Thailand

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Introduction

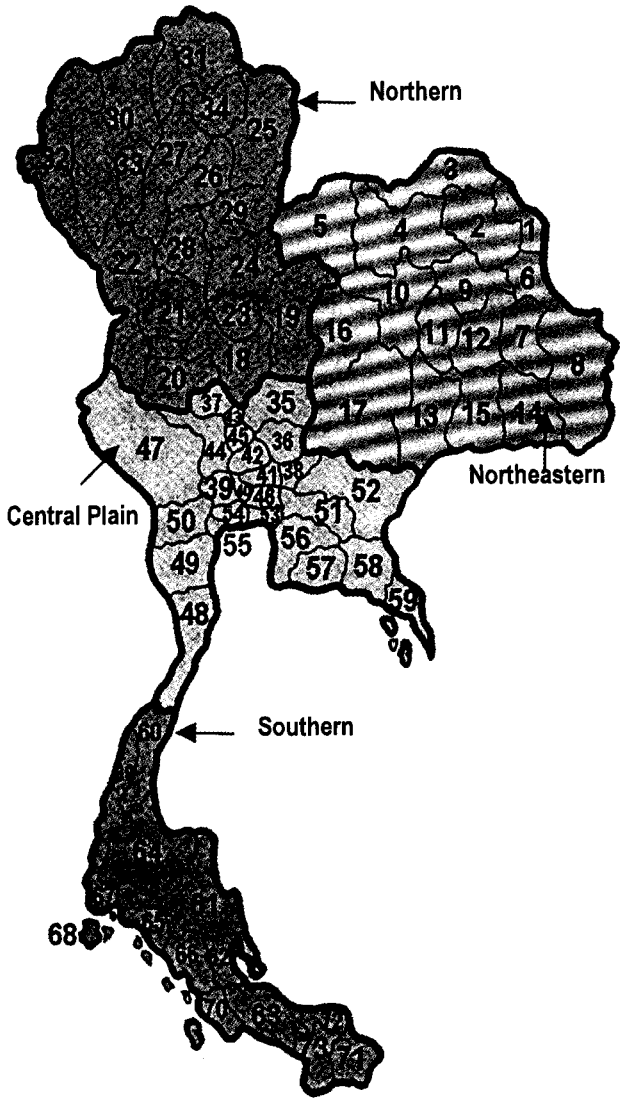
Thailand is a country on the mainland of Southeast Asia in the middle of the Indo-Chinese Peninsula. To the north and west of the country lies Myanmar, and to the east are Laos and Cambodia. Thailand extends to the south, deep into the Malay Peninsula, where it shares a short border with Malaysia. The total area of Thailand is 513,000 km^2; its greatest length is about 1650 km^2 and greatest breadth is 770 km^2. In the south are the Gulf of Thailand and the China Sea, and to the west of the Malay Peninsula is the Bay of Bengal. The population of Thailand in 1994 was 58.7 million. About 6 million of those people live in the capital city, Bangkok, 2.0 million in Chiang Mai, 1.8 million in Korat, and 1.9 million in Ubonratchathani. The country is divided into 73 administrative units or provinces. The GNP of Thailand in 1996 was US$2943 (Council for Economic Planning and Development 1998).

Vegetables are an important crop group in Thailand. The planted area of all vegetables, including onion, garlic, chili, but excluding potato, was 353 thousand ha in 1994, which accounted for about 2.0% of the total cropped area, or 3.6% of rice area. Total production, including onion and chili, but excluding potato, was 3.4 million t, worth more than 25 billion THB (or US$1 billion), which is about 19% of the value of all cereal production in the country. The average yield was 9.7 t/ha.

During 1994, annul per capita availability of vegetables at the farm level was about 53 kg (or 145 g/day). The latest available consumption survey suggests that Thais consume an average of 742 g/day of all foods, of which vegetables account for about 14%. Cereals, meat and meat products, and fruits account for 45%, 16%, and 12%, respectively.

Topography

The country can be divided into four geographical regions: north, northeast, central, and south (Fig.1). The Central Region is a large alluvial plain called the Menam Basin, which mostly becomes inundated during the rainy season. Winding rivers and numerous canals and streams intersect the Basin. Its main river is the Menam Chao Phya, commonly known as the river Menam, meaning "mother of water." About 40 km from its left bank lies Bangkok.



Northeastern Region
1. Nakhon Phanom
2. Sakon Nakhon
3. Nong Khai
4. Udon Thani
5. Loei
6. Mukdahan
7. Yasothon
8. Ubon Ratchathani
9. Kalasin
10. Khon Kaen
11. Maha Sarakham
12. Roi Et
13. Buri Ram
14. Si Sa Ket
15. Surin
16. Chaiyaphum
17. Nakhon Ratchasima

Northern Region
18. Nakhon Sawan
19. Phetchabun
20. Uthai Thani
21. Kamphaeng Phet
22. Tak
23. Phichit
24. Phitsanulok
25. Nan
26. Phrae
27. Lampang
28. Sukhothai
29. Uttaradit
30. Chiang Mai
31. Chiang Rai
32. Mae Hong Son
33. Lamphun
34. Phayao

Central Plain Region
35. Lop Buri
36. Saraburi
37. Chai Nat
38. Nakhon Nayok
39. Nakhon Pathom
40. Nonthaburi
41. Pathum Thani
42. Ayutthaya
43. Sing Buri
44. Suphan Buri
45. Ang Thong
46. Bangkok Metropolis
47. Kanchanaburi
48. Prachuap Khiri Khan
49. Phetchaburi
50. Ratchaburi
51. Chachoengsao
52. Prachin Buri
53. Samut Prakan
54. Samut Sakhon
55. Samut Songkhram
56. Chon Buri
57. Rayong
58. Chanthaburi
59. Trat

Southern Region
60. Chumphon
61. Nakhon Si Thammarat
62. Phatthalung
63. Songkhla
64. Surat Thani
65. Krabi
66. Trang
67. Phangnga
68. Phuket
69. Ranong
70. Satun
71. Narathiwat
72. Pattani
73. Yala

Fig. 1. Regional map of Thailand

The northern region has hilly or mountainous terrain divided by four rivers into relatively large valleys, which run to the south and join the river Menam. Parts of the rivers Salween and Mekong make up the western and northern boundaries. The well-known chief city of this region is Chiang Mai, which is the second city of Thailand in terms of its degree of economic development.

The northeastern region is a saucer-shaped plateau, commonly known as the Korat Plateau, with the Mekong River as its eastern boundary. It is the largest of the four regions and is poorly watered. Its chief cities are Korat (Nakhon Ratchasima) and Ubon Ratchathani.

The southern region, or peninsular Thailand, covers about two-thirds of the Malay Peninsula. Mountains run the length of the peninsula, on either side of which are coastal plains.

Climate

Thailand has three seasons: summer, February–May; 2) rainy season, June–September; and 3) winter, October–January. The climate is tropical, with an average annual temperature of 29°C. Summers are hot and humid, and winters are cool. In the rainy season, depressions occur from time to time until early winter. The central plain region is one of the most agriculturally productive places in all of Asia, and enjoys an annual rainfall of more than 1200 mm.

Important Vegetables, Growing Areas, and Seasons

Thailand grows more than 100 vegetable species. Important vegetables, in order of their contribution to total vegetable area, are peppers, garlic, cucumber, baby corn, chili, yard long bean, tomato, shallot, kale, cabbage, and pumpkin (Table 1).

The cultivation of each vegetable is concentrated in its own specialized area (Table 1). Regional comparative advantage is determined by a number of factors affecting cost, including climate, varieties, labor cost and availability, and others.

Major vegetable growing areas in the north are Chiang Mai and Chiang Rai; in the northeast Nakhon Ratchasima and Khon Kaen; in the central plains Pathum Thani, Bangkok, Chon Buri, Kanchanaburi, and Samut Sakhon; and in the south Chumphon, Nakhon Si Thammarat, and Surat Thani.

Growing season and harvesting season for each of the primary vegetables in Thailand are shown in Table 1. Many vegetable species can be grown year round in multiple cropping and intercropping systems. Leaf vegetables need less time to be grown—Convolvulus, kale, lettuce, and welsh onion, for instance, are ready to harvest in just 20-35 days. In some specialized vegetable production areas, such as Bangkok, Chiang Mai, Ratchaburi, Kanchanaburi, and others, there can be 8 to 10 harvests of these early-maturing crops. On the other hand, bamboo shoot and asparagus take 3-7 years before they are ready for harvest.

