

Review of Economic Researches on Vegetables in Taiwan and Future Perspects

*Joyce Jong-Wen Wann and Tso-Kwei Peng**

I 、 Introduction

In Taiwan, vegetables have been an important crop group, ranking forth in farm value next to rice, hogs, and fruits. It provided an annual average of NT\$26.6 million through the 1980s. In addition, vegetables are rapidly growing farm enterprises among Taiwan's relatively declining agriculture.

This article intends to give an overview of past research achievements in the area of vegetable economics. Based on the summary of the performance of agricultural economics research related to vegetables, a number of economic issues important to future viability of vegetable farms and development of the industry will be raised. Then, suggestions on further research areas and topics in vegetable industry are proposed.

* The authors are associated professor and professor in the Research Institute of Agricultural Economics, National Chung-Hsing University, Taichung, Taiwan, R.O.C.

**Paper presented in the workshop on Agricultural Economics Research on Vegetable Production Systems and Consumption Patterns in Asia, October 11-13, 1994, Bangkok, Thailand.

II 、 Historical Situation of Taiwan Vegetable Economy

There are hundreds of vegetable species being grown in Taiwan which can be classified into four categories based on the edible part of plants, i.e., leaf, stem, root, as well as flower and fruit. The relative importance of classified vegetables in terms of annual production and value are listed in table 1. Among the four groups of vegetables, stem vegetables lead in both production and value of production presently, followed by fruit, leaf and root vegetables. Root vegetables has the most steady status relative to all other vegetables. The importance of leaf vegetables is very stable accounted 22% ~ 25% of total vegetable production over the 1982-92 period. However, both the production and value of fruit vegetables declined to near 20 percent to total vegetables. Overall speaking, the total production of vegetables has decreased year by year, its total annual value has moved up fastly and continuously.

The main market for Taiwan vegetables is domestic individual purchases, accounted for near 90 percent of total production. Foreign sales are low in average and limited to canned vegetables such as tomatoes, mushrooms, asparagus, and bamboo shoot, as well as some fresh and frozen vegetables. On the other hand, Taiwan also imports vegetables in many varieties each year with onions and potatoes are the two primary items. In the year of 1992, 7% of the vegetable production were exported, while 598,480 m.t. equivalent to 21.19% of 1992 total production of vegetables were imported. Hence, total demand for all vegetables in Taiwan were over 3 million m.t. and/or average of 115 kilograms per person in 1992.

According to table 2, the food consumption pattern in Taiwan in the last three decades had changed tremendously. Per capita consumptions on vegetables and meats have increased from 16.04 kg. and 56.16 kg. in 1962

Table 1 Production and Value of Taiwan Vegetables by Product Group, 1982-92

Unit: 1,000 tons, million NT\$, %

Items Year	Leaf		Stem		Root		Fruit and Flower		Total ¹	
	Production	Value	Production	Value	Production	Value	Production	Value	Production	Value
1972	510.0 (30%)*	929.1 (21%)*	452.3 (27%)*	2045.1 (45%)**	192.7 (11%)*	287.6 (6%)**	548.6 (32%)*	1265.5 (28%)**	1703.7	4527.4
1977	680.8 (26%)	2458.8 (20%)	608.4 (24%)	4371.1 (36%)	279.1 (11%)	914.2 (7%)	978.1 (38%)	4259.6 (35%)	2587.2	12260.6
1982	757.8 (25%)	4489.6 (17%)	739.6 (24%)	8253.5 (32%)	286.7 (9%)	1297.0 (5%)	875.9 (29%)	8056.3 (31%)	3044.1	22096.4
1983	694.7 (23%)	5428.9 (20%)	719.1 (24%)	8283.4 (31%)	272.8 (9%)	1584.1 (6%)	978.2 (32%)	6754.4 (25%)	3018.7	26555.0
1984	750.7 (22%)	4258.7 (16%)	824.3 (24%)	9182.2 (35%)	315.4 (9%)	1427.4 (5%)	11172.5 (34%)	6308.7 (24%)	3416.4	26494.1
1985	729.5 (22%)	4564.8 (17%)	805.1 (25%)	8443.1 (32%)	291.0 (9%)	1433.9 (5%)	11002.2 (31%)	6425.5 (24%)	3243.4	26506.5
1986	724.3 (23%)	5134.1 (19%)	745.9 (24%)	8084.1 (30%)	266.5 (9%)	1424.2 (5%)	927.7 (30%)	6569.2 (25%)	3127.9	26610.2
1987	743.0 (23%)	5481.4 (19%)	848.5 (26%)	8553.1 (30%)	302.9 (9%)	1688.4 (6%)	912.7 (28%)	5809.6 (21%)	3283.9	28203.9
1988	724.2 (23%)	5422.2 (19%)	848.5 (27%)	8643.4 (31%)	256.9 (8%)	1528.0 (5%)	760.5 (25%)	5377.4 (19%)	3094.5	28127.8
1989	656.6 (22%)	5211.3 (19%)	861.6 (29%)	9357.7 (34%)	241.5 (8%)	1551.5 (6%)	733.5 (25%)	5974.7 (22%)	2954.6	27788.1
1990	599.8 (22%)	5040.3 (19%)	826.0 (30%)	9079.5 (34%)	243.9 (9%)	1717.2 (6%)	668.9 (25%)	6123.3 (23%)	2713.3	26854.0
1991	633.2 (22%)	5008.0 (17%)	810.3 (28%)	10287.7 (35%)	251.0 (9%)	1452.6 (5%)	650.7 (23%)	6076.0 (21%)	2863.9	29272.8
1992	655.8 (23%)	5199.4 (17%)	799.3 (28%)	9762.5 (32%)	273.7 (10%)	1812.0 (6%)	591.4 (21%)	5991.4 (20%)	2824.9	30417.3

Data Source: Taiwan Agricultural Yearbook, Provincial Government of Taiwan.

