type of marketing relationships among stakeholders

Table 8. Supply chain and type of marketing relationships among stakeholders

GI-designated area		Rachaburi	
Grower		Grower	
Domestic		Export	
Domestic		Export	
Sales to local market	Long-term trading relationships with local markets, which sell to people from towns or to visiting tourists	Long-term informal relationships with consolidators, who have long-term formal relationships with exporters. Consolidators move about the country to obtain supplies. After on-farm pre-grading, they may provide transportation from farm to packing plant. The purchase price is set by the exporters and consolidators are paid on a commission basis.	Sales to local market
Sales to visiting traders	Either spot arrangements during the harvest season when traders come with truck to pick up produce, or through long-term arrangements with traders who organize transportation	Packing plants operated by the exporter. Inspection, grading, cleaning, waxing, packaging and final loading into the container	Sales to visiting traders
Sales via wholesale market	Only large growers with large quantities sell to wholesale markets in other provincial towns or Bangkok		Sales via wholesale market
Roadside stalls	Roadside to tourists	Farmers' roadside stalls, direct sale	Roadside stalls selling to tourists
Peri-urban markets	Usually to a group of large fruit stalls commonly located on the outskirts of Bangkok	Through local traders, long-term relationship	Peri-urban markets

Price formation and gross margin of stakeholders along the supply chain

Several factors were identified as affecting price formation to varying degrees and are described under the various headings below.

Export as a factor in price formation

Table 9. Monthly exports of pummelos, 1999-2007

Month	1999		2001		2003		2005		2007	
	Volume (tonnes)	Value (1 000 baht)	Volume (tonnes)	Value (1 000 baht)	Volume (tonnes)	Value (1 000 baht)	Volume (tonnes)	Value (1 000 baht)	Volume (tonnes)	Value (1 000 baht)
J	357	3 547	334	5 781	410	6 455	227	3 369		
F	157	3 834	40	951	139	2 055	133	4 110		
M	26	360	294	4 831	436	7 823	168	4 781		
A	92	1 326	210	3 928	563	10 269	257	8 078		
M	372	5 870	186	2 184	434	7 226	345	7 071		
J	202	6 916	268	4 990	507	10 845	538	10 785		
J	391	9 544	546	9 134	559	10 227	679	13 003		

A	1 349	20 502	1 257	20 457	2 050**	25 149	1 015**	16 774		
S	2 608**	45 176	2 712**	38 142	1 453**	23 238	1 116**	12 734		
O	135	2 547	244	2 351	374	5 123	514	5 385		
N	248	2 769	242	4 425	389	3 812	519	5 344		
D	120	1 089	236	4 351	306	1 896	275	8 232		
Total	6 431	10 3467	6 573	101 530	7 606	114 124	6 292	99 672		

** Peak export season

Exports are a major driving force in price formation and are the single most important determinant for pummelo prices in GI-designated zones. This is especially true for CV Tongdee, because pummelo exports to Hong Kong are based mainly on this cultivar.

At the packing plant, the purchase price is paid on a “per fruit” basis, depending on quality and size. The price has not fallen below 20 baht per piece for several years and has sometimes risen to as high as 45 baht per piece. Peak export demand is in August and September, although recent years have seen a gradual increase in demand during other months. Available supplies in the Nakornchaisri zone are limited, and sourcing from alternative supply bases in other regions of the country to ensure a year-round supply will increase. Fruit quality from these new sources is already improving.

Geographical indications. GI registration is a major factor in high prices. With regard to exports, the purchase price and quality of Nakornchaisri pummelos have been used as benchmarks for fruit from other regions. CV Tongdee fruit from Nakornpathom (GI-designated areas) receive 2 to 4 baht more than fruit from Phetchaburi or other areas of almost equal quality. Supplies from other regions of the country are growing. In markets, consumers are paying a higher price for fruit claiming to be from Nakornchaisri, even when there are some reservations about the true origin of the fruit. Traders rely mainly on consolidators to guarantee the production area. This close long-term working relationship between exporters and consolidators is a key success factor in establishing a trader’s reputation.