The north and the northeast regions not only produce tropical leafy vegetables and root vegetables, but also temperate vegetables, such as spinach, Brussels sprouts, and tomato. In the central plain, and in the east, west, and south, farmers usually grow leafy and fruit vegetables.

Table 1. Growing and harvesting seasons and major growing areas by vegetable species, 1994

Vegetable [% share in all vegetable area]	Growing Season	Harvesting Season	Major growing province (% share in total area of the vegetable)
Angled loofah [1.1]	All seasons	All seasons	Nakhon Pathom (6), Ratchaburi (6), Chumphon (5), Saraburi(4).
Baby corn [7.5]	All seasons	All seasons	Ratchaburi (38), Kanchanaburi (13).
Bitter gourd [1.4]	All seasons	All seasons	Ratchaburi (71).
Cabbage [3.3]	Winter, Summer, Rainy	Winter, Summer, Rainy	Chiang Mai (42).
Cauliflower [1.0]	All seasons	All seasons	Bangkok (13), Chiang Mai (13), Phetchabun (8), Songkhla (7).
Chili [6.4]	Rainy, Winter	Winter, Summer	Chaiyaphum (13), Chiang Mai (13), Loei(11).
Chinese cabbage [1.9]	Winter, Summer, Rainy	Winter, Summer, Rainy	Chiang Mai (25), Pathum Thani (6), Nakhon Ratchasima (5), Bangkok (4).
Chinese radish [1.0]	Jan – Dec	Jan – Dec	Ratchaburi (29), Kanchanaburi (17), Nonthaburi (11), Phetchabun (7).
Cucumber (long) [2.9]	All seasons	All seasons	Udon Thani (13), Chumphon (8), Kalasin (7), Nong Khai (6).
Cucumber (short) [6.1]	All seasons	All seasons	Prachin Buri (10), Ratchaburi (8), Samut Songkhram (5), Buri Ram (5).
Garlic [9.3]	Winter, Rainy	Winter, Rainy	Chiang Mai (29), Lamphun (23), Phayao (8), Chiang Rai (8).
Kale [3.5]	Jan – Dec	Jan – Dec	Bangkok (12), Nonthaburi (9), Nakhon Pathom (8), Pathum Thani (7).
Kangkong [0.9]	Jan – Dec	Jan – Dec	Nonthaburi (36), Samut Prakan (11), Bangkok (7).
Leaf mustard [2.5]	Oct – Feb	Nov – Mar	Lampang (11), Chiang Rai (9), Nonthaburi (9), Phayao (8).
Lettuce [0.9]	Jan – Dec	Jan – Mar	Nonthaburi (26), Bangkok (12), Pathum Thani (11), Chiang Mai (8).
Onion [0.9]	Winter, Rainy	Winter, Rainy	Chiang Mai (82), Kanchanaburi (16).
Pakchoi [2.6]	Jan – Dec	Jan – Dec	Nonthaburi (12), Bangkok (10), Pathum Thani (7).
Peppers [14.0]	Rainy, Winter, Summer	Rainy, Winter, Summer	Nakhon Ratchasima (11), Chiang Mai (10), Prachuap Khiri Khan (9).
Pumpkin [3.1]	Summer, Winter	Summer, Winter	Chumphon (19), Chiang Mai (7), Prachuap Khiri Khan (6).
Shallot [4.3]	Winter, Rainy	Winter, Rainy	Si Sa Ket (32), Chiang Mai (22).
Sweet pea [0.2]	Winter, Summer	Winter, Summer	Chiang Mai (19), Phetchabun (19), Tak (8), Nonthaburi (7).
Tomato [4.9]	Rainy, Winter, Summer	Rainy, Winter, Summer	Nong Khai (24), Sakon Nakhon (20), Chiang Mai (14), Nakhon Phanom (13).
Yard long bean [6.4]	All seasons	All seasons	Ratchaburi (27).

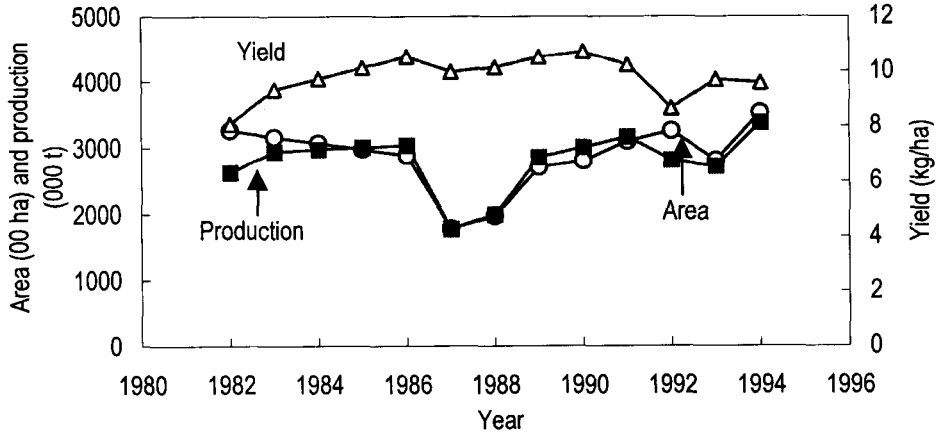
Figures in brackets represent percentage share of total area of all vegetables, and figures in parentheses represent the percentage contribution of a province to the total area of the vegetable.

Source: The data on vegetable area and production across regions are reported in Division of Planning (1995). The data on growing and harvesting seasons is from official files of the Department of Agricultural Extension, Ministry of Agriculture and Co-operatives.

Trend Analysis

Production

The area under vegetables remained in the range of 300 thousand ha during 1982-94, except during 1987-88 when it plummeted. Similarly, vegetable production remained stagnant at around 3 million t, except for 1987-88 when there was a setback due to reduction in area. Per hectare yield showed a slightly declining trend during the last couple of years of the study period (Fig. 2).



Source: Division of Planning (various issues 1983-1995).

Fig. 2. Trend in overall area, production, and yield of vegetables, 1982-94.

The results of trend analyses for area, production, and yield of individual and total vegetables as a group for the period 1982-94 suggest that total vegetable area decreased during the initial study period (because of the dip during 1987-88), and then began to recover. Yield ran opposite to this. This resulted in stagnant production during 1982-94 (as both linear and quadratic terms were insignificant) (Table 2).

Among the individual vegetables, only baby corn and onion area increased linearly; chili, and garlic area decreased linearly; and tomato, pepper, and cucumber area did not show a significant trend. Area of all other individual vegetables decreased in the initial years of the study, suggested by the negative linear terms, while every vegetable recovered its area in the later years, as suggested by the positive quadratic terms. This pattern was shaped by the setback in area during the middle of the study period. Per-hectare yield for most individual vegetables showed the opposite. The trend in production was mixed (Table 2).

Table 2. Trend in area, production, and yield of major vegetables in Thailand, 1982-94

Vegetable	Area		Production		Yield	
	t	t^2	t	t^2	t	t^2
Baby corn	0.1149	-	0.1325	-	0.1907	-0.0124
Cabbage	-0.1442	0.0092	0.0410	-	0.1437	-0.0062
Chili	-0.0369	-	-0.0524	-	-	-

Contd. Table 2.

Vegetable	Area		Production		Yield	
	t	t^2	t	t^2	t	t^2
Chinese cabbage	-0.3575	-0.0257	-0.1642	0.0155	0.1933	-0.0102
Chinese kale	-0.1241	0.0085	0.0313	-	0.1106	-0.0053
Chinese leaf mustard	-0.2126	0.0131	-	0.0043	0.0851	-
Chinese radish	-0.2725	0.0136	-0.1756	0.0089	0.0321	-
Cucumber	-	-	-	-	0.0222	-
Garlic	-0.0369	-	-0.0524	-	-	-
Onion	0.0712	-	0.2298	-0.0090	0.1387	-0.0076
Pepper	-	-	0.4112	-0.0173	0.4767	- 0.0229
Pumpkin	-0.2023	0.0128	-	-	0.0402	-0.0026
Shallot shoot	-0.1618	0.0090	-	-	-	-
Taro	-0.3541	0.0218	-0.2592	0.0174	0.0948	-0.0044
Tomato	-	-	0.0949	-	0.0768	-
Water convolvulus	-0.7497	0.0478	-0.7704	0.0482	-	-
Yard long bean	-0.1434	0.0094	0.0676	-	0.1742	-0.0068
Other vegetables	-	0.0030	-0.3139	0.0185	-0.0928	-
Total vegetables	-0.1395	0.0102	-	-	0.0703	-0.0047

- implies that the coefficient is not significant at least at the 10% level.
Source: Division of Planning (various issues 1983-1995).