* Proportion of total vegetable production.

** Proportion of total vegetable value.

1 Watermelon, honeydew and mushrooms are also included.

to 115.15 kg. and 66.2 kg. in 1992, respectively, while the per capita consumption of food grains dropped from 156.81 kg. to 98.02 kg. in this period. However, per capita vegetable consumption was only up by 0.8% per year during 1983-92, despite the increasing nutrition advice to consume more fruits and vegetables.

Vegetable utilization has not changed much over the last two decades, nearly 70 percent of vegetables purchased by households were consumed in fresh in the 1980s. Processed vegetables have only slightly increased. In terms of variety, the relative importance among vegetable groups has not

Table 2 Taiwan Per Capita Consumption of Food

unit: kilogram						
Year	Grain		Meat		Vegetables	
	Consumption	Index	Consumption	Index	Consumption	Index
1962	156.81	120.38	16.04	38.15	56.16	47.51
1972	165.78	127.27	27.31	64.95	91.17	77.13
1982	130.26	100.00	42.05	100.00	118.21	100.00
1983	122.94	94.38	44.16	105.02	116.61	98.65
1984	116.41	89.37	51.67	122.88	129.08	109.20
1985	116.16	89.18	54.30	129.13	127.07	107.50
1986	116.42	89.38	56.84	135.17	118.29	100.07
1987	110.15	84.56	57.69	137.19	125.35	106.04
1988	110.55	84.87	57.79	137.43	122.10	103.29
1989	105.13	80.71	60.30	143.40	117.55	99.44
1990	105.91	81.31	61.86	147.11	105.91	89.59
1991	101.76	78.12	63.48	150.96	114.44	96.81
1992	98.02	75.25	66.20	157.43	115.15	97.41

Data source: Taiwan Food Balance Sheet.

changed much in the last decade. As shown in table 3, per capita consumption of root and stem vegetables has up slightly to be near 40 kilograms, while continuously declining in leaf vegetable consumption is observed. The decrease of leaf vegetable consumption does not mean leaf vegetables were less preferred but rather be treated as the reflection of changing structure of demand. Since consumers become pursuing quality leafy greens, only the demand for cabbage and Chinese cabbage dropped off.

Table 3 Taiwan Per Capita Consumption of Vegetables by Product Group, 1981-91

Unit: kilogram

Year	Per Capita Vegetable Consumption				
	Leafy	Roots and Stems	Fruits	Others	Total
1981	34.70	36.13	26.05	18.72	115.60
1982	35.23	36.53	24.95	21.50	118.21
1983	32.66	31.55	22.36	27.46	113.81
1984	33.30	40.93	22.97	31.88	129.08
1985	32.59	41.11	25.57	27.80	127.07
1986	31.64	34.58	27.50	24.57	118.29
1987	32.89	39.76	28.46	24.24	125.35
1988	31.47	40.02	29.08	21.53	122.10
1989	28.20	41.67	25.06	22.60	117.55
1990	26.81	40.80	20.78	17.52	105.91
1991	26.46	39.76	27.69	19.53	114.44

Data source: Taiwan Agricultural Yearbook (1983~1993 Edition).

National Chung Hsing University

Variation

Year to year variations in the individual vegetable production are of different magnitude. The production coefficient of variation for eleven selected vegetable species were calculated and listed in table 4. Crops with the least production variation are cabbage (11.69), radishes (15.73), and Chinese Cabbage (16.89), they are all the leading vegetables and two of

Table 4 Production, Area, and Yield Coefficient of Variation (CV) of Major Taiwan Vegetables, 1971-92

Item	Production	Area	Yield
Cabbage	11.69	11.88	7.55
Radishes	15.73	19.23	13.79
Chinese Cabbage	16.89	15.77	8.06
Onions	20.93	17.71	15.75
Cauliflower	26.36	19.74	8.35
Celery	31.26	17.84	10.02
Bamboo Shoot	38.61	32.49	111.78
Carrots	43.52	28.41	25.24
Mushroom	46.81	60.87	25.05
Asparagus	54.30	44.67	20.64
Tomatoes	58.05	34.01	35.63
Ginger	62.71	55.39	18.19

$$* CV = \frac{\sigma}{\mu} \times 100\%$$

σ = standard deviation of product i, 1971-92 ;

μ = mean of product i, 1971-92 °

National Chung Hsing University

them are leaf vegetables, ginger, tomatoes, and asparagus with the value of variation coefficient of 62.71, 58.05 and 54.3, respectively, are the most unstable vegetable crops. A common feature of the three products is that a large production of their annual production was exported. Area and yield coefficients of variation for the twelve vegetable species are also shown in table 4.

Seasonality in prices

Because monthly vegetable production data are lacking, detailed seasonality in vegetable production can only be investigated based on the wholesale trade volume. From table 5, the high season for total vegetable transaction are December, January and March with a seasonal index of 123, 121, and 112, respectively. Low season happens in summer, July-September, with the lowest volume occurred in September (79). This seasonal pattern of wholesale quantities reflects significant seasonality in transaction/production.

Table 5 exhibits individual vegetable price seasonal indexes which were calculated based on 1982-92 wholesale level data. In the common seasonal pattern of these selected price series, prices tend to peak for the year during July-September, and prices normally drop significantly from January through March. This seasonal pattern of prices is reversely consistent with production and consumption seasonality of vegetables. The difference between the highest and the lowest seasonal price indexes for most of the leaf vegetables was near 100 percent and was over 140 percent for cabbage in particular. Price seasonality for some root and stem vegetables (i.e., car-

rots and bamboo shoot) is mild in comparison with leaf vegetables. In addition, February-April are the peak months for the prices of bamboo shoot which reflects an opposite pattern against other vegetables. Generally speaking, movements of most of the individual vegetable wholesale prices tend to rise in the summer months and to decline during winter and spring.