Preference as to variety. The preference of domestic demand as to variety has changed as new cultivars have started to appear on the market. The most popular varieties on the domestic market are Kao Nam Pueng, Kao Daeng Gua and Kao Phuang. All these cultivars have whitish to yellow pulp. They are medium to large fruited cultivars and are well-accepted by markets in Bangkok, and some consistently receive higher prices than CV Tongdee. A high price is guaranteed for CV Tongdee especially during the peak export season in late August as it is the favourite variety for export to Hong Kong.

Appearance. It is very important for pummelos to meet minimum visual requirements. The most common defects leading to lower prices – or to almost unsaleable fruit – are surface blemishes of various kinds, sunburn, sooty mould, external damage caused by insects or disease, odd shapes, sizes not complying with standards, thick peel, light feel when picked up, puffiness, underripe fruit, overripe fruit and peel colour more yellow than green. If the taste is acceptable, such fruit can still end up in the ready-to-eat packs that are now increasingly available in city stores. Urban retailers peel and pack the fruit for these ready-to-eat packs, and the price is set at an average of 25 baht for a 200- to 300-gram pack.

Size difference. Fruit is always sold by the piece rather than by weight, with larger fruit receiving higher prices. As can be seen from the table below, fruit that is size graded receives a higher price and suffers smaller seasonal price fluctuations than fruit of mixed sizes. In the case of exports, price differences due to size differences are significant at the farmgate. It is an established practice for packing plants to purchase fruit based on circumference. For the export market, fruit larger than 20 inches or smaller than 14 inches is rejected, but may still be acceptable for the domestic market. Price differences for different sizes at the farmgate and in Bangkok wholesale markets are shown in Table 10.

Table 10. Comparison of prices (baht) of pummelos of various sizes at the farmgate and in the Bangkok wholesale market, 2005

		CV Tongdee											
		J	F	M	A	M	J	J	A	S	O	N	D
2005 (farmgate)	Large	11.70	12.42	10.84	8.66	11.23	13.68	13.37	12.52	11.37	11.94	12.04	10.51
2005 (Bangkok)	Large	24.00	30.71	32.50	32.50	32.50	32.50	32.50	32.50	32.50	28.50	26.14	22.50
2005 (farmgate)	Small		4.00	4.66	5.66	7.60	7.50	6.50	5.00	6.00	6.00	6.13	7.37
2005 (Bangkok)	Small	-	20.61	22.50	22.50	22.50	22.50	-	22.50	-	18.25	-	-
		CV Kao Nam Pueng											
2005 (farmgate)	Large		19.17	16.00	14.33	17.00	15.00	15.00	-	-	-	-	16.67
2005 (farmgate)	Mixed	14.50	16.37	15.25	-	16.00	-	7.00	7.00	5.00	5.00	-	-

Price fluctuations from year to year. To obtain a picture of yearly price fluctuations for pummelos, it is necessary to look at long-term trends over a five- to seven-year cycle because newly planted trees take at least four years to become productive and fruit harvested during the first two years is usually of poor or unreliable quality. From 1982 to 1992 the farmgate price remained stable at 11 to 13 baht per kilogram. The farmgate price then rose to more than 15 baht per kilogram from 1997, remaining high until 2002. The price increase then led to an increase in supplies, with total production rising from 121 000 tonnes in 1997 to 267 000 tonnes in 2002. This led to a fall in price to less than 10 baht in 2003 and 7.38 baht in 2006. Low farmgate prices do not appear to have been reflected in Bangkok wholesale prices.

Seasonal price changes. As compared with other more perishable fresh fruit with a shorter shelf life, pummelo prices are less affected by seasonal variations (see Table 10 above). Prices are more affected by export demand or demand during festivals, particularly the mid-autumn festival, Chinese New Year etc.

Different market segments. Prices are affected by the delivery distance from production areas, although to a lesser extent than in the case of more perishable fresh fruit. Retail prices are more affected by market location and are two to three times higher on markets in high-income areas. However, growers selling fruit to the high-end market or modern trade outlets do not necessarily enjoy the price premium that stores charge their customers.