Prices

With few exceptions, all individual vegetable nominal prices are increasing at the wholesale and farm gate levels. However, increases in most cases are higher at the wholesale level. In real terms, the prices of many individual and total vegetables, as a group, increased at the wholesale and farm gate levels (Table 3).

Table 3. Growth rate (%) in vegetable prices in Thailand, 1984-1996

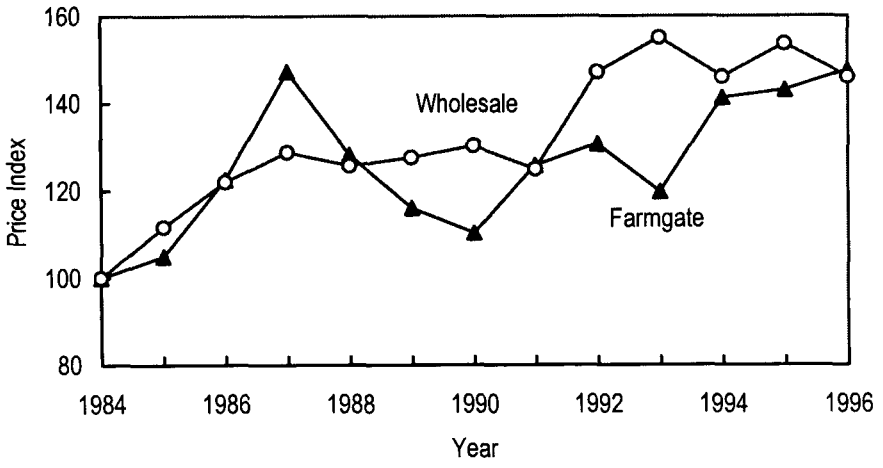
Vegetable	Nominal		Real[1]	
	Wholesale	Farm gate	Wholesale	Farm gate
Asparagus	-	-	-4.24	-4.57
Baby corn	14.46	-	10.57	-
Cabbage	-	-	-	-2.99
Chili	4.11	-	-	-3.51
Chinese cabbage	10.20	6.78	6.31	2.89
Chinese kale	4.78	1.72	-	-2.17
Cucumber	9.19	7.31	5.30	3.42
Garlic	4.55	-	-	-
Ginger	7.78	-	3.89	-
Mushroom	-	6.01	-	2.11

Contd. Table 3.

Vegetable	Nominal		Real[1]	
	Wholesale	Farm gate	Wholesale	Farm gate
Kangkong	6.57	6.65	2.68	2.76
Onion	7.49	5.47	3.60	-
Pakchoi	4.40	2.41	-	-
Pumpkin	4.54	3.65	-	-
Shallot	11.09	7.06	7.19	3.17
Tomato	5.10	-1.40	-	-5.29
Yard long bean	6.68	3.53	2.79	-
Overall vegetables	6.88	6.65	2.99	2.17

[1] The real prices were estimated by deflating the nominal prices with the consumer price index for the respective year.
- implies that the coefficient is not significant at the 15% level.
Source: Individual farm and wholesale vegetable prices were obtained from OAE (various issues[a], 1985-97) and OAE (various issues[c]). Overall farm vegetable price indices were obtained from OAE (1995), and overall wholesale prices were estimated from the individual prices using the Laysper price index.

During the 1990s, increase in overall real vegetable prices has been quite sharp, both at the wholesale and farm levels (Fig. 3). Demand pressure generated by the economically influential group (unaccompanied by breakthroughs in vegetable production) was a factor in pushing the real farm and wholesale vegetable prices up. A shift in vegetable cultivation to distant, more competitive places, raised transportation costs, and resulted in a sharper increase in wholesale prices. These trends will have serious negative implications for the consumption of vegetables by the low-income group.



Source: See footnote to Table 3.

Fig. 3. Trend in overall vegetable prices at the wholesale and farm gate levels.

Production Instability

Shortfalls in supply, and subsequent higher prices, motivate farmers to produce more. As a result, supply rises to excess, causing reduction in prices, which discourages farmers from producing, which in turn causes supply shortfalls and higher prices. This cycle, along with government's lack of interest and support to minimize such fluctuation, and the shortage of production technologies to mitigate the effects of environmental stress, cause great instability in vegetable area and production. The detrended coefficients of variation in vegetable area, production, and yield are a reflection of this (Table 4). Overall, vegetable area, production, and yield have higher CVs than rice, suggesting that vegetables are more risky to produce than rice.

Table 4. Detrended coefficients of variation (CV %) for major vegetables and rice area, production, yield, and prices[1]

Crop	Area	Production	Yield	Prices	
				Wholesale	Farm
Baby corn	33.3	37.0	32.4	25.0	12.3
Cabbage	19.6	16.1	8.0	19.8	9.5
Chili	30.1	24.2	40.4	8.9	14.5
Chinese cabbage	34.5	24.0	18.4	28.0	9.3
Chinese kale	16.5	13.3	8.2	-	-
Chinese leaf mustard	22.7	25.3	12.0	-	-
Chinese radish	26.4	21.0	12.4	-	-
Cucumber	11.4	20.0	16.0	11.9	12.1
Garlic	8.1	24.4	28.0	29.2	27.2
Kangkong	90.3	94.7	15.4	13.7	8.5
Onion	18.0	21.2	16.1	21.0	23.7
Pepper	19.9	36.9	34.5	-	-
Pumpkin	23.9	23.3	5.2	11.6	10.1
Taro	36.4	35.1	9.5	-	-
Tomato	30.5	30.3	16.9	14.0	7.3
Shallot shoot	24.2	24.0	21.9	7.5	18.9
Yard long bean	16.9	17.0	10.1	11.8	8.2
Other vegetables	32.4	38.5	24.7	-	-
Total vegetables	17.3	15.7	7.6	15.0	16.4
Rice	4.3	6.9	3.8	13.2	13.5

[1] The CVs for area, production, and yield for the period 1982-94; CVs for prices for the period 1984-96.
Source: See footnote Table 2 for area, production, and yield data on vegetables. See footnote in Table 3 for the individual and overall farm and wholesale vegetable prices.

The highest variability in individual vegetable production is in kangkong, perhaps because its cultivation mainly depends upon rain. With few exceptions, variability in area is greater than variability in yield in all individual and total vegetables, indicating that variability in production has more to do with area than yield. This suggests that policies, such as assured prices, could contribute

relatively more to stabilizing production. That said, technologies that make crops tolerant to biotic and abiotic stresses could also contribute significantly to stabilizing production.

Variation in vegetable production makes prices unstable. Vegetable prices, as a group, are less stable than rice prices, especially at the farm level. Interestingly, with few exceptions, farm gate vegetable prices are more stable than wholesale prices.

Seasonality in Prices

Low temperatures spur plant growth, and curb vegetable pests and diseases. This leads to higher yield and lower per unit production cost in winter than in summer. As a consequence, farmers favor growing vegetables in winter just after rice. The resulting increase in vegetable area in winter leads to lower prices for farmers, compared to prices paid in the rainy season and summer. This creates seasonality in vegetable production and prices.

Monthly price data show that vegetable prices are usually highest in the middle of the year (May–June), and lowest during September–December or January–March. The only exceptions are garlic, asparagus, and convolvulus. Seasonality in monthly vegetable prices ranges from 22% in asparagus (a perennial crop), to 175% in celery. Despite it being a fruit vegetable, the seasonality in chili prices is relatively high (Table 5).

Table 5. Seasonality in vegetable prices (average of 1989-93)

Vegetable	Month												Seasonality (%)
	1	2	3	4	5	6	7	8	9	10	11	12	
Angled loofah	100	105	93	90	127	115	96	103	109	103	97	98	41
Asparagus	100	101	96	93	89	95	94	99	98	97	105	109	22
Baby corn	100	92	97	101	96	93	58	86	91	91	95	102	76
Cauliflower	100	103	112	147	149	176	188	195	210	212	159	110	112
Celery	100	71	69	105	158	190	175	148	122	120	110	101	175
Chili	100	102	85	105	154	126	120	119	102	78	87	95	97
Chinese cabbage	100	84	85	108	136	149	137	123	111	131	115	99	77
Chinese radish	100	123	124	141	158	158	122	135	153	159	132	116	59
Cucumber	100	90	81	96	114	108	85	96	96	102	92	102	41
Garlic	100	89	69	67	77	76	88	87	85	80	85	87	49
Ginger	100	113	130	156	168	170	143	107	93	84	91	105	102
Hot pepper	100	99	82	87	111	88	74	91	70	68	67	71	66
Kale	100	92	82	116	140	153	92	101	98	139	139	80	91
Kangkong	100	110	83	93	96	83	87	89	99	108	108	98	33
Leaf mustard	100	96	95	120	145	158	148	140	128	141	121	108	66
Lettuce	100	90	77	123	166	189	118	119	119	114	108	94	145
Pakchoi	100	93	98	118	141	143	130	120	126	120	113	82	74

Contd. Table 5.