Table 5 Seasonal Indexes for Taiwan Wholesale Vegetable Prices Based on 1982-92

Item	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
<u>Leaf Vegetables</u>												
Cabbage	60	51	49	49	65	104	128	173	190	166	97	67
Chinese Cabbage	55	47	59	89	89	102	138	156	157	134	93	83
<u>Stem Vegetables</u>												
Bamboo Shoot	118	132	144	138	113	72	64	77	82	81	85	96
Garlic	69	65	63	69	94	113	117	138	156	132	96	88
Onions	93	86	75	73	77	89	89	116	131	135	129	108
Celery	64	62	70	76	78	104	134	136	170	134	96	77
Ginger	90	94	95	102	102	96	96	113	108	106	102	98
<u>Root Vegetables</u>												
Radishes	62	51	51	69	91	114	132	146	182	143	83	76
Carrots	83	76	75	85	93	97	103	110	119	131	120	107
<u>Fruit and Flower Vegetables</u>												
Cauliflower	46	45	60	76	87	111	154	152	173	138	90	68
Tomatoes	61	52	60	71	87	94	123	147	154	162	115	74

Data Source: Taiwan Agricultural Product Wholesale Market Yearbook.

Note: The centered 12-month moving average approach was employed.

III 、 Review of Existing Literature

This section will discuss the characteristics associated with the production system, the marketing system, as well as the consumption pattern of vegetables in Taiwan.

3.1 、 The economics of vegetable production system

Adjustments in vegetable production

A major problem facing Taiwan summer vegetable growers has been the frequency of unpredicted changes in summer weather conditions, such as typhoons, floods and hails, which could cause severe damage to vegetable crops. In order to ensure the production of summer vegetables, especially leafy greens, the practice of horticultural production under structure was introduced to vegetable growers in 1971 and has been quickly extended thereafter. However, adoption of the new cultural practice is still low in Taiwan mainly because most vegetable growers are unable to afford the high material costs. (Kuo, 1993; W.C. Yang, 1993)

Institutional reforms

In order to improve yield and quality of vegetables, to enhance farm income, and to balance the gap in supply and demand for vegetables, the government has encouraged farmers in the vegetable growing regions to form the specialized vegetable production zone under the Accelerating Rural Development Program (ARDP) since 1973. Metro areas such as Taipei

and Kaohsiung were among the areas at first to set up the specialized zones. For carrying out planning of production, the government has provided farmers a revolving fund of NT\$ 9,800,000 to jointly purchase seeds, pesticides, fertilizers, and machinery to reduce the cost of production. The local farmers' association is responsible in helping vegetable growers in each specialized zone to set up production teams, teaching members the newly developed cultural and management practices, as well as inducing cooperation in practice (Hsieh and Chen, 1991).

Although the areas of specialized zones account for less than 2% in total vegetable areas, its production was near 7% of annual total vegetable production. It is obvious that the yields of specialized zones is much higher and stable than nonspecialized production areas.

Profitability

The profitability of vegetable production could be determined by many factors, such as farming scale, yield, number of multiple crops, cost of inputs, and degree of specialization. It also varies for different species, region and type of operation. For instance, the average net earning per 0.1 ha. was only NT\$2,098 for celery cabbage, but NT\$74,522 for highland cabbage in 1992 (Shuai and Chang, 1993). Shuai and Chang have also compared the profitability between the specialized vegetable production zone and the ordinary vegetable farms. They found that the net return earned by the specialized zone for a typical vegetable was normally higher than ordinary farms except for cabbage and celery cabbage.

Table 6 exhibits the costs of production, net return, and family income, in 1990/91 production period for selected vegetables and alternative crops. Among reported vegetable crops, the highest returns are associated with crops produced in summer-fall period, NT\$210,198 per ha for second crop cabbage and NT\$209,374 per ha. for second crop Chinese cabbage. The net profit existed in carrots, winter crop cabbage and tomatoes for fresh use and for processing all in negative value, per ha. crop lost about NT\$57,662, NT\$30,104, NT\$197 and NT\$1127,278, respectively. However, family income is still positive for those farms with negative profit due to earnings made by family labor, except in carrot. The relative profitability of vegetables to alternative crops is between cereals and fruits. As indicated in table 6, per ha. vegetable farm income on average is higher than the rice farm but less than the banana and citrus-tankans farms.

3.2 ˆ Vegetable Marketing System

Vegetable channels

Today, vegetables grown in Taiwan moves to domestic markets through many different channels with each channel involves different number of marketing stages. Most of the fresh vegetables are marketed via the following three channels (Wann, 1993a):

(1) the shippers' channel:

farmer → shipper → wholesaler → jobber, retailer → consumer

This channel is also called the traditional channel which is the longest marketing channel for fresh vegetables.