Growers' reputation and innovative marketing skills. Individual growers' reputations are also a factor in price formation. Although this is still more the exception than the rule, it is becoming a more influential element.

3. Lessons learned

1. Pummelos are a favourite fresh fruit among Thai people, most of whom consider it a high-priced fruit. The country's total annual production has stood at about 250 000 tonnes in recent years, with exports accounting for less than 10 percent of the total. Thailand has a history of exporting pummelos (CV Tongdee), especially to Hong Kong, where there is a group of loyal, enthusiastic consumers.

2. Overproduction is almost impossible because of the restricted geographical conditions required to grow pummelos. After years of high prices, production has expanded from the central region to the south, north and northeastern regions. However, it should be borne in mind that many new farms are not yet productive and fruit from most farms is not of export quality. Even for domestic consumption, farms with only 30 to 50 percent tradable fruit are common rather than the exception.
3. Pummelo production was first introduced into Samphram District and spread naturally to surrounding areas. The main production areas in the central region of the country are in Nakornpathom Province. Nakornchaisri District and neighbouring Samphram District are considered prime pummelo production areas. Nakornchaisri has a long established reputation for quality pummelo production, and it can be said that pummelo exports from Thailand are linked to the fame of the Nakornchaisri name. Fruit grown in Nakornchaisri depends more on exports than fruit grown in any other region. Growers in the Nakornchaisri zone enjoy an almost guaranteed market and a price premium for their fruit. Consumers have long appreciated the quality and reputation of Nakornchaisri pummelos, especially CV Tongdee, which has a long cultivation history in the area.
4. The application for GI registration for Nakornchaisri pummelos was made by the Nakornchaisri Chamber of Commerce. GI registration was limited to growing regions in Nakornchaisri, Samphram and Puttamonton Districts for two cultivars, CV Tongdee and CV Kao Nan Pueng. The registration process was initiated to provide protection to the Nakornchaisri pummelo name for growers in the region.
5. Some unique traditional farming practices are used for pummelo production in Nakornchaisri. Pummelo trees naturally grow well on the low-lying land along the river, which is rich in organic deposits. There are few adverse temperatures and humidity fluctuations. As the orchards age and the trees mature, growers tend to use less chemical fertilizer and more organic fertilizer. Fruit quality is stable and reliable. Moreover, highly specialized skills have been developed to adjust the harvest season to meet peak export demand. The marketing networks in the area are already functioning efficiently, with established price structures and marketing costs, and profits are maximized to the benefit of both growers and traders.
6. In neighbouring Rachaburi Province outside the GI-designated area, farming is based on a totally different concept. The land is famous for mangos, coconuts, grapes, a whole range of other fruit and orchids. Farming is based on more sustainable practices, with low inputs and intercropping with various crops. Pummelo production is not the main source of income, production costs are low and yields per rai are probably some of the lowest in the country.
7. The cost of pummelo production in GI-designated districts remains lower than the national average. The major cost items are material inputs, mainly fertilizers and agricultural chemicals such as insecticides, fungicides and other foliar sprays containing nutrients, trace elements or growth promoters. There are also the costs incurred for fuel and hired labour. The amount spent on activities to prevent flooding and erosion of the channels and beds has increased each year.
8. Pummelo farms are less labour-intensive than other types of fruit farm. Since the majority are small, family labour is almost exclusively used. Labour costs are high in the area, and if hired labour is used, this is only for specific activities under contract.
9. CV Tongdee is a cultivar particularly favoured by Nakornchaisri growers, since it is more tolerant of adverse conditions (flooding, saline water, disease etc.) and has fewer nutritional requirements, while its productivity is higher than that of CV Kao Nan Pueng. Growers use their traditional farming systems to grow a cultivar that meets consumers' preferences in terms of variety, developing techniques to adjust the time of the harvest and attract traders' or exporters' interest in order to form effective sourcing networks.