Vegetable	Month												Seasonality (%)
	1	2	3	4	5	6	7	8	9	10	11	12	
Pumpkin	100	95	100	105	109	117	96	87	91	88	98	90	34
Straw mushroom	100	81	78	93	103	102	108	142	130	134	123	123	82
Yard long bean	100	88	77	82	102	96	74	68	64	74	76	89	59

Source: OAE, various issues[b] (1989-93).

Prices of all vegetables as a group begin drifting up April, and reach their peak in May–June. Prices begin to decline in July, but do not drop below their average level until November–December. Prices remain low during December-March (Fig. 4).

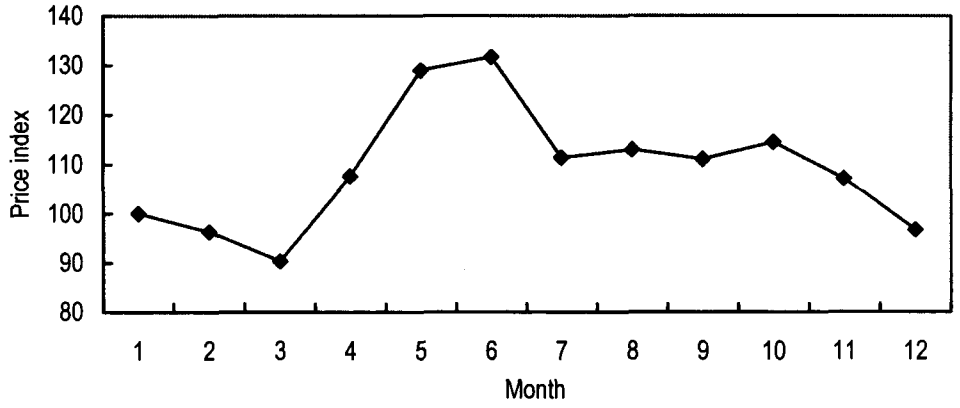


Fig. 4. Seasonality in total vegetable prices at the farm gate (average of 1987-93)

Production Management

Production Systems

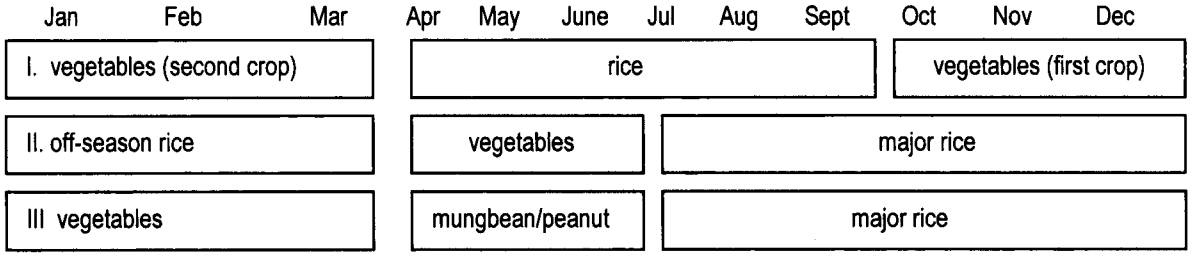
Land-preparation-based Classification

Vegetable production systems in Thailand can be classified based on type of land preparation, as follows:

Sorjon type. A distinctly large raised bed of 5-10 m breadth is commonly prepared throughout the length of the parcel. An irrigation/drainage ditch of about 1-m wide and deep is dug between the raised beds. Irrigation water is drawn from this ditch using either a primitive, manual watering tool or watering equipment similar to modern sprinklers, mounted on a small boat manually navigated.

This system is generally preferred in low-lying areas, suited for 3-5 crops in rotation in a year. Mostly leafy vegetables, cauliflower, chili, cucurbits, and beans are grown. Up to eight crops of early maturing vegetables, such as kangkong and multiplier onion, can be harvested in a year.

Bed type. Flat plots 1–1.5 m wide, elevated 10–15 cm, are used to grow vegetables before or after rice in all regions, but mostly in upland areas. Several cropping patterns are followed:



Farm-business-based Classification

Based on business type, vegetable farms can be classified into four groups:

Backyard Vegetable Gardening. Vegetables are grown primarily for subsistence on idle spaces of the farmstead. Produce in excess of what is needed for subsistence is sold for cash. The vegetables commonly grown are chili, eggplant, and pumpkin.

Vegetables as a Main Occupation. Various crops are cultivated and rotated all year round, depending on agroclimatic conditions, to satisfy market demand. The land is prepared using either furrows or beds. In this system, the vegetables (including green soybean, sweet corn, baby corn, processing tomato, asparagus, leafy vegetables, and others) are grown primarily for processing and for export. The system is quite intensive with respect to input use, and different farm operations, such as harvesting, grading, and packaging, are adjusted to meet the needs of either the processing or export market.

Seasonal Vegetable Cultivation. This is the main farm business where vegetables, including garlic, multiplier onion, onion, fresh tomato, and others, are normally grown, in the uplands and lowlands, after rice.

Use of Machinery

Small landholders usually rely on manual labor and draught power or small machinery. Larger vegetable farms, on the other hand, make use of modern, large farm machines to prepare the land (plow furrows), plant, and, wherever possible, harvest.

Machines are used to plant baby corn, but cobs are picked by hand. Shortage of labor is a serious problem in certain cropping seasons, especially when vegetable harvesting overlaps with the planting of field crops. This problem requires the urgent attention of researchers.

Most vegetables are transplanted, which saves seed, reduces crop length in the field, and facilitates other crop operations. Transplanting requires, however, much more labor than direct seeding, although under-employed family members supply most of this labor. Some large holders hire labor for transplanting.

Economics of Production

Cost of production is generally divided into fixed cost and variable cost. Fixed cost, in our case, includes land tax, rent, and depreciation of farm equipment, while variable cost includes labor and power, and farm supplies, including seeds, compost, chemical fertilizers, pesticides, and miscellaneous items.

Based on a cost survey conducted on 16 vegetables, asparagus has the highest per hectare cost of cultivation. Although roselle is not costly to produce, its low yield makes its unit output cost very high. Other high value crops in terms of per unit output cost are asparagus, chili, garlic, and green soybean (Table 6).

Table 6. Economics of vegetable cultivation (THB/ha) in Thailand, 1992

Crop	Fixed Cost (THB)		Variable Cost (THB)			Total cost (THB)	Yield (kg/ha)	Gross income (THB)	Net benefit (THB)	Cost/kg (THB)	Benefit /cost ratio
	Tax & land rent	Depreciation	Labor & power	Farm supplies	Miscellaneous						
Asparagus	709	1793	61575	53890	10238	128205	8658	223215	95010	14.8	74.1
Baby corn	1031	300	7193	6963	1104	16591	12602	30497	13906	1.3	83.8
Bamboo shoot	20	2965	1908	3153	552	8598	6176	18652	10054	1.4	116.9
Chili	1208	2152	38312	23296	3097	68065	6695	140649	72584	10.2	106.6
Garlic	1564	1846	19485	33370	3038	59303	4101	79963	20660	14.5	34.8
Ginger	1338	226	12402	22532	1807	38305	6823	48275	9970	5.6	26.0
Green soybean	2458	214	35719	16511	1636	56538	5607	67286	10748	10.1	19.0
Lady's finger	2505	2072	40024	31120	9596	85317	12421	99366	14049	6.9	16.5
Onion	1287	1923	21957	24366	2313	51846	16396	132155	80309	3.2	154.9
Roselle (dry)	1789	547	8839	296	302	11773	384	13433	1660	30.7	14.1
Shallot	2190	2406	22179	55017	3555	85347	11271	93996	8649	7.6	10.1
Taro	3084	806	38357	36073	5011	83331	21166	110523	27192	3.9	32.6
Tomato	1970	87	16798	10990	1077	30922	25242	42911	11989	1.2	38.8
Watermelon	307	502	6761	13328	441	21339	16328	32819	11480	1.3	53.8
Yard long bean	535	1274	16428	13646	3120	35003	8580	67695	32692	4.1	93.4
Yam bean	1258	422	7498	1890	428	11496	27543	24902	13406	0.4	116.6
Rice	-	-	-	-	-	6235	2350	8704	2469	2.7	39.6

Source: Office of Agricultural Economics (1993b).

