CHINESE - AMERICAN

JOINT COMMISSION ON RURAL RECONSTRUCTION

Plant Industry Series: No. 6

VEGETABLE PRODUCTION IN TAIWAN AND ITS PPOBLEMS

By

Luh, Chi-Lin

Senior Horticulturist

TAIPEI, TAIWAN, CHINA

March 1956 (1st edition)

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BY

Chi-Lin LUH, SENIOR SPECIALIST

PLANT INDUSTRY DIVISION

MARCH 1967

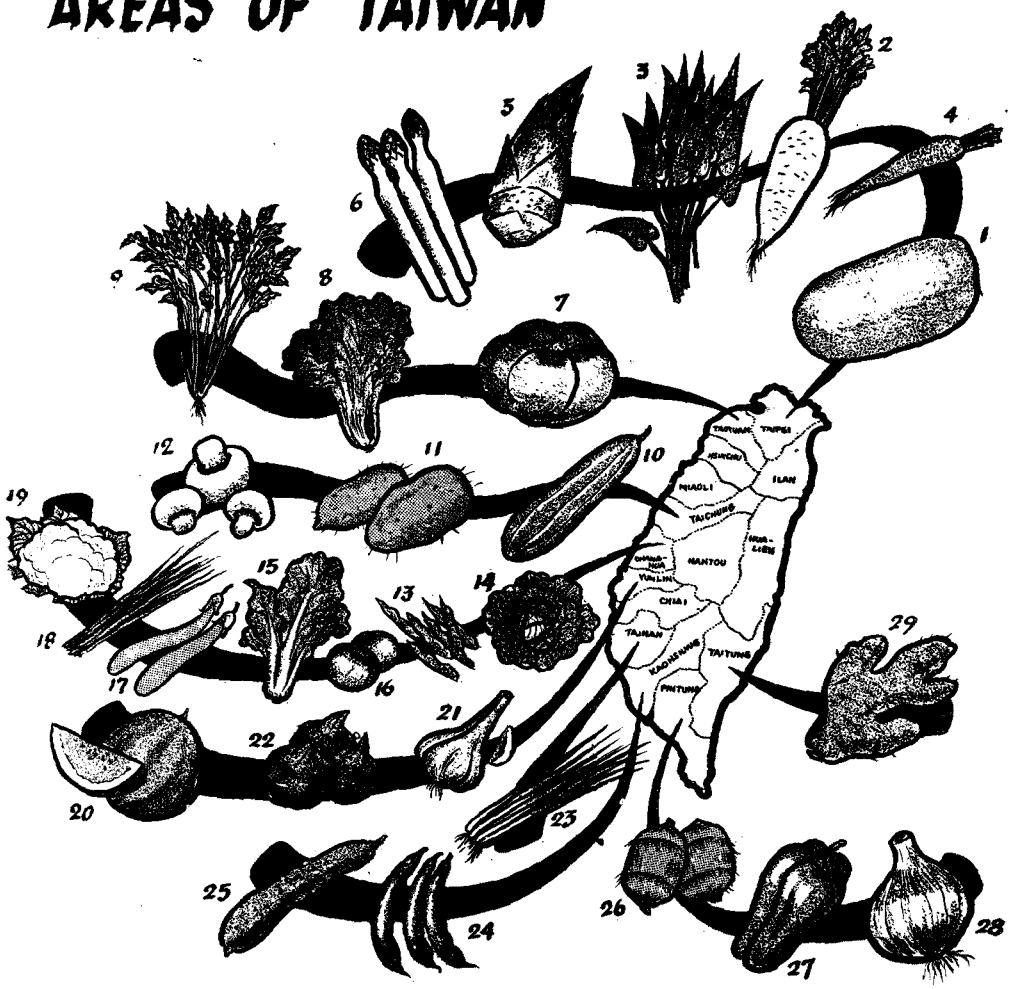
INTRODUCTION

Over population has made the diet of the Asian people preponderant in starch food and poor in protective foods. Taiwan is no exception. The need for growing more vegetables in Taiwan has become increasingly urgent because of the rapid growth of population, the need for improving the nutritional intake of the general populace in the form of cheap vegetable protein foods and the necessity of conserving foreign exchange for the importation of vegatables (fresh or processed) and vegatable seeds.