National Chung Hsing University

Table 6 Production Cost & Income of Vegetable and Alternative Farm Products, 1990/1991

Unit: NT\$

Item	1st Crop		Winter Crop					2nd Crop		1st Crop		2nd Crop		Banana	Citrus-Tankans
	Radishes	Carrots	Onions	Potatoes	Cabbage	Cabbage	Chinese Cabbage	Sweet Corn	Tomatoes for process	Tomatoes	Japonica Rice	Japonica Rice			
1. Production Cost Per Ha															
Seed & Seedling	2,224	4,588	9.48	26,454	11,907	14,465	7,862	4,697	4,866	15,864	5,376	4,898	13,881	11,180	
Fertilizer	9,560	13,750	15.743	28,316	14,884	16,153	22,712	15,332	10,121	20,089	5,224	5,218	35,351	26,197	
Farm machine/labor	39,999	109,669	152.755	71,342	93,038	98,776	92,384	81,064	108,665	306,147	51,975	48,642	171,37	137,380	
Man-Labor	37,283	93,038	128.945	55,070	81,530	91,456	80,692	64,968	95,264	283,872	23,280	21,783	156,44	110,310	
Animal Labor	—	1,168	—	142	455	244	—	244	3,658	1,869	549	672	—	—	
(Self-Supplied)	—	1,253	—	—	181	—	—	—	2,464	3,143	—	—	—	—	
Mechanization	2,716	13,810	21,443	14,953	10,131	7,076	11,692	10,544	6,970	15,096	28,164	26,187	13,026	14,490	
(Self-Supplied)	—	400	2,344	1,177	741	—	—	5,308	309	2,167	—	—	1,907	12,580	
Chemical & Herbicide	7,061	7,176	13,509	10,610	11,167	16,201	24,969	13,463	8,059	18,522	4,927	4,816	13,096	17,563	
Energy	281	2,332	1,464	626	548	587	308	407	62	349	—	—	2,744	981	
Materials of Equipment	—	3,771	17,380	—	11,380	—	14,178	7,728	—	30,697	376	304	50,920	7,231	
Direct Cash Expense	59,125	139,602	207,882	136,170	142,002	146,182	162,413	117,383	128,999	386,358	68,733	64,062	285,457	187,951	
Indirect Costs	4,773	20,925	24,378	23,144	9,195	11,333	11,367	11,122	13,167	24,523	17,899	13,717	35,909	19,621	
Total Cost.	63,898	160,527	232,260	159,314	151,197	157,515	173,780	128,505	142,166	410,81	86,632	77,779	321,366	207,572	
Family Labor	31,255	19,000	92,052	35,142	75,954	86,529	80,692	60,886	73,111	186,723	—	—	143,255	104,115	
2. Production Revenue Per H															
Main Production(kg/ha)	37,740	53,202	55,907	22,540	31,779	24,236	24,085	8,815	71,507	38,802	6,221	4,661	23,256	11,816	
Gross Income	118,121	102,865	318,042	251,791	121,063	367,714	383,154	157,916	141,969	283,602	101,155	80,795	271,453	193,503	
Surplus/Loss	54,224	-57,662	85,782	92,477	-30,134	210,198	209,374	29,411	-197	-127,27	14,523	3,016	-49,913	-14,069	
Family Labor	85,479	-38,662	177,834	127,619	45,820	296,727	290,066	90,297	72,913	62,444	21,483	20,515	93,342	90,046	
Farm Family Income	89,442	-20,554	200,111	150,355	53,791	306,567	300,335	105,219	85,360	9,287	53,068	34,430	127,297	118,383	
3. Production Cost Per 100 kg	169	300	415	707	476	650	722	1,458	199	1,059	1,394	1,675	1,382	1,757	
4. Return per unit of cost	1.85	0.64	1.37	0.63	0.80	2.33	2.20	1.23	0.999	0.69	1.17	1.03	0.84	0.93	

Note: 1. Indirect cost: Water + Depreciation + Land Rents + Tax + Interest

2. Family Labor Remuneration: Profit and Loss + Family Labor.

3. Farm Family Income: Family Labor Remuneration + Mechanization (Self-supplied) + Land Rents (Self-supplied) + Interest.

Data Sources: Taiwan Agricultural Yearbook, 1992.

(2) farmers' cooperative marketing channel

farmer co-ops → wholesale market → jobber, retailer → consumer

This channel was initiated in June 1973. Small scale growers usually lack of market information and marketing capital, so that the terms of marketing trade are normally dominated by shippers under the traditional marketing channel.

(3) direct marketing channel

farmer co-ops → produce packing/distribution center → supermarket chains → consumer

Direct marketing channel that has increased its importance in recent years and which by passes the normal trade routes, is the selling of produce by grower cooperatives directly to retail stores, restaurants, and institutions. Although this is not strictly farm to consumer direct marketing, this channel was created for stabilizing farm income and reduce the marketing margins of vegetables since 1983.

Marketing margins

There are two common ways to measure marketing margins for fresh vegetables. The first is based on secondary price data in different marketing stage. Marketing margins between any two stages can be obtained for individual vegetable. Previous studies have focused on the distribution of margins in different marketing stages with particular attention on farm's share and identifying the market power exercised by retailers (M. H. Yang,

National Chung Hsing University

1992; Wann, 1993a; J. N. Yang, 1993; Huang and Huang, 1994). General findings are that farmer's share of the price paid for individual vegetable by consumers, normally falls into a range of 20% ~ 50%, is declining during the last decade. Farmer's share tends to rise during the off-season of vegetables and after the crop failure due to natural catastrophe. The wholesale-retail margin accounts for near two-thirds of the total marketing margin for most vegetables.

The second approach is based on primary data collected from survey on price of raw products, marketing service costs, and wastage rate in each marketing stages. Farm-retail spread of individual vegetable varied by marketing channel and marketing season. Shuai (1992) analyzed the farm-retail spread for selected summer vegetables in different marketing channels based on data from their survey. They concluded that the farm-retail spreads of summer vegetables resulted from direct marketing were less than in other marketing channels. While no obvious relation can be found for that in cooperative marketing and traditional marketing channels. Wann (1993a) investigated the marketing margins for radishes, cabbage, Chinese cabbage, celery cabbage, and cucumber in winter 1992. The findings, in summary, are: (i) the highest costs of marketing services were generated at the retail stage; (ii) the retail wastage percentage of leaf vegetables via traditional channel was higher than other marketing stages while in the cooperative marketing channel, the highest rate of wastage occurred at the wholesale stage and (iii)retailers made the highest gross return and rate of return in comparison with all other marketing agents.