In most vegetables, the largest cost items are labor and farm supplies. However, the relative importance of these two varies across vegetables (Table 7).

Thai farmers choose to grow a cash crop, such as vegetables, if it gives more net return under the given resources available to the household (Benchaphun 1985). As seen in the previous section, when grown under optimal conditions vegetables produce higher net returns than cereals. Low vegetable production in the country, therefore, is believed to be due to lack of farming experience, unsuitable land, and unavailability of capital and labor required for vegetable cultivation. Very little is known about the extent and nature of these constraints in Thailand.

Table 7. Factor share (%) in vegetable production, 1992

Crop	Tax and land rent	Depreciation	Labor	Farm supplies	Miscellaneous
Asparagus	0.6	1.4	48.0	42.0	8.0
Baby corn	6.2	1.8	43.3	42.0	6.7
Bamboo shoot	0.2	34.5	22.2	36.7	6.4
Chili	1.8	3.2	56.2	34.2	4.6
Garlic	2.6	3.1	32.9	56.3	5.1
Ginger	3.5	0.6	32.4	58.8	4.7
Green soybean	4.3	0.4	63.2	29.2	2.9
Lady's finger	2.9	2.4	47.0	36.5	11.2
Onion	2.5	3.7	42.3	47.0	4.5
Roselle (dry)	15.2	4.6	75.1	2.5	2.6
Shallot	2.6	2.8	26.0	64.4	4.2
Taro	3.7	1.0	46.0	43.3	6.0
Tomato	6.4	0.3	54.3	35.5	3.5
Yard long bean	1.5	3.6	47.0	39.0	8.9
Yam bean	10.9	3.7	65.3	16.4	3.7
Watermelon	1.4	2.4	31.6	62.5	2.1

Source: Estimated from data reported in Table 6.

Although farmers are quick to make adjustments in cropping pattern according to the market situation, shifts from lower to higher value crops are not always accompanied by a parallel change from traditional to more modern cultivation techniques, especially if such technologies are difficult to afford. In such cases, expansion in the output of new crops is attempted using low-cost inputs and fairly traditional techniques. This indicates that the low yields recorded for most vegetables in Thailand are not necessarily the result of a lack of innovation or dynamism on the part of Thai farmers. On the contrary, they probably reflect farmers' response to the relatively high prices of modern technologies, and lack of resources to adopt these technologies.

Marketing

Wholesale Markets in Bangkok

In terms of significance and volume of transactions, Bangkok is the central market for major vegetables. Supplies of important and high-value vegetables are collected in the Bangkok central market before being redistributed to the provincial markets and sent for export.

Five wholesale markets located in metropolitan Bangkok are:

Ongarntalard Market

Ongarntalard Market is 8800 m^2. It is a semi-government institution directed by a governing board, including a number of prominent government officials attached to the Interior Ministry.

Yodbhimarn Market

Yodbhimarn Market is 14,400 m^2. It is a private-run business located adjacent to the aforementioned Ongarntalard Market.

Songsermkaset-Thai Market

Songsermkaset-Thai Market adjoins the Yodbhimarn Market. It is a private enterprise focused on creating opportunities for farm producers and upcountry assemblers to sell their own vegetables.

Warehouse Organization Market

As the name suggests, this market belongs to the Internal Trade Department's Warehouse Organization. The market is 2800 m^2, and employs a manager who is in charge of supervising activities and providing facilities for both sellers and buyers. The market provides a place for farmers to conduct their own trade and bargain a good price for their produce.

Northern Simummeung Market

Northern Simummeung Market is a central market established recently near northern Bangkok's major transport routes. This is a main receiving and distributing depot for vegetables and fruits from the north, northeast, and central regions. It is the biggest (2 km^2) semi-government wholesale market in the country. Like Ongarntalard, it is a marketplace for farmers and provincial brokers.

Wholesale Business Characteristics

Most vegetable trade is conducted by sole proprietorships, and the rest by partnerships and corporations. About one-third of traders own a means of transport, such as a pickup truck or six-wheel truck. The manual two-wheelers, owned by one out of two traders, are used for hauling, loading, and unloading vegetables. Materials commonly used for packing vegetables include bamboo baskets of different sizes, plastic bags, and plastic ropes. An average vegetable trader requires 25 bamboo baskets and 2.5 kg of plastic bags daily (OAE 1993a).

Marketing Channels

The three main marketing channels for vegetables are as follows:

Marketing Channel Involving a Central Market

Most vegetables are delivered through this channel. Neighboring farmers combine their produce and sell it in a central market, or sell it to a village assembler, who takes it to a central market. From the central market, the Bangkok or provincial wholesalers purchase the produce and then sell it to retailers. Some output goes for export, by way of a processor or a Bangkok wholesaler (Fig. 5).

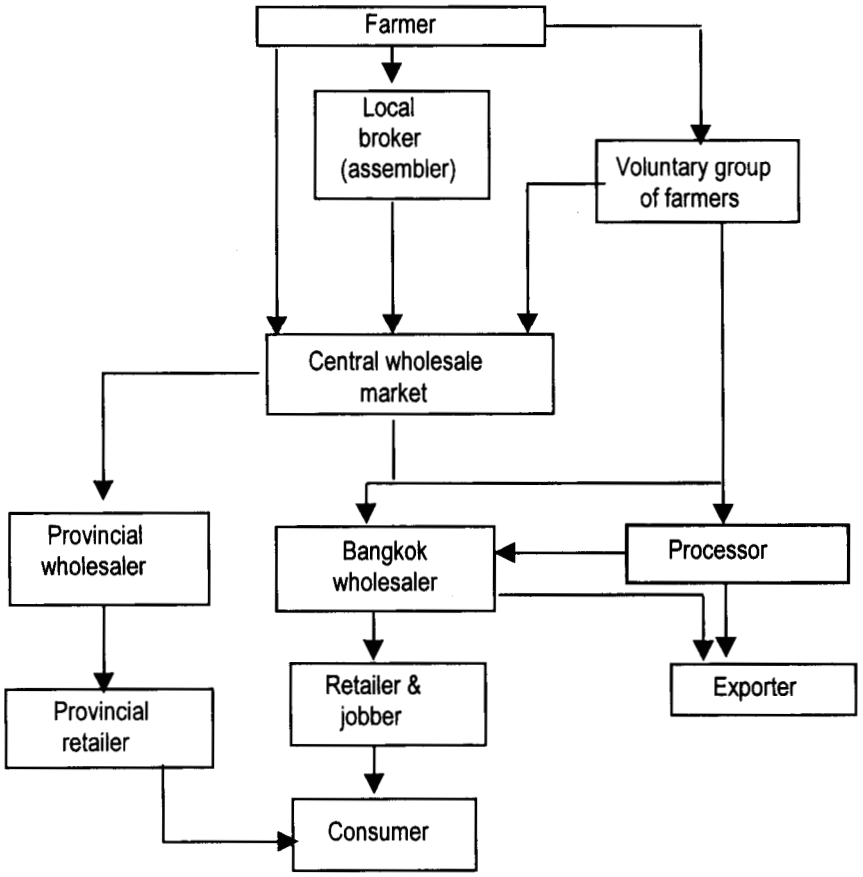


Fig. 5. Marketing channel involving a central market for fresh vegetables.