The vegetable production in Taiwan is confronted with many problems, among which the important ones are (1) a lack of good varieties, especially leafy vegetables adaptable to the local sub-tropical weather, (2) for want of a sound vegetable seed production and marketing system, (3) technical inability to produce locally seeds of a number of important vegetables, (4) for lack of a rational vegetable marketing system and (5) the limited means of vegetable storage, efficient processing and shipping. These and other factors have made the vegetables in Taiwan uneven in seasonal supply, prominent in seasonal price fluctuation, wide in difference between farm price and retail market price, high in percentage of spoilage during peak producing periods and dependent on import for the supply of many kinds of vegetable seeds.

The purpose of this paper is to present a bird's-eye view of the present condition and achievement of vegetable production made in recent years as well as a discussion on the problems pending immediate solution.

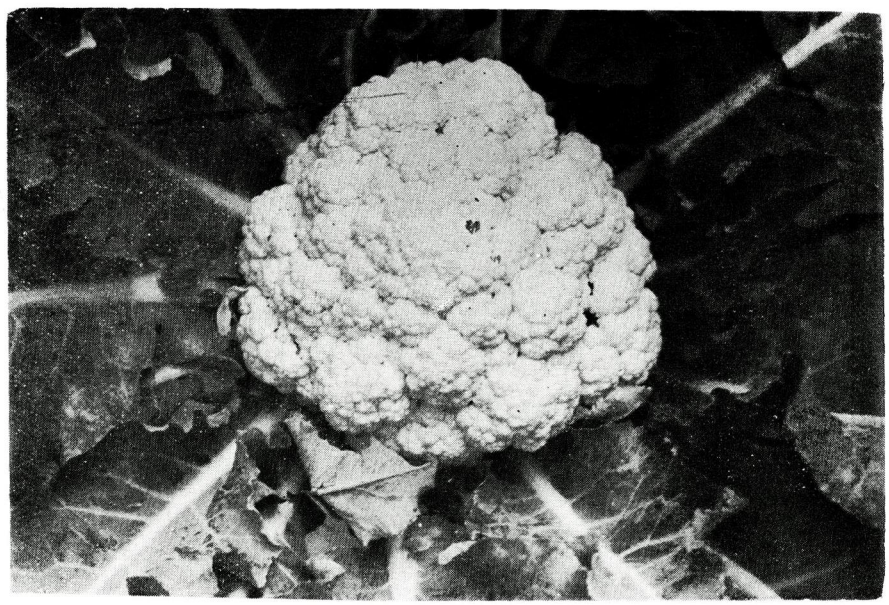
GEOGRAPHICAL DISTRIBUTION OF IMPORTANT VEGETABLE PRODUCTION AREAS OF TAIWAN



1. WAX GOURD
2. RADISH
3. WATER CONVOLVULUS
4. CARROT
5. BAMBOO SHOOT
6. ASPARAGUS
7. SQUASH
8. LEAF-MUSTARD
9. CELERY
10. ORIENTAL PICKLING MELON
11. POTATO
12. MUSHROOM
13. PEA
14. CABBAGE
15. PAI-TSAI
16. TOMATO
17. EGGPLANT
18. CHIU-TSAI
19. CAULIFLOWER
20. WATERMELON
21. GARLIC
22. WATERCHESTNUT
23. SHALLOT
24. BEAN
25. CUCUMBER
26. TARO
27. PEPPER
28. ONION
29. GINGER

Picture 1. Geographical Distribution of Important Vegetable Producing Areas of Taiwan, China