Market efficiency

Efficiency of vegetable marketing system has always been widely criticized because of the coexistence of persistently increased marketing margins, poor packing methods, high percentage of wastage in each marketing stages, and inconsistent grading, etc. In general, pricing efficiency, operation performance of wholesale markets, as well as progress of cooperative marketing are the three directions most agricultural economists would choose to approach the problem of vegetable marketing efficiency.

1. Pricing efficiency

Various empirical studies (Lin 1984; Wann 1993a; J. N. Yang 1993) have found that vegetable markets were not competitive because the farm-wholesale-retail price transmission was incomplete and asymmetric bargaining abilities between sellers and buyers. On the other hand, vegetable retailers have often been suspected to possess certain degree of market power since they usually adopt either constant or fixed proportion mark-up pricing, with a range of NT\$ 2 ~ 10 per kilogram amounting to 20% ~ 65%, respectively. Traditional approach to the question was to decompose marketing margins into costs, transportation losses, and gross return based on daily survey data. Then retailers' average net return was estimated in order to determine whether retailers only make normal return (Hsu, 1984; Huang 1991). Since selling vegetables is labor intensive and mostly is family business, the net return earned by vegetable retailers were hard to estimate. It can be expected that such accounting-based studies could not provide a convincing conclusion. Yang (1992) and Wu (1992) test the hy-

pothesis that vegetable retailers make only normal profits. Empirical results found that retailers of Chinese cabbage, celery cabbage, cabbage, cauliflower, and carrots all had opportunities in making abnormal profit particularly during the main crop season and at the time when typhoon occurs.

2. Wholesale market

Presently, there are 70 fruit and vegetables wholesale markets in Taiwan which were established and owned either by the local government, farmers' association, or a joint venture of the two. These markets are non-profit organizations with the primal goal of serving farmers. Among the 70 fruit and vegetable wholesale markets, only two Taipei markets adopt the auction system, all the rests are markets of price negotiating. Currently, approximately 40 percent of annual vegetable production is traded via wholesale markets.

Most fruit and vegetable wholesale markets in the consumption areas have serious problems of limited space and deterioration in the environment due to surrounding congestion traffic and rapid population growth in metropolitan areas. On the other hand, some wholesale markets in the production area have faced a decreasing transaction quantity due to structural changes of the industry and/or substitution for cooperative marketing. (Hsu, 1993)

Furthermore, many buyers of wholesale markets refused to pay market assessment for caused some markets gave up their normal managerial func-

tions of product collection, distribution, and price formation. The replaced activities of the market operation become receiving rents as management charges from market buyers who are authorized to use a certain stall space inside the market. The functions of wholesale market have then gradually disappeared for such markets. (Liu, 1985; Lin, 1990; R. S. Chen, 1991; S. E. Chen 1991; Wu, 1992)

3. Cooperative marketing

Cooperative marketing in Taiwan has been promoted in some fashion for more than twenty years. While wholesale markets in consumption areas are the major outlet for products marketed by farmer co-ops, nearly 95 percent of the vegetables and 80 percent of the fruits from cooperatives are concentrated in the two Taipei wholesale markets operated by the Taipei Agricultural Products Marketing Corporation. Such situation indicates that the outlets for products marketed by farmer cooperatives are limited. Meanwhile, the performance of cooperative marketing has been unsound in spite of implementing production planning since 1978. (Wu, 1993)

3.3 Consumption of Vegetables

Price and income elasticities

Both the own price demand elasticity and income elasticity for selected species are calculated from single regression models where quantity of annual production is specified as the dependent variable, with retail price and per capita income both in real term as explanatory variables by Huang (

1991). The estimated demand elasticities are exhibited in table 7 All of the coefficients fall between zero and minus one which reveals demand for these vegetables are all inelastic. Coefficient of demand elasticity for carrots (-0.06) and scallion (-0.002) are the least in absolute value while radishes (-0.57), celery cabbage (-0.56), cucumbers (-0.56) and onions (-0.55) have the highest absolute value. These coefficients implicitly reflect the fact that stronger consumption response to a price change occurs in those vegetable products with significant production seasonality.

Table 7 also provides the coefficients of income elasticities for twenty selected vegetable species. Except vegetable soybeans and asparagus, all of the examined species are normal goods since their income elasticities fall between zero and one. Asparagus seems to be luxury goods because its income elastic.

Consumer preferences

Few literature has documented the characteristics of consumers' preferences for different types of vegetables which are possibly owing to individual preference on vegetables are hard to identify and explain. There was also no study which aimed to investigate and make comparisons on preferences for vegetables by consumers in different regions or different levels of income. Insufficient data should be the primary cause of such shortage.

Furthermore, Taiwan consumers commonly prefer fresh leaf vegetables to the other varieties of vegetables. Significant consumption of canned or frozen vegetables is observed only after the post-disaster period, particular-

Table 7 Demand and Income Elasticity of Selected Vegetables, 1988-89

Item	Demand Elasticity		Income Elasticity	
	Elasticity	tstatistics	Elasticity	tstatistics
<u>Leaf Vegetables</u>				
Cabbage	-0.44	-2.13*	0.2993	2.1145*
Chinese Cabbage	-0.11	-2.93*	0.0746	1.2511
Celery Cabbage	-0.56	-3.48*	0.4735	2.6721*
Leaf Mustard	-0.34	-1.44	0.2029	20.499*
<u>Stem Vegetables</u>				
Bamboo Shoot			0.6752	1.7521
Asparagus			1.5564	2.0479*
Garlic Bulbs			0.6171	2.6614*
Garlic	-0.15	-2.98*	0.3227	3.4175*
Onions	-0.55	-3.24*	0.6376	2.6194*
Scallion	-0.002	-1.01	0.2670	2.1352*
<u>Root Vegetables</u>				
Carrots	-0.06	-1.05	0.2468	2.5611*
Radishes	-0.57	-3.60*	0.4468	3.2001*
Taros			0.8387	3.1421*
<u>Fruit and Flower Vegetables</u>				
Cauliflower	-0.35	-2.51*	0.1835	3.5721*
Vegetable Soybeans			0.7407	1.2215
Tomatoes	-0.32	-2.08*	0.1891	3.1021*
Cucumbers	-0.56	-3.48*	0.4240	2.4785*
Kidney Beans	-0.52	-1.76	0.3854	3.4766*

Singnificant in 95% confidence level.