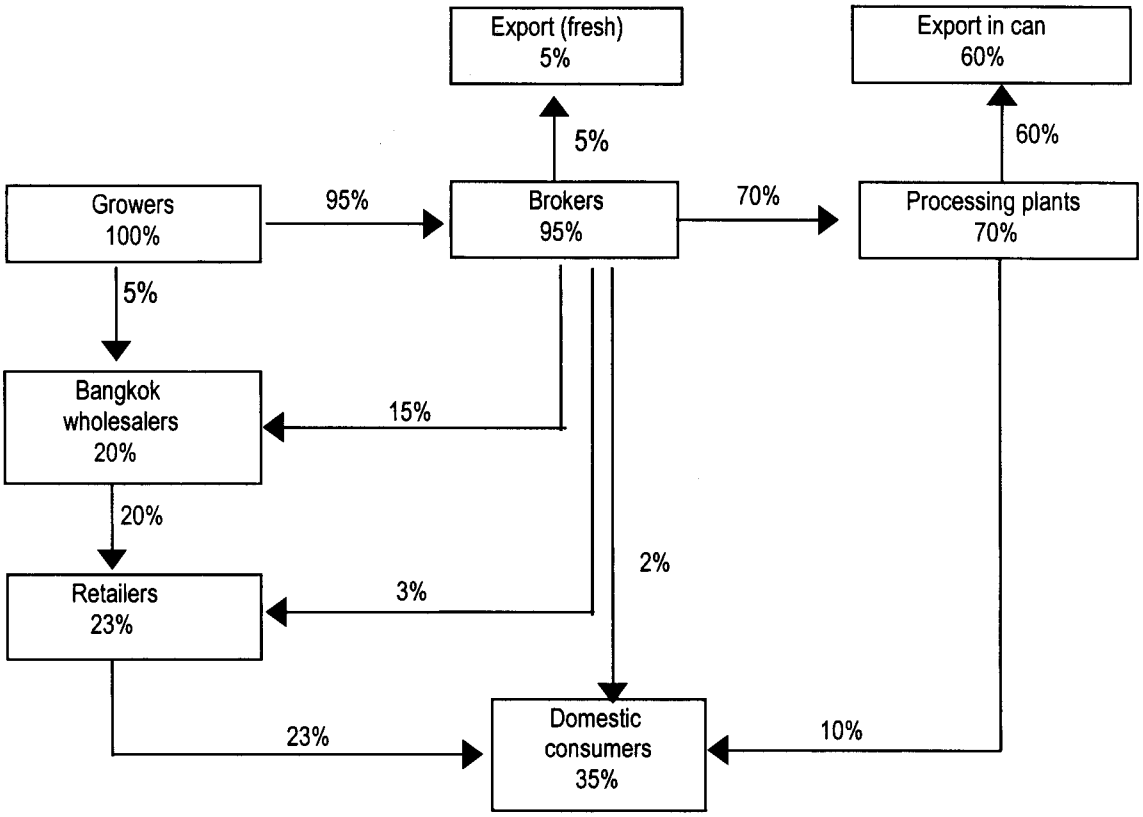
Marketing Channel Not Involving a Central Market

In this channel, farmers sell their vegetables at their farms, either to village assemblers, provincial wholesalers, processors, or directly to exporters. Some farmers haul their produce to a vegetable trader or processor. Some farmers enter into contracts to supply their vegetables exclusively to a particular processor or exporter.

The village broker or assembler might sell his produce to a wholesaler or processor. The wholesaler in turn sells the produce to retailers, or processors and exporters.

This marketing channel handles vegetables (tomato, sweet corn, baby corn, bamboo shoot, white asparagus for canning, green asparagus, lady's finger, potato, and others) mostly destined for processing and export. An example of this type of marketing channel is shown in Figure 6 for baby corn.

In the case of onion and potato, members of growers' cooperatives sell their produce through their cooperative's managers who negotiate with assemblers and processors. Other farmers sell to assemblers and processors directly.



Source: APO (1989).

Fig. 6. Marketing Channel for fresh baby corn, 1986.

Direct Channel

In this channel, growers sell their vegetables directly to consumers in their locality or in the provincial market. Most of the produce is consumed within the province. This channel handles sweet potato, taro, and other root and tuber vegetables.

Marketing Margins

Estimates of marketing margins are not available for many vegetables passing through the different marketing channels. Thus, the causes of the large differences in producer and consumer prices, and degree of monopoly power in vegetable marketing, if any, cannot be determined. Estimates for onion and bamboo shoot suggest that cooperative marketing increases farmers' share of the consumer price. In the case of onion exported through farmers' cooperatives, the farm production cost and farmers' profit account for 41% of the consumer price, freight charges account for 36%, while the growers' cooperative retains 14% of the margin. Internal transportation, port charges, taxes, labor, and other charges account for the remaining 9%. Similarly, cost of production of bamboo shoot contributes 35% of the consumer price, and farmers retain 22% as profit margin. In turn, traders account for a marketing cost of 24%, with a profit margin of 19% (OAE 1993b).

Estimates suggest high losses during transportation of vegetables from one marketing stage—as high as 20% or more in the case of Chinese cabbage, Chinese kale, and coriander. Post-harvest losses are usually higher when vegetables are transported from the wholesale to the retail level, as compared to when they are transported from the farm to the wholesale level (Table 8).

Table 8. Post-harvest losses (%) in selected vegetables

Vegetable	Farm to wholesale	Wholesale to retail	Total
Cabbage	4.20	11.09	15.29
Chinese cabbage	15.40	4.89	20.29
Chinese kale	8.84	12.42	21.26
Chive	5.83	10.24	16.07
Coriander	16.20	7.62	23.82
Cucumber	6.40	7.21	13.61
Fresh chili	7.40	8.46	15.86
Green onion	9.80	9.82	19.62
Lettuce	5.50	6.80	12.30
Luffa	4.70	8.09	12.79
Tomato (small fruit)	10.22	9.49	19.71
Yard long bean	7.80	4.09	11.89

Source: APO (1989).

International Trade

Thailand enjoys a surplus in vegetable trade, both in quantity and value, and the surplus increased at an annual rate of 13.9% and 23.3%, respectively, during 1983-94. This is because the quantity and value of exports increased at a much higher rate, 13.6% and 22.9%, respectively, compared to the quantity and value of imports, which grew at 8.3% and 18.9%, respectively, during this period (Table 9).

Table 9. International trade in vegetables, 1983-94

Year	Imports					Exports					Surplus
	Fresh	Frozen	Preserved	Dried	Total	Fresh	Frozen	Preserved	Dried	Total	
						Quantity (t)					
1983	64	19	66	3678	3827	24477	65	29869	3653	58064	54237
1984	90	31	140	5188	5449	27297	194	34701	2892	65084	59635
1985	61	24	152	3802	4039	24578	127	46608	5898	77211	73172
1986	68	46	161	3811	4086	22332	48	58007	9701	90088	86002
1987	62	27	1376	6878	8343	23930	333	106675	7104	138042	129699
1988	95	52	548	4699	5394	39374	2665	115189	5326	162554	157160
1989	38	43	759	4861	5701	37468	8767	131306	4098	181639	175938

Contd. Table 9.

Year	Imports					Exports					Surplus
	Fresh	Frozen	Preserved	Dried	Total	Fresh	Frozen	Preserved	Dried	Total	
1990	700	76	2523	5085	8384	35562	14870	140721	2870	194023	185639
1991	219	68	2819	4140	7246	35573	18955	201292	2612	258432	251186
1992	958	66	5168	3689	9881	38548	23600	167838	3628	233614	223733
1993	1430	118	4782	4424	10754	22747	14484	65480	1750	104461	93707
1994	949	122	6655	5023	12749	46432	34737	214055	2308	297532	284783
Growth (%)	35.1	17.0	54.1	0.5	8.3	4.3	92.3	16.4	-7.6	13.6	13.9
						Value (million THB)					
1983	1.9	0.7	1.5	94.9	99.0	145.4	2.1	396.5	33.6	577.6	478.6
1984	2.9	1.3	5.1	119.2	128.5	168.1	3.6	424.8	43.7	640.2	511.7
1985	2.3	0.9	6.7	98.7	108.6	168.7	4.3	624.3	81.3	878.6	770.0
1986	3.5	1.7	6.1	74.6	85.9	134.9	2.0	943.0	123.3	1203.2	1117.3
1987	3.9	0.9	26.7	66.6	98.1	173.3	15.1	1892.0	105.2	2185.6	2087.5
1988	4.3	2.0	16.1	64.9	87.3	300.1	70.5	1954.0	64.4	2389.0	2301.7
1989	2.9	1.6	30.1	95.5	130.1	465.4	169.6	2317.5	66.1	3018.6	2888.5
1990	15.5	3.0	77.0	109.8	205.3	630.6	268.8	2680.1	67.8	3647.3	3442.0
1991	43.7	2.5	105.1	111.5	262.8	607.3	476.3	4072.8	90.7	5247.1	4984.3
1992	218.6	3.4	192.8	107.5	522.3	751.7	741.6	3570.4	108.7	5172.4	4650.1
1993	302.9	4.5	156.9	110.9	575.2	437.0	373.6	1375.8	92.9	2279.3	1704.1
1994	218.5	5.0	191.6	154.3	569.4	1016.9	924.7	4021.8	124.5	6087.9	5518.5
Growth (%)	64.4	18.3	55.1	3.3	18.9	20.1	88.9	22.0	7.4	22.9	23.3

Sources: Estimated from data reported in Department of Customs (various issues, 1984-95).