Picture 2. Most Popular Vegetable Crops of Taiwan



Cauliflower

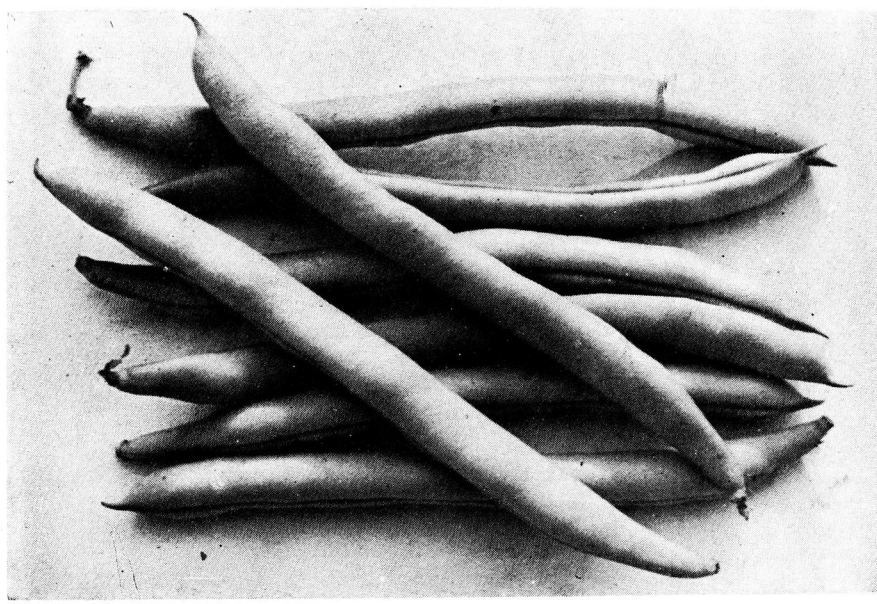
Broccoli

Cabbage

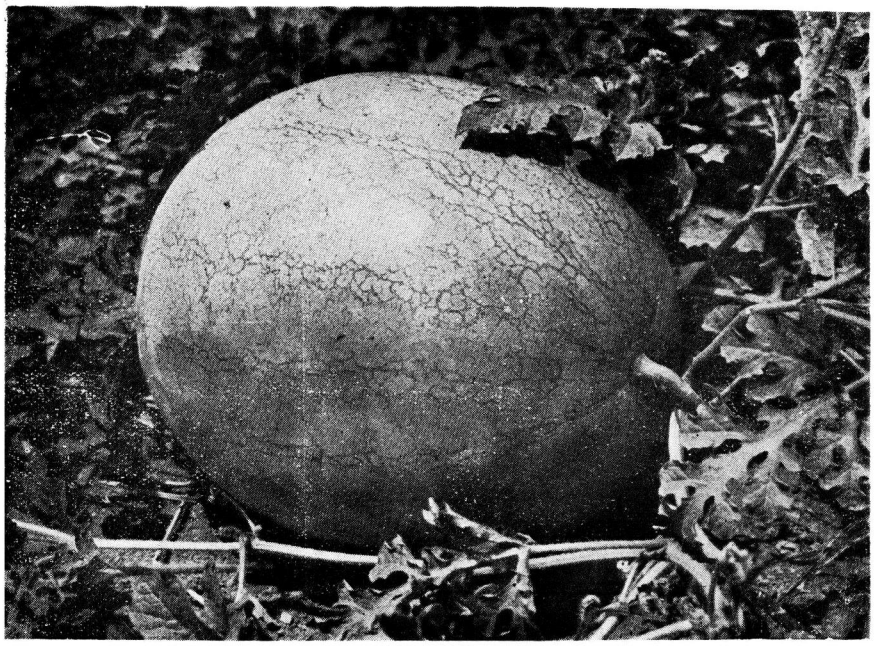
Eggplant

Tomato

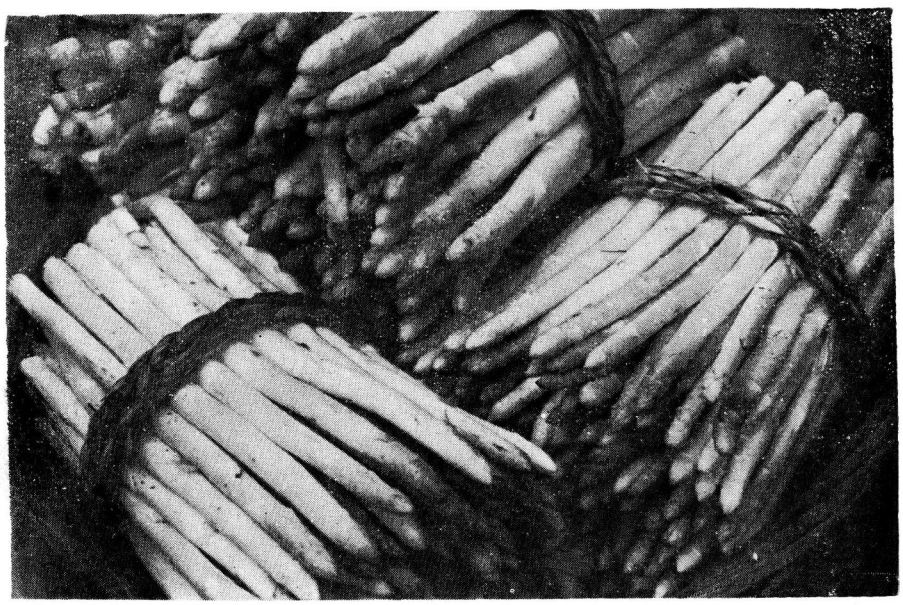
Onion



Bean



Watermelon



Asparagus

I. Present Situation of Vegetable Production in Taiwan

A. Types of vegetable farming: By types of farming, the vegetable gardening in Taiwan may be classified into the following four groups:

1. Home gardening: It has an important place in every household of rural Taiwan, varying in size from a small patch to 1/100 ha. or more. Several kinds of vegetable are produced by each family for home consumption. Cumulatively, they form a sizable portion of the total vegetable production of Taiwan. But since vegetables so produced seldom reach the market, they bear very little economic significance.

2. Market gardening: This type of vegetable gardening is developed in the vicinity of the large cities. For instance, in the outskirts of Taipei City, Kaohsiung City and Pingtung City, there are concentrated areas of vegetable farms engaged in commercial vegetable production on a year-round basis. Limited by natural land features, they form tracts varying from 100 to 300 hectares in size and are planted to different kinds of vegetable crops by the large number of vegetable growers each operating a small piece of land. On these lands, vegetables are grown all the year round to supply the nearby big cities with fresh vegetable. For example, in Hsinchuang, a suburban township of Taipei City, some 300 hectares of land is annually producing a vegetable crop enough to supply some 40 percent of the total amount consumed by the City's pouplation of about 1.3 million. The balance of the vegetable supply comes from other producing areas by land transportation.

3. Vegetable intercropping: This type of vegetable farming is another important type of gardening in Taiwan, especially when the farmers' income is concerned. By this method, vegetables are raised in the rice field during the winter season after the second or fall rice crop is harvested and before the first or spring rice crop of the next year is planted. Not infrequently, the vegetables are transplanted or sown between the rice rows a few weeks (usually from two to four weeks) before the harvest of the second rice crop. Many kinds of winter vegetables, especially the crucifers, are

planted in the fall in this manner. This relay-planting method is commonly called muddy-in cultural method by the farmers in Taiwan.

When the winter fallowed rice field is utilized, the farmers can afford to grow vegetables in much larger areas than other types of vegetable gardening without having to compete for land with the major farm crops in this particular period of year. This method is quite popular in the central and southern parts of Taiwan. According to a rough estimate, some 50,000 hectares of land out of total vegetable area of of 100,000 hectares are cultivated by inter-cropping. This type of vegetable farming is therefore unique in its importance to vegetable production and for providing additional income to the rice growers.

4. Vegetable forcing: The early varieties of tomato and cabbage sown in late spring or early summer for summer marketing are examples of this type of gardening. They are produced in limited quantities by a few experienced growers at selected spots of high altitude which is adaptable for the growing of these vegetable crops during the summer season in this tropical country. Though the crops so produced are of insignificant quantity and in view of their short seasonal of supply, they are much demanded by the city people and therefore command handsome prices.

B. kind of vegetable crops commercially cultivated:

Agaricacese

Agaricus compestris (Mushroom or Champignon)
Volvariella volvacea (Padi straw mushroom or Tsu-ku)
Lentinus spp. and Tricholoma spp.(Tung-ku or Shang-ku; Shiitake)

Amaranthaceae (Amaranth family)

Amaranth (Amaranthus mangostanus)

Aracear (Arum family)

Colocasia esculenta (Taro or Dasheen)

Chenopodiaceae (Goose Foot family)

Spinacia oleracea (Spinach)

Compositae (Composite family)

Lactuca sativa (Lettuce)

Lactuca sativa v. angustana (Celtuce)

Chrysanthemum coronarium (Tung Hao)

Convolvulaceae (Morning Glory family)

Ipomoea batatas (sweet patato)

Ipomoea aquatica (Water convolvulus)

Cruciferae (Mustard family)

Raphanus sativus var. longipinnatus (Chines radish)

Brassica oleracea var. capitata (Cabbage)

Brassica oleracea var. botrytis (Cauliflower)

Brassica pekinensis (Shangtung pai-tsai, heading type)

Brassica chinensis (Pai-tsai)