Data Source: Huang, 1991.

lly in summer months. Wu(1989) noted that Taiwan consumers are less interested in frozen vegetables in comparison with fresh vegetables. Unreasonable high prices of frozen vegetables may be the main reason for the dislikeness.

3.4 ˆ Policies analysis related to vegetables

In order to stabilize summer vegetable prices and to induce orderly marketing, the Taiwan Provincial Department of Agriculture and Forestry assures the guaranteed prices and contracts marketing through farmer cooperatives for various important summer vegetables since 1976. Then number of contracting farmer cooperatives and volume of contract marketing have both increased significantly, from 33 and 10,140 metric ton in 1976 to 99 and near 50 thousand metric tons in 1992. (Wu et al, 1993) The money to finance the program was shared by the central and local government budgets, participated wholesale markets, and farmers cooperatives. Until 1993, total payments to vegetable producers were NT\$312.2 million with an average deficiency payment of NT\$0.8 per kilogram.

Recently, more attention is paid to the problem of low vegetable prices in the winter season. At present, the government is evaluating the feasibility of expanding the summer vegetable contract marketing program to year-round (Wann,1993b and 1994).

Vegetable exports have been an important source of farm income and made significant contribution to economic growth. Exported volumes of canned mushroom, asparagus and bamboo shoot had been over 400 million

cases per year and ranked the first in world trade during 1970s. Since then, canned vegetable exports declined gradually and became trivial.

In order to achieve an orderly exporting system, the government had issued three vegetable exporting enhancement programs. The first is the planning production and marketing program which was designed for stabilizing the prices of exports. The second program is the contract system conducted by processors in procuring raw materials for processed vegetables for export. The requirement of exporting approval certificate, the third exporting system, was practiced since 1986 to replace the previous rules on exports adjustment. Under this program, exporters are able to procure vegetables from growing regions depending on their actual needs. Exporting vegetable under this system, thus, is completely liberal as long as the exporter provides his scheduled quantity and shipping date of exports to the vegetable exporters association for record and to obtain an approval certificate. Then, a visa for exporting would be issued based on the certificate. Fresh vegetables, such as ginger, cauliflower, potatoes, and broccoli are under this exporting system. Since it has put the least restriction on exporters, it not only meets the principle of free market, but also encourages exporters to expand foreign markets.

During the 1980s, many studies aimed to evaluate the system of production and marketing for various exporting vegetables such as onions (Tai, 1983), garlic bulbs (Lee, 1985), canned asparagus (Wu, 1986), and canned bamboo products (Lee, 1987; Shuai, 1988; Kan, 1986). These researches have all concluded that our vegetable exporting systems have improved. But

there is a need of improving the forecasts on domestic and international agricultural situations, and to establish a complete agricultural production and marketing information system.

Vegetable import is normally regarded as totally liberal in Taiwan except the requirement of submitting an approval certificate issued by the Council of Agriculture along with each shipment of imports.

IV 、 Achievements of Past Research in Vegetable Economics

Previous economic researches on vegetable were problem oriented. The mission of agricultural economists was to define the existing or potential problems clearly and to provide effective solution to the target problem from an economic point of view. Because vegetable was less important relative to rice, the principal crop of the country, and cultural techniques for vegetables were improved persistently under production oriented policy in early stage of development, the economics of vegetables had not attracted much attention. Economic researches on vegetable industry, hence, were rarely conducted prior to 1970.

During 1970s, the primary mission to agricultural economists was to suggest policy reforms to alleviate the price fluctuations and to increase the supplies of summer vegetables. In order to ensure farmers' income and to adjust marketing flow to meet summer market demand, the guaranteed price marketing program for summer vegetables and cooperative marketing were initiated. To gain the economy of scale in farm operation, specialized vegetable zones were suggested. To protect crops from unfavor weather

conditions, horticultural production under structure was introduced to vegetable growers. Meanwhile, exports of processed vegetable products expanded significantly. Relative to traditional canned products of asparagus, bamboo shoots, and mushroom, processed tomatoes was newly developed for exporting. The tomato processing industry had drawn more attentions from agricultural economists (Chu, 1975; Hsu, 1978).

The 1980s was a transition period for vegetable exports. Growth of most exporting vegetables had either stagnated or dropped off. Economic evaluation on vegetable exporting system was put in force. Numerous promotion and adjustment strategies for vegetable export were proposed by the economists.

From late 1980s to present, agricultural economists have given more attention to the domestic vegetable production and marketing system. Directions of research are diversified reflecting the ever increasing complication associated with the economy of vegetables. In particular, the inefficiency of marketing system is wildly criticised and alternatives for improvement are being suggested. Recent advances in industrial economic theory and econometric methods have improved the tools for analyzing pricing behavior of agents under imperfect competition. And welfare economics is implemented for evaluating government vegetable policies(e.g., Wu, 1994; Wann, 1994).