The vegetables traded in the international market can be classified into four groups: fresh, frozen, preserved (in vinegar or other than vinegar in different types of containers), and dried. During 1983-94, the highest increase in exports came from frozen vegetables, while the quantity of dried vegetables exported decreased, although their value increased. The highest increase in imports was in preserved vegetables (Table 9).

The share of dried vegetables in import value declined steadily, while the share of fresh vegetables increased steadily during 1983–1993. The share of preserved vegetables increased during the period. Frozen vegetable imports remained small (Table 10).

Preserved vegetables have accounted for 60-87% of the value of total vegetable exports in different years. The value shares of fresh and dried vegetable exports declined during 1983-94, while the value share of frozen vegetables increased steadily (Table 10).

Table 10. Share of various categories of vegetables in total import and export values, 1983–1994

Year	Imports				Exports			
	Fresh	Frozen	Preserved	Dried	Fresh	Frozen	Preserved	Dried
1983	1.9	0.7	1.6	95.8	25.2	0.4	68.6	5.8
1984	2.3	1.0	3.9	92.8	26.3	0.6	66.3	6.8
1985	2.1	0.8	6.1	91.0	19.2	0.5	71.0	9.3
1986	4.0	2.0	7.1	86.9	11.2	0.2	78.3	10.3
1987	3.9	0.9	27.2	68.0	7.9	0.7	86.6	4.8
1988	5.0	2.3	18.4	74.3	12.6	3.0	81.7	2.7
1989	2.2	1.2	23.2	73.4	15.4	5.6	76.8	2.2
1990	7.6	1.5	37.5	53.4	17.3	7.4	73.4	1.9
1991	16.6	1.0	40.0	42.4	11.6	9.1	77.6	1.7
1992	41.9	0.7	36.9	20.5	14.5	14.3	69.1	2.1
1993	52.7	0.8	27.3	19.2	19.2	16.4	60.3	4.1
1994	38.4	0.9	33.6	27.1	16.7	15.2	66.1	2.0

Source: Estimated from data reported in Table 9.

More than 40 vegetable products are being traded internationally each year. Among the fresh vegetables, onion and shallot, lady's finger, chicory, asparagus, and salad beet root are the leading vegetable exports, while bamboo products and sweet and baby corn are the major preserved vegetable exports. Frozen beans are a major export, as well as a major import, which suggests that they are being imported mainly for re-export. The same is true for salad beet root. Peas and mushrooms and turfs are the major dried vegetable import (Table 11).

Table 11. Contribution of important vegetables in the international trade of vegetables, 1994

Item	Export	Import
Fresh and chilled	100.0	100.0
Onion and shallot	21.5	-
Lady's finger	16.5	-
Chicory	14.4	-
Asparagus	14.2	-
Salad beet root	13.1	93.6
Frozen	100.0	100.0
Mixture	36.9	14.3
Beans	29.1	61.1
Other leguminous vegetables	5.6	15.7
Sweet corn	5.2	-

Contd. Table 11.

Item	Export	Import
Preserved	100.0	100.0
Bamboo shoot	30.0	-
Sweet and baby corn	24.2	-
Tomato	6.9	15.0
Mushrooms and truffles	6.6	15.2
Other vegetables in airtight containers	14.7	-
Dried	100.0	100.0
Peas	-	33.3
Shallots	10.0	6.0
Bamboo shoots	3.9	9.9
Mushrooms and turfs	3.7	22.3

Source: Estimated from data reported by Department of Customs (1995).

Thailand's exports are narrowly focused on the Japanese market. Imports come from more diverse sources, although individual import categories have narrow origins (Table 12).

Table 12. Direction of vegetable trade during 1994

Fresh		Dried		Frozen		Preserved	
Country	Share (%)	Country	Share (%)	Country	Share (%)	Country	Share (%)
				Export			
Japan	75.1	Japan	44.4	Japan	64.1	Japan	37.5
Malaysia	9.9	S. Korea	17.6	United Kingdom	8.7	USA	26.1
United Kingdom	3.4	USA	9.7	Hong Kong	5.1	Australia	5.2
Taiwan	2.1	Australia	8.6	USA	3.0	Germany	4.6
Netherlands	2.0	Germany	4.5	Taiwan	2.6	United Kingdom	3.8
Others	7.5	Others	15.2	Others	16.5	Others	22.8
				Import			
Taiwan	95.2	China	68.2	New Zealand	60.3	China	55.7
Others	4.8	Canada	8.8	Japan	14.1	Vietnam	22.0
		New Zealand	5.4	USA	9.5	Others	22.3
		Others	17.6	Others	16.1		

Source: Department of Customs (1995).

A wide variety of temperate vegetables are being produced in Thailand. But so far, little of their export potential has been exploited. The major constraints to exploiting export markets are: i) high production cost, ii) lack of a consistent supply of good quality produce, iii) insufficient quality control, and iv) stringent quality restrictions by importers.

High cost of production makes certain vegetables noncompetitive in the international market. For example, an analysis of onion production indicated that cost per unit of output is higher in Thailand than in mainland China and New Zealand. Thus, onions from these two countries are available in

Thailand during the off season when prices of the imported onions make them more attractive than local onions, despite a 158% import tariff.

An important characteristic of Thailand's vegetable production is that most is grown for the local market, and the export and processing markets often take what is left. The local vegetable market has been protected by a tariff as high as 46% (World Bank 1987), which has restricted healthy competition. Primitive post-harvest technologies prevent the industry from meeting export quality requirements.

Supply and Demand

Per Capita Availability

Per capita annual vegetable availability in Thailand ranged from 31 to 58 kg (or 84-159 g/day) during 1983-94. The worst years with respect to availability were 1987 and 1988, due to setbacks in production. Unlike cereals, the wide variation in vegetable availability suggests government and consumer insensitivity to the consumption level of vegetables. Excluding the worst years, availability ranged from 45 to 58 kg, without significant gains throughout the decade (Table 13).

Table 13. Per capita availability of vegetables in Thailand, 1983-94

Year	Production (million t)	Trade surplus (million t)	Net availability (million t)	Population (million)	Per capita availability (kg)
1983	2.946	0.053	2.893	49.680	58.2
1984	2.977	0.059	2.918	50.637	57.6
1985	3.008	0.073	2.935	51.189	57.3
1986	3.040	0.085	2.955	52.382	56.4
1987	1.777	0.129	1.648	53.421	30.8
1988	1.994	0.157	1.837	54.417	33.8
1989	2.855	0.176	2.679	55.425	48.3
1990	3.005	0.186	2.819	56.096	50.3
1991	3.167	0.251	2.916	56.532	51.6
1992	2.815	0.224	2.591	57.375	45.2
1993	2.720	0.094	2.626	58.083	45.2
1994	3.382	0.285	3.097	58.716	52.7
Growth rate (%)	0.832^{ns}	12.997	0.873^{ns}	1.544	-1.236^{ns}

Source: For the source of production data see Table 2; vegetable surplus is taken from Table 9, while population of Thailand is taken from OAE (1995).

ns implies that the growth rates are not significant at the 10% level.

Consumption

Since 1962, only three consumption surveys have been conducted in Thailand. The latest was in 1986, which found that Thais consume an average of 742 g of all foods every day. Average daily consumption of vegetables is 106 g, which accounts for 14% of the total food consumed. The fruit consumption is lower than vegetable consumption. Typical of Southeast Asia, food in Thailand is dominated by cereals followed by meat and meat products (Table 14).

Table 14. Consumption of major food items in Thailand (g/day), 1986

Food Item	Urban	Rural	Overall
Rice and other starch	297.6 (37.1)	360.4 (49.9)	336.5 (45.4)
Meat and meat products	149.9 (18.7)	103.3 (14.3)	121.2 (16.3)
Vegetables	107.5 (13.4)	105.5 (14.6)	106.3 (14.3)
Fruits	108.0 (13.5)	71.1 (9.8)	85.3 (11.5)
Fat	29.6 (3.7)	19.1 (2.6)	23.2 (3.1)
Sugar	12.9 (1.6)	9.1 (1.3)	10.5 (1.4)
Milk	12.3 (1.5)	3.0 (0.4)	6.6 (0.9)
Others	84.0 (10.5)	51.5 (7.1)	52.8 (7.1)
Total	801.8 (100.0)	723.0 (100.0)	742.4 (100.0)

The figures in parentheses represent the percentage share of the total food.
Source: Department of Health, Ministry of Public Health, and School of Public Health, Mahidol University (1995).