10. The Nakornchaisri farmgate price for a 16- or 17-inch fruit seldom falls below 20 baht, with a retail price ranging from 25 baht to over 70 baht. In conclusion, two major factors – the consistent quality of the fruit and the concentration of pummelo farms in the Nakornchaisri zone – make sourcing and marketing efficient. Growers’ high profits are a result less of high yields than of the high price received for the fruit.
11. Prohibitively high land prices in Nakornpathom Province have acted as a constraint on the expansion of new orchards in neighbouring areas with similar geographical conditions, and led to the migration of skilled growers from Nakornchaisri to other parts of the country, either to establish new farms or to lease established pummelo farms. An interesting development in the export trade is that supply bases have expanded greatly in recent years, with quality fruit increasingly being sourced from as far as the southern and lower northeastern regions of the country.
12. Pummelo production has expanded, for example, to Petchaburi and Chumporn in the south, the lower eastern region and the northern part of the country. Some 25 to 30 percent of new pummelo farms are not yet productive. Despite the expansion and the possibility of new supply sources, there are still problems to be solved over unreliable fruit quality and over an inability to adjust the time of harvesting to meet peak export demand. New farms receive too much fertilizer, and fruit harvested during the first two years is usually of very poor quality. Older trees receive too little fertilizer and too much chemical spray. The quality is inconsistent and there are tell-tale signs indicating the real production area. With the recent downward trend in overall pummelo prices, there will be little incentive for these new farms to improve their farming practices.
13. Sourcing from areas outside GI-designated zones is for experienced traders only. Supplies from other parts of the country of a quality almost on a par with Nakornchaisri GI fruit have increased recently. It seems that “Nakornchaisri pummelo” is seen more as a generic term associated with a certain quality than as indicating a specific link to a geographical zone.
14. The recent application for GI registration for Nakornchaisri pummelos was made by the Nakornchaisri Chamber of Commerce in order to protect the name and reputation. The initiative was based on the unique geographical conditions of the area, the traditional farming practices, the recognized and reliable quality of the fruit and a loyal group of consumers. However, the majority of growers are poorly organized and poorly informed on the pros and cons of GI registration. Commercial operators, traders and exporters also express reservations on GI implementation, so that there is little sense of urgency regarding progress in this connection.
15. Pummelo production in GI-designated areas has decreased in recent years and its market share is shrinking, factors that have militated against the formation of any organization to ensure compliance with GI requirements.
16. Although there is still a general recognition of the geographical link with a certain quality and reputation, it is becoming tenuous. The GI application contains no specific implementation plan to ensure compliance with requirements. Moreover, traders supplying both the domestic and export markets welcome opportunities to obtain additional supplies from outside the Nakornchaisri zone in order to reduce costs.

4. Recommendations

1. The GI registration of Nakornchaisri pummelos should involve stakeholders all along the supply chain and should take into account how the fresh produce trade operates.
 - *Growers.* Nakornchaisri growers have long enjoyed an almost guaranteed market and a high farmgate price for their pummelos, and there is a well-established marketing network in growing areas. Although there appears to be a major gap between farmgate and domestic wholesale prices, this is less the case with pummelos produced in GI-designated areas. The gap can be explained partly by transportation costs, storage rental, the low turnover rate etc. Growers are currently poorly informed and poorly organized regarding the GI issue.
 - *Traders.* The supply of pummelos from Nakornchaisri is fairly limited and fruit is usually so expensive as to be out of reach of most local consumers. Traders for the domestic market would obviously prefer to avoid confining their supplies to a few thousand tonnes of high-priced fruit from Nakornchaisri. There are therefore considerable doubts and reservations as to the benefits of GI registration for the trade or the traders. Nakornchaisri GI pummelos rely on the export trade. Although success in exporting fresh produce involves more than the use of a GI name, the importance of the GI name and reputation in the export market should be measured.
 - *Consumers.* The capacity of GI registration to provide protection against consumer deception with non-GI pummelos is probably more easily understood. Consumers have long appreciated the quality and reputation of GI fruit and probably associate high prices with the GI mark. The price can be as high as 60 or 80 baht for a single fruit, and consumers are reluctant to pay such a high price or to purchase GI fruit on a regular basis. Moreover, consumers have the choice of increasing numbers of other cultivars producing good to excellent quality fruit in other regions. The high retail price of GI pummelos may reduce purchases by consumers.