Brassica oleracea var. acephala (Kale)

Brassica juncea (Leaf-mustard)

Brassica caulorapa (Kohlrabi)

Brassica oleracea var. gemmifera (Brussels sprouts)

Brassica oleracea var. italica (Broccoli)

Brassica chinensis var. oleifera (edible rape)

Brassica napus (Rape)

Cucurbitaceae (Gourd family)

Cucumis sativus (Cucumber)

Benincasa cerifera (Wax gourd)

Citrullus vulgaris (Watermelon)

Cucurbita maxima (Squash)

Cucumis melo var. conomon (Oriental Pickling melon)

Lagenaria vulgaris (Calabash)

Luffa cylindrica (Vegetable sponge)

Momordica charantia (Balsam pear)

Sechium edule (Chayote)

Cucumis melo var. culta or reticulatus (Muskmelon)

Benincase hispida (Nodese wax gourd)

Gramineae (Grass family)

Phyllostachys spp (Bamboo sprout)

Zizania latifolia (Chiao pei)

Amaryllidaceae (Amaryllis family)

Allium fistulosum (Green onion)
Allium Porrum (leek)
Allium odorum (=A. tuberosum; Chiu Tsai)
Allium Cepa (Onion bulb)
Allium ascalonicum (Shallot or Scallion)
Allium Bakeri (Scallion or Chiao-tou)
Allium sativum (Garlic)

Liliaceae (Lily family)

Hemerocallis flava (Common Yellow Day-lily)
Hemerocallis fulva (Common Orange Day-lily)
Asparagus officinalis var. altilis (Garden asparagus)

Leguminosae (Pulse family) = Papilionaceae (Butterfly flower family)

Pisum sativum (Garden pea)
Pisum sativum var. macrocarpon (Edible pea pod)
Pisum sativum var. arvense (Field pea or purple flowered pea)
Pisum sativum var. humile (Early dwarf white flowered pea)
Vicia Faba (Broad bean)
Arachis hypogaea (Peanut or Groundnut)
Phaseolus vulgaris (kidney bean or common bean)
Phaseolus limensis (Lima bean)
Phaseolus aureus (Mung or green bean)
Vigna sinensis (Cowpea)
Vigna sesquipedalis (Asparagus bean or yard-long bean)
Pachryhizus erosus (Yam bean)
Dolichos Lablab (Hyacinth bean)
Dolichos Lablab var. purpureus (Purple hyacinth bean)
Dolichos Lablab var. albiflorus (White hyacinth bean)
Glycine Max (Soybean)

Malvaceae (Mallow family)

Malva verticillata (Mallow)
Hibiscus esculentus (Okra or Gumbo)

Zingiberaceae (Ginger family)

zingiber officinalis (Common ginger)

Nymphaeaceae (Water-lily family)

Nelumbo nucifera (Lotus root)

Solanaceae (Nightshade family)

Solanum tuberosum (Irish potato)
Solanum Melongena var. esculentum (Eggplant)
Lycopersicon esculentum (Common tomato)
Capsicum annuum var. grossum (Sweet pepper)
Capsicum annuum var. longum (Long hot papper)

Umbelliferae (Parsley family)
Daucus Carota var. sativa (Carrot)
Coriandrum sativum (Coriander)
Foeniculum vulgare (Fennel)
Apium graveolens var. dulce (Celery)

Family-wise, the pulse family, mustard family and gourd family consist of the largest number of vegetables. Most of the above listed vegetables are perishable and their supply to the market is limited strictly by their respective producing areas and seasons. Among the less perishable ones are peanut, yam bean, wax gourd, squash, hot pepper, onion bulb, garlic, taro and ginger. They have fairly good keeping and storing quality even when stored under simple facilities, and are important vegetables when the market is in seasonal short supply of fresh vegetables or when the supply is interrupted by typhoon or rainstorms.

C. Seasonal and geographical distribution of vegetable production

Of some 70 kinds of vegetables belonging to 17 families, half of them are produced between October and March when the fresh vegetable supply is at its highest of the year. It is apparent that the lowest production or the lowest supply of fresh vegetable is during the period from May to September. This uneven seasonal distribution is caused largely by the natural or climatic factors, i.e. the limited land available for vegetable gardening during the summer season and the problem of limited land area further aggravated by typhoon.