V 、 Directions for Future Research

In sum, future development of vegetable economics is not well understood under the potential influence of the GATT. In the next few years, the vegetable industry may undergo more structural change than any previous period of time. Thus, further economic research need go deep into the realities. The following directions for future research are proposed for consideration:

1. Exploring the decision-making processes of growers

The decision-making process of vegetable growers under a changing economy and market regulations need to be better understood so that effective adjustments can be carried out. Questions such as "how are production decisions influenced by relative prices?" and "how would farmers respond to impacts from open trade?" are questions agricultural economists definitely should pay more attention.

2. Improving the efficiency of vegetable marketing system

Relevant issues under this aspect are multiple and maybe inter related. More attention has been given to marketing efficiency for vegetables in recent years by agricultural economists. Further studies in this area still need to be continued to sort out obstacles and to integrate solutions for improving marketing efficiency. Important researchable directions include:

(1) The impacts of changing business organization and operation

Apart from the traditional family firm, the growing supermarket chains and discount wholesale stores control increasingly more marketing function in the vegetable distribution system. Effects of increased market competition on producers agribusiness, marketers and consumers need to investigate.

(2) The benefit of direct marketing on farmers and consumers

Direct marketing is a newly created channel by vegetable growers, and is believed to be more efficient than other marketing channels. In fact, no sufficient evidence supports this believe. Moreover, most farmers with small output felt they should concentrate on farming rather than involving themselves in the time consuming and retailing function.

(3) Alternatives for market operation and management

To ensure the survival of wholesale market, market operation and management have to be strengthened by implementing proper transaction methods, applying computer operations and cost reducing practices, etc.

3. Preferences of consumers

Consumption behavior on vegetables has been a neglected area to agricultural economics. Under the new era of towarded demand oriented market, understanding the characteristics of vegetable consumption is critical to the success of vegetable industry. More sophisticated packing meth-

ods and products with better quality may boost the demand for vegetables.

4. Impacts of agricultural trade liberalization

The multinational treaty, the General Agreement on Tariffs and Trade (GATT), has established rules for reducing or eliminating both tariff and nontariff trade barriers. Taiwan is aggressively in preparing of participating into the GATT and WTO(World Trade Organization). Therefore, competitions in both international and domestic markets of agricultural products would be increasing. Since there is no empirical analysis of the effect of GATT on vegetable trade of Taiwan yet, how would rapid growth in vegetable imports affect the farm sector and what kinds of action farmers can make for survival, thus, become important tasks for agricultural economists to provide answers.

VI 、 Information Needs and Priorities for Future Research

Numerous vegetable economic studies have succinctly discussed the need for information on production and management practices, marketing conditions, consumption structure, and enterprise specific costs and returns, etc. Although data systems exist to monitor conditions in the farm sector, data are aggregated to county level and/or crop group, so farm-level ramifications and seasonal differences are difficult to assess. Furthermore, the annual survey on individual vegetable costs and returns is taken only irregularly and does not provide detailed information on adjustments that individual farmers have made or expected to make as well as difficulties that growers will confront.

On the other hand, primary data collection by individual vegetable production regions is important for understanding farm problems, monitoring changes, and studying farm-level behavior and relationships. These objectives require more than an occasional cost of production and marketing survey. Thus, a panel design is required where the same farmers are surveyed to create a longitudinal data set.

In addition, the data on disappearance for some individual vegetable products are either incomplete or inaccurate. Since a large volume of fresh vegetables are traded outside of wholemarkets, it is hardly possible to trace out the destinations of these products. Vegetable distribution, therefore, is difficult to access. Not only useful to the research purpose but also important to policy consideration, the consumption information system is needed to improve. therefore, is difficult to access. Not only useful to the research purpose but also important to policy consideration, the consumption information system is needed to improve.

References

1. Chen, R. S., "The Issues and Improvement of Fruit and Vegetable Wholesale Market," Agricultural Marketing Quarterly, Agricultural Marketing Association of Republic of China, No.86 Mar., 1991.
2. Chen, S. E., "Marketing Modernization of Fruit and Vegetable," Agricultural Marketing Quarterly, Agricultural Marketing Association of Republic of China, No.86, Mar., 1991.

3. Chu, Kuang-Fu, "Production and Marketing Situations of Processed Tomatoes in Taiwan", Quarterly Review of the Bank of Taiwan, 26 (4): 209-225, 1975.
4. Lin, Hui-Tzu, "A Study on Management and Marketing of Fruits and Vegetables Wholesale Market in Taiwan", Agricultural Finance As-says, No. 24, China Farmer Bank, 1990.
5. Lin, Ning-Hsien, "A Study on Pricing Efficiency of Vegetable Market in Taiwan — An Application of Time Series Analysis", Research In-stitute of Agricultural Economics, National Taiwan University, July, 1984. (unpublished MS thesis)
6. Hsieh, Shui-Lai and Chen, Chi-Hsiang, "The Implementation of Special-ized Vegetable Production Zones", Agricultural Situation and Out-look, Vol. 101, Department of Agricultural and Forestry, Provin-cial Government of Taiwan, 1991.
7. Hsu, Chih-I, "A Study of the Taiwan Processing Tomato Industry and a Forecast on the Supply and Demand for Processing Tomatoes", Journal of Agricultural Economics, The Association of Agricultural Economics, National Chung-Hsing University, Taiwan, 1978.
8. Hsu, Wen-Fu, A Study on the Cooperative Marketing for Agricultural Products, Research Institute of Agricultural Economics, National Taiwan University, Apr., 1984.
9. Huang, Wan-Tran, Establishment of Taiwan Vegetable Price Stabilization Schemes in Taiwan Dept. of Agricultural Economics National Ping-tung Agriculture College, June 1991.