Per capita food consumption is significantly higher in urban areas than in rural areas. Rural people consume more cereals, while urban people consume more meat products, fruits, fats, sugar, and miscellaneous other products. The difference in vegetable consumption is not significant (Table 14).

The consumption survey in 1986 suggested that bamboo shoots, Chinese cabbage, cucumber, kangkong, and string beans are major vegetables consumed in Thailand, in both rural and urban areas (Table 15).

Table 15. Consumption of major vegetables (g/day)

Food Item	Urban	Rural	Overall
Angle gourd	4.21	3.31	3.60
Asparagus	1.14	0.00	0.44
Bamboo shoots	8.64	5.35	6.61
Bean sprouts	3.69	3.24	3.41
Cauliflower	3.35	1.69	2.23
Chili	2.29	1.88	2.10
Chinese cabbage	9.67	6.58	7.77
Coriander	0.49	1.26	0.96
Cucumber	9.68	13.67	12.13
Eggplant	5.27	5.73	5.56
Garlic and ginger	0.14	0.51	0.37
Jack fruit (young-raw)	0.24	2.73	1.77
Kale	4.87	2.38	3.34
Kangkong	6.67	7.54	7.21
Mushroom	0.96	3.53	2.53
Mustard	3.52	1.86	2.49
Onion	2.42	1.99	2.16

Contd. Table 15.

Food Item	Urban	Rural	Overall
Papaya (raw)	1.21	5.07	3.58
Peas	1.63	0.00	0.63
Pumpkin	1.44	1.19	1.28
Snake gourd	0.44	0.21	0.30
Spinach	0.29	0.07	0.16
String beans	7.15	7.37	7.29
Tomato	2.43	1.30	1.74
Wax gourd	2.28	2.64	2.50
Others	23.41	24.43	24.15
Total	107.53	105.53	106.31

Source: Department of Health, Ministry of Public Health, and School of Public Health, Mahidol University (1995).

Estimation of the consumer expenditure function for vegetables, both in urban and suburban districts in Bangkok, suggests that the income elasticities of leafy vegetables are higher in urban areas than in suburban areas, and that the opposite is true for fruit and root vegetables (Table 16).

Table 16. Income elasticities of vegetables in Bangkok urban and suburban areas, 1982

	Income elasticities
Urban	
Expenditure for leafy vegetables	0.5312
Expenditure for fruit vegetables	0.1619
Expenditure for root vegetables	0.2200
Suburban	
Expenditure for leafy vegetables	0.4203
Expenditure for fruit vegetables	0.5594
Expenditure for root vegetables	0.5911

Source: Eamkitsumrit (1984).

Thais, especially children and more specifically female children in rural areas, suffer a high incidence of anemia (Table 17). As vegetables are the cheapest source of minerals and vitamins (Ali and Tsou 1997), increased consumption of these can be an economical way to correct deficiency.

Table 17. Prevalence of anemia (% of the total population) in Thais by age and sex

Age group	Male			Female		
	Urban	Rural	Overall	Urban	Rural	Overall
0-1	73	75	74	58	80	73
2-5	29	40	37	30	42	37
6-9	53	73	64	43	54	51
10-14	40	27	31	17	67	44
15-19	25	10	14	42	48	45
20-59	2	6	5	22	20	21
60+	25	30	28	25	65	48
Pregnant women	-	-	-	41	40	40

Source: Department of Health, Ministry of Public Health, and School of Public Health, Mahidol University (1995).

Vegetable Research

Vegetable research in Thailand is conducted by a number of government agencies, and, lately, by a few big private corporations, which concentrate on high-value crops. The Department of Agriculture focuses mainly on variety improvement, crop pest and disease prevention and management, soils, and fertilizer use with the ultimate goal of lowering per-unit cost of production. Aside from the Department of Agriculture, other major research organizations working on vegetables include the research departments of various universities, the Ministry of Science, Technology and Energy, and the National Research Council. The Office of Agricultural Economics is responsible mainly for commodity analysis and development plans.

Since 1974, the Vegetable Research and Development Group has been functioning under the National Research Council. In 1980, the group, which includes research and development officers from the government and universities, became a subcommittee of the National Research Council of Thailand. Now there are five working parties in the subcommittee focused on tomato, brassica, legumes, baby corn, and fruit vegetables. In addition, the Ministry of Agriculture and Co-operatives has two working groups, one focused on alliums and the other on vegetables for export. The working and groups subcommittees promote their respective crops and work to control supply fluctuations. The latter objective involves a bid to enforce zoning in production (Department of Business Economics 1987), and the recommendation of specific crops in the light of price projections. In the case of onion, loans to growers for cold storage and restrictions on seed imports are additional tools of control.

Summary and Conclusion

Vegetables hold an important place in Thai agriculture and are important to the country's dietary well being. Vegetables are grown on 353 thousand ha, producing 3.4 million t , worth 25 billion THB. Per capita annual availability amounts to about 53 kg (14% of all food consumed). In terms of consumption, this figure is far below the 73 kg recommended by AVRDC. This has caused serious health problems, such as anemia, especially among women and children. For example, 37-74% of children and 40% of pregnant women were found to have anemia in Thailand.

Despite the health consequences of low vegetable consumption, no serious attempt has been made to increase vegetable supply. Production has remained stagnant, and per hectare yield has been on a declining trend during the 1990s. This has created a demand pressure on vegetables as incomes and population have continued to grow, and has resulted in higher vegetable prices in real terms, both at the farm gate and wholesale levels. Although the country enjoys a surplus in international trade of vegetables, and exports continue to rise, the share of vegetables going for export is still negligible relative to total production. Revitalization of the vegetable sector will require commercialization of the agriculture sector in general and the vegetable sector in particular, coupled with continuous introduction of low-cost production techniques.

Poor, small landholders with high production costs, lack of suitable varieties and appropriate technology (including good quality seed), and the absence of an auction mechanism in the wholesale markets are the major problems facing Thailand's vegetable industry. To resolve these issues, an extensive vegetable research and development program on all aspects of vegetable production, distribution, and consumption is needed.

Currently, certain types of the vegetable seeds are domestically produced, collected, and distributed. Some quantities of hybrid seeds and seeds of some subtropical and temperate vegetables are also produced. Despite this, imports of vegetable seeds in 1988 amounted to 634 t (OAE 1989). A study on the constraints to vegetable seed production, along with government policies to encourage vegetable seed production, could save foreign exchange and help to boost vegetable productivity.

Vegetable production is shifting from areas close to cities to more distant areas with a comparative advantage, as vegetable dealers are able to transport produce. This, however, has pushed wholesale prices higher, despite a common notion that market arrangements have improved. Constraints and potential of production and marketing of leafy vegetables (from peri-urban production areas) and fruit and bulb vegetables (from provincial locales) need to be evaluated.

The vegetable farm decision-making process needs further investigation to facilitate economic planning. Farm-level production and socioeconomic constraints should be quantified and ranked on a regional basis to help better understand farm resource allocation decisions.

Wide fluctuations in vegetable production were observed. Development of pest and disease resistant varieties and stress tolerant management practices could boost and stabilize vegetable production. This should be combined with policies designed to stabilize vegetable area. More research and development are needed on processing in order to reduce high seasonality in prices and improve quality. This could also generate substantial additional employment and income for rural and urban poor.

Given the changing economy, accentuated by implementation of the GATT, an impact study on vegetable trade is urgently needed. The study should determine the competitiveness of various regions. For this, the economics of vegetable production and distribution, post-harvest activities, and the processing industry need to be quantified for individual vegetables at the regional level. Thailand's competitiveness in the exportation of fresh and chilled vegetables could be improved through quality control and more research into post-harvest technologies, with due emphasis on technology transfer.

Vegetable marketing is a big black box largely untouched by researchers. Studies on alternative marketing systems, with the goal of suggesting marketing reforms, are urgently needed. The studies should quantify marketing margins, itemize losses as vegetables pass through marketing stages, shed light on the power of marketing agents, and explore consumer preference. Research is needed into the factors affecting the supply and demand of vegetables.

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