With regard to the geographical distribution of vegetable production, it is still true that the Changhua area or central Taiwan is the leading section of vegetable production in Taiwan, both from the view point of the quantity and kinds of vegetables produced. Prefectures along the east coast depend on shipments from other areas for their vegetable supply largely throughout the year.

The major producing areas of each of the important vegetable crops in Taiwan are shown in the following map. The increase in the production of most of the vegetables in recent years was attributed to the expansion of area, rather than the increase in the yield per unit area. In view of the shortage of arable land in Taiwan, future emphasis should certainly be placed on elevating the per unit vegetable production which will be further discussed in later sections.

Table 1. Leading Producing Areas of 14 Major Vegetable Crops (based on 1966 data)

Kind of vegetable	Provinical		Four leading producing areas							
			Prefection		Prefection		Prefection		Prefection	
	Total Production (MT)	Total area (Ha.)	Production (MT)	Area (Ha.)	Production (MT)	Area (Ha.)	Production (MT)	Area (Ha.)	Production (MT)	Area (Ha.)
Pea (Pisum sativum)	11,782	3,064	Changhua 7,812	2,001	Taichung 1,402	305	Hsinchu 294	115	Chiayi 277	59
Bean (Phaseolus volgaris)	20,943	2,965	Taichung 3,830	507	Kaohsiung 3,635	421	Pingtung 1,586	258	Chiayi 1,543	200
Cucumber (Cucumis sativus)	18,107	1,920	Kaohsiung 4,154	387	Taichung 2,239	216	Pingtung 2,100	244	Taichung City 1,977	127
Wax gourd (Benincasa cerifera)	14,686	1,293	Taipei 2,078	211	Changhua 1,871	116	Taichung 1,785	102	Tainan City 1,767	78
Watermelon (Citrullus vulgaris)	84,161	9,186	Yunlin 28,214	3,137	Kaohsiung 14,580	1,891	Miaoli 10,292	1,056	Chiayi 5,912	546
Squash (Cucurbita maxima)	7,849	955	Taoyuan 996	124	Taitung 892	88	Taichung 873	775	Pingtung 716	104
Oriental pickling melon (Cucumismelovar.conomon)	25,428	2,738	Taichung 5,316	314	Changhua 3,443	357	Taoyuan 2,410	282	Chiayi 2,038	248
Tomato (Lycopersicon esculentum var. commune)	31,307	2,951	Changhua 7,346	600	Kaohsiung 3,749	413	Taichung 3,281	324	Tainan 3,191	275
Eggplant (Solanum melongena var. esculentum)	14,050	1,728	Changhua 2,742	284	Pingtung 2,344	215	Taichung 1,639	200	Tainan 837	82
Pepper (Capsicum annuum)	2,977	366	Tainan City 1,010	40	Pingtung 723	85	Kaohsiung 268	46	Hsinchu 194	37

Chinese radish (Raphanus sativus var. longipinnatus)	113,271	10,484	Taipei	14,228	1,126	Taichung	13,250	1,173	Taoyuan	13,044	1,144	Miaoli	11,099	1,320
Carrot (Daucus carota var. sativa)	6,183	549	Taipei	2,839	218	Changhua	703	95	Tainan	434	29	Tainan City	386	17
Taro (Colocasia antiquorum var. esculenta)	20,827	3,532	Pintung	6,483	1,698	Taitung	2,219	295	Chiayi	1,234	148	Taipei	1,159	141
Ginger (Zingiber officinale)	12,101	1,599	Taitung	4,932	581	Ilan	1,442	164	Chiayi	854	110	Nantou	691	117
Potato (Solanum tuberosum)	16,015	1,219	Taichung	15,581	1,172	Nantou	186	19	Taichung City	113	10	Taoyuan	32	4
Wat r chestnut (Elecharis plantaginea var. tuberosa)	2,677	214	Changhua	729	63	Nantou	483	47	Tainan	408	25	Yunlin	272	12
Onion (Allium cepa)	18,614	719	Pintung	10,384	410	Taitung	2,809	71	Tainan	2,219	74	Kaohsiung	1,970	66
Garlic (Allium sativum)	22,969	2,581	Yunlin	4,894	451	Changhua	3,213	354	Ilan	2,654	279	Chiayi	2,477	265
Garlic bulb (Allium sativum)	9,903	1,317	Changhua	4,961	594	Tainan	2,005	350	Tainan City	1,369	195	Yunlin	360	136
Shallot (Allium ascalonicum)	26,726	3,101	Tainan City	3,720	341	Taoyuan	3,682	327	Taipei	2,618	277	Chiayi	2,614	293
Shallot bulb (Allium ascalonicum)	4,044	757	Tainan	3,715	692	Tainan City	150	30	Taitung	77	10	Chiayi	41	9