10. Huang, Chin-Jung, and Huang, Yin-Hsien, "A Study on Reasonable Marketing Margin of Major Vegetables", Agricultural Marketing Quarterly, Agricultural Marketing Association of Republic of China, 98:21-36, 1994.
11. Kan, Chung-Hui, "A Study on Competitiveness of Canned Bamboo Export Japan in Taiwan", Research Institute of Agricultural Economics, National Taiwan University, 1986.
12. Kuo, Fu-Yao, "Problems and Solutions for Producing Vegetables by Simple Horticultural Production under Structure", Taiwan Agriculture Bimonthly, Provincial Government of Taiwan, 29(4):110-115, 1993.
13. Lee, Kun-Mu, "Current Situation of Trade and System of Production and Marketing for Taiwan Garlic Bulbs", Quarterly Review of the Bank of Taiwan, 36(2):291-306, Jun., 1985.
14. Lee, Shun-Cheng, "Economic Evaluation on the System of Production and Marketing for Canned Bamboo Shoot Products in Taiwan", Quarterly Review of the Bank of Taiwan, 18:83-119, July, 1987.
15. Lin, Ning-Hsien, A Study on Pricing Efficiency of Vegetable Market in Taiwan— An Application of Time Series Analysis, Research Institute of Agricultural Economics, National Taiwan University, July, 1984. (unpublished MS thesis)
16. Liu, L. G., "The Management of Fruit and Vegetable Wholesale Market", Agricultural Marketing Training Manuscript, Unpublished Mimeograph, Council of Agriculture Republic of China and Department of Agriculture and Forestry, Taiwan Provincial Government, 1985.

17. Shuai, Lin, "An Economic Analysis on Bamboo Shoot Production and Marketing in Taiwan", Agricultural Finance Assays, 19:137-191, Jan., 1988.
18. Shuai, Lin, A Study on Stabilized Strategy and Plan for Production and Marketing of Summer Vegetables Taiwan, Agricultural Finance Assays, 28:183-240, 1992.
19. Shuai, Lin and Chin-hsiu Chang, A Study on Stabilized Strategy and Plan for Production and Marketing of Summer Vegetables Taiwan, Department of Agricultural Economics, National Chia-Yi Institute of Agriculture, 1993.
20. Tai, Hsu-Ju, "A Study on Problems in Producing and Marketing Taiwan Onions", Agricultural Finance Assays, 10:173-208, 1983.
21. Wann, Jong-Wen, A Study on the Reasonable Marketing Margins for the Major Vegetable Products in Taiwan, Research Institute of Agricultural Economics, National Chung-Hsing University, 1993a.
22. Wann, Jong-Wen, A Study on the Feasibility of Implementing the Year-round Guaranteed Price Marketing Program for Vegetables, Research Institute of Agricultural Economics, National Chung Hsing University, 1993b.
23. Wann, Jong-Wen, Cost-Benefit Analysis of the Year-round Guaranteed Price Marketing Program for Vegetables, Research Institute of Agricultural Economics, National Chung-Hsing University, 1994.
24. Wu, I-Tsui, "An Economic Analysis on the Canned Asparagus Industry in Taiwan", Quarterly Review of the Bank of Taiwan, 15:103-137, Jan., 1986.

25. Wu, Jung-Fang, Welfare Analysis of Guarantee Price Marketing Program for Vegetables in Taiwan — An Application of Disequilibrium Market Model, National Chung-Hsing University, July 1994. (Unpublished Master Thesis)
26. Wu, Ming-Che et al., "Current Situation of Government Assistances on Summer Vegetable Production", Agricultural Policies and Situation, Vol. 15, Council of Agriculture, Executive Yuan, Sept. 1993.
27. Wu, Ming-Ming, "Analysis on Frozen Vegetable Consumption by Taiwan Household". Agricultural Finance Assays, 22:189-232, 1989.
28. Wu, Ming-Ming, Cooperative Marketing and the Wholesale Market for Fruits and Vegetables in Taiwan: Achievements and Issues in Adjustment, Department of Agricultural Marketing, National Chung-Hsing University, 1993.
29. Wu, Ting-Ying, The Relationship of Markup Pricing Method and Profits on Vegetable Retailers, Research Institute of Agricultural Marketing, National Chung-Hsing University, 1992.
30. Yang, Jung-Nen, A Study on Marketing Margins and Market Power of the Vegetable Industry in Taiwan, National Chung-Hsing University, July 1993. (Unpublished Master Thesis)
31. Yang, Ming-Hsien, "A Study on Markup Pricing Method and Profits on Vegetable Retailers", Agricultural Finance Assays, 27:187-202, 1992.
32. Yang, Wen-Chen, "Cultural Practice of Summer Vegetables", Taiwan Agriculture Bimonthly, 29(1):65-69, Provincial Government of Taiwan, 1993.

台灣蔬菜經濟研究之過去與未來

萬鍾汶、彭作奎*

本文旨在針對過去有關蔬菜產銷之各相關經濟研究，依生產、運銷、消費及政策制度四方面分別進行回顧，以瞭解臺灣蔬菜經濟的特色，歸納出前人研究所關注的課題及研究所獲之成果。

在當前經貿環境之急遽變化下，本文及依據過去蔬菜經濟研究之經驗進而提出下列四大重點課題：(1) 對生產者決策過程之探討，(2) 蔬菜運銷效率之改善，(3) 蔬菜消費偏好之特性，及(4) 農產貿易自由化對蔬菜產業之衝擊，以供作未來蔬菜經濟問題研究之參考方向。此外，加強蔬菜供需面基本資料收集的一致性與連續性，以及促進資訊系統化乃充實未來研究蔬菜經濟問題之必備條件。

*作者分別為國立中興大學農業經濟系副教授與教授。