All these factors lead to a lack of any real progress on application of the GI system in the Nakornchaisri zone.

2. A national approach is required in order to pursue implementation of GIs in Thailand. The specific quality of Thai pummelos and their reputation in overseas markets should be assessed in order to consider the potential for GI protection. However, this would perhaps fall under a brand-focused strategy and would require in-depth discussion of the pros and cons among researchers and communication of this decision-making process to stakeholders along the supply chain.
3. Lastly, implementation of the GI system requires some control measures and systems. These have not yet been discussed by any of the stakeholders, but their establishment should be the next major step in guaranteeing the specific quality linked to the origin of Nakornchaisri GI pummelos.

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ประกาศกรมทรัพย์สินทางปัญญา เรื่องการขึ้นทะเบียนสิ่งบ่งชี้ทางภูมิศาสตร์ ส้มโอนครชัยศรี ทะเบียนเลขที่ สข 48100002

เกษตรดีที่เหมาะสม สำหรับส้มโอ (Good Agricultural Practice (GAP) for Pummelo, Number 26). 2002. กรมวิชาการเกษตร 26 หน้า

Annex: Methodology

This report is the outcome of an examination of the “Impact on farming practices of producing pummelos under the Nakornchaisri geographical indication”. The study was carried out by analysing the information on fruit originating in the GI-designated zone and comparing it with that on pummelos produced in the neighbouring Rachaburi Province outside the GI zone. The information was then used to determine the economics, efficiency, competitiveness and market acceptance of GI-registered produce and to suggest future implementation of the GI system.

Three field visits were conducted, using a questionnaire especially designed for the survey.* The first two interviews with six growers were accompanied by a pummelo researcher from the Department of Agriculture, who also helped to identify the growers to be interviewed. The first visit was to three farms in GI-designated areas in Nakornchaisri and Samphram Districts, whereas the second visit was made a week later to nearby farms in Rachaburi Province and surrounding areas outside the GI-designated zone. The information from the survey served as a basis for calculating the volume of production, production standards and conditions, the production costs of key operations specific to the area, the competitive capacity of GI production methods and the economic benefit of producing Nakornchaisri pummelos. Because of major differences in traditional production practices (unrelated to GI issues) between these two districts, and also the differences in operations among growers, the survey results cannot be organized as a simple comparison of production practices and economics between GI-designated and non-GI-designated areas. In order to avoid bias in drawing conclusions on the impact of GI registration on farming practices, the results of the survey were presented in such a way as to show that specific differences sprang from a variety of reasons. In other words, decisions taken by growers and having an impact on farming practices and production costs had many causes and were not only the result of efforts to meet GI requirements. A comparison was made between general production costs in Nakornpathom and Rachaburi, based on information from the Office of Agricultural Economics.

The third visit was to two pummelo packing plants, one exporting to Hong Kong and the other to China, both located in the Nakornchaisri zone. Several interviews and telephone conversations were held with two major exporters (with a combined export market share to Hong Kong of close on 85 percent) to obtain market information regarding the export of pummelos. Both exporters are members of the Thai Fresh Fruit Traders and Exporters Association with more than 15 years of experience in the export trade. This information was used in order to analyse the supply chain, export quality and grading requirements, price information, marketing relationships and market acceptance of the GI system.

Short personal meetings were held with researchers at the Department of Agricultural Extension and the Office of Agricultural Economics. The information gathered was organized to illustrate pummelo production and export trends, average national production costs, seasonal price variations and price differences between farmgate and Bangkok wholesale prices.

Information on pummelo standards was obtained from the National Office of Agricultural and Food Standards of the Ministry of Agriculture and Cooperatives.

The Nakornpathom Chamber of Commerce was contacted in order to obtain information on the Nakornchaisri pummelo application for registration and recent progress in this connection. GI information was researched on the website of the Thai Department of Intellectual Properties and translated, with some modifications, into English.

* All the methodological materials are available from the author upon request.