Chiu Tsai (Allium odorum)	14,558	1,982	Changhua	4,325	680	Yunlin	1,840	287	Taichung	1,468	124	Taipei	895	105
Asparagus (Asparagus officinalis var. altilis)	44,120	10,877	Changhua	12,177	2,453	Yunlin	6,364	1,577	Chiayi	5,680	1,449	Taichung	5,591	1,080
Bamboo shoot	28,126	4,244	Nantou	4,899	667	Taipei	4,323	851	Yunlin	3,019	480	Kaohsiung	2,567	294
Cabbage (Brassica oleracea var. capitata)	99,044	8,930	Changhua	17,390	1,401	Taoyuan	8,509	784	Chiayi	8,434	677	Taichung	7,624	617
Pai Tsai (White petioled cabbage) (Brassica chinensis)	64,220	7,244	Changhua	10,366	1,225	Taipei	10,064	898	Taoyuan	6,622	633	Taichung	4,750	477
Leaf-mustard (Brassica juncea var. rugosa)	57,027	5,469	Taichung	9,128	701	Taoyuan	8,862	845	Changhua	5,984	524	Miaoli	5,191	616
Water convolvulus (Ipomoea aquatica)	21,765	2,529	Taipei	2,521	238	Changhua	2,464	259	Taichung	2,165	242	Taoyuan	1,695	194
Celery (Apium graveolens var. dulce)	16,035	1,612	Taoyuan	2,635	245	Yunlin	1,760	88	Taipei	1,746	160	Changhua	1,237	143
Cauliflower (Brassica oleracea var. botrytis)	28,603	2,764	Taichung City	6,903	494	Changhua	4,636	477	Kaohsiung	2,699	308	Yunlin	2,566	210
Mushroom (Agaricus campestris)	38,454	1,156	Changhua	9,363	246	Taichung	7,668	225	Miaoli	5,357	186	Tainan	3,167	108

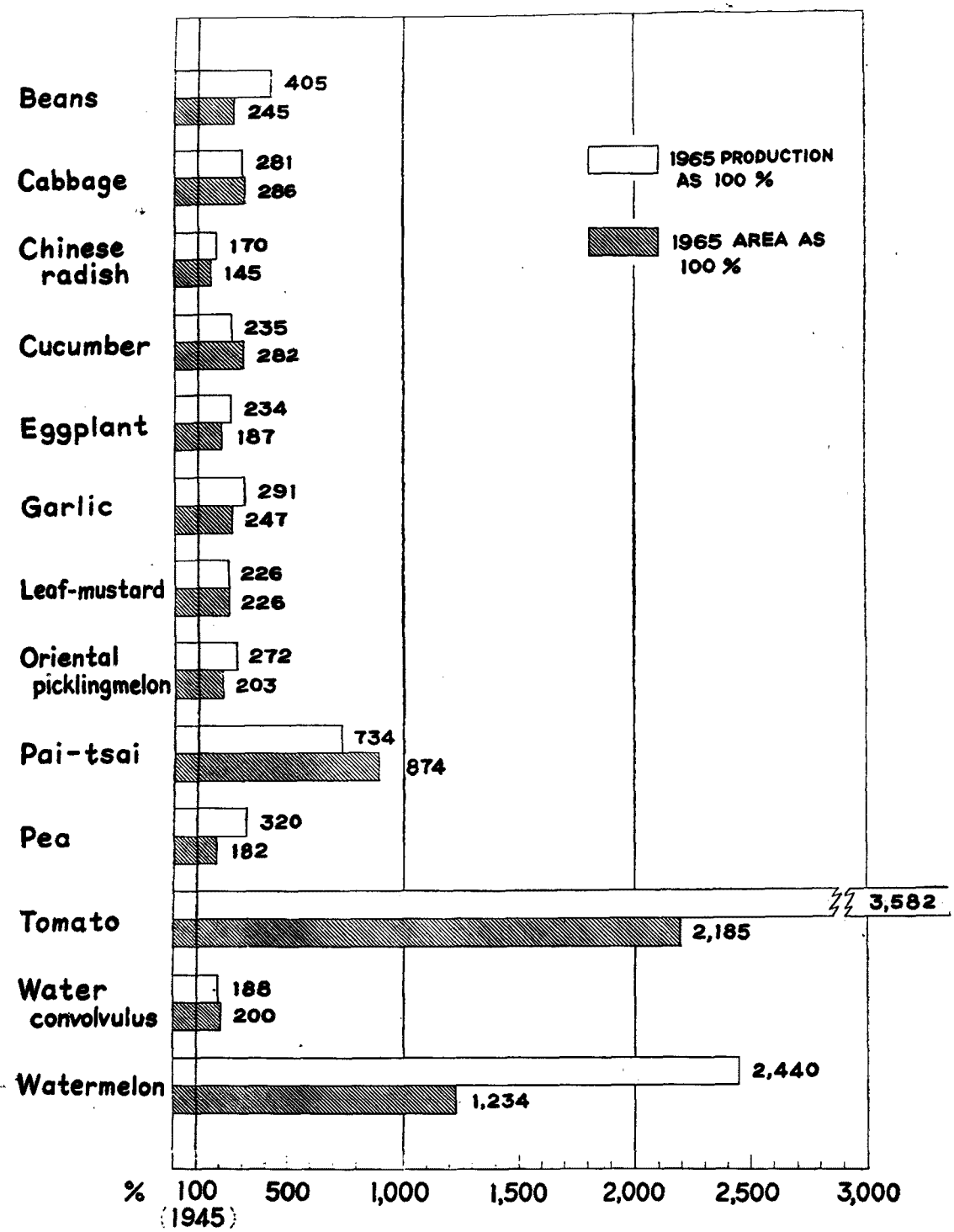
Table 2. Geographical Distribution of Vegetable Production on a Prefectural Basis (as of 1966 data)

Kind of vegetable	Prefectures (MT)								
	Changhua	Taichung	Taipei	Yunlin	Kaohsiung	Pingtung	Chiayi	Tainan	Taoyuan
Pea	7,812	1,402	—	—	—	—	277	—	—
Bean	—	3,830	—	—	3,635	1,586	1,543	—	—
Cucumber	—	2,239	—	—	4,154	2,100	—	—	—
Wax gourd	1,871	1,785	2,078	—	—	—	—	—	—
Watermelon	—	—	—	28,214	14,580	—	5,912	—	—
Squash	—	873	—	—	—	716	—	—	996
Oriental pickling melon	3,443	5,316	—	—	—	—	2,038	—	2,410
Tomato	7,346	3,281	—	—	3,749	—	—	3,191	—
Eggplant	2,742	1,639	—	—	—	2,344	—	837	—
Pepper	—	—	—	—	268	723	—	—	—
Chinese radish	—	13,250	14,228	—	—	—	—	—	13,044
Carrot	763	—	2,839	—	—	—	—	434	—
Taro	—	—	1,159	—	—	6,483	1,234	—	—
Ginger	—	—	—	—	—	—	854	—	—
Potato	—	15,581	—	—	—	—	—	—	32
Water chestnut	729	—	—	272	—	—	—	408	—
Onion	—	—	—	—	1,970	10,384	—	2,219	—
Garlic	3,213	—	—	4,894	—	—	2,477	—	—
Garlic bulb	4,961	—	—	1,360	—	—	—	2,005	—
Shallot	—	—	2,618	—	—	—	2,614	—	3,682
Shallot bulb	—	—	—	—	—	—	41	3,715	—
Chiu Tsai	4,325	1,468	850	1,840	—	—	—	—	—
Asparagus	12,177	5,591	—	6,364	—	—	5,680	—	—
Bamboo shoot	—	—	4,323	3,019	2,567	—	—	—	—
Cabbage	7,390	7,624	—	—	—	—	8,434	—	8,509
Pai Tsai	10,366	4,750	10,064	—	—	—	—	—	6,622
Leaf-mustard	5,984	9,128	—	—	—	—	—	—	8,862
Water convolvulus	2,464	2,165	2,521	—	—	—	—	—	1,695
Celery	1,237	—	1,746	1,760	—	—	—	—	2,635
Cauliflower	4,636	—	—	2,566	2,699	—	—	—	—
Mushroom	9,363	7,668	—	—	—	—	—	3,167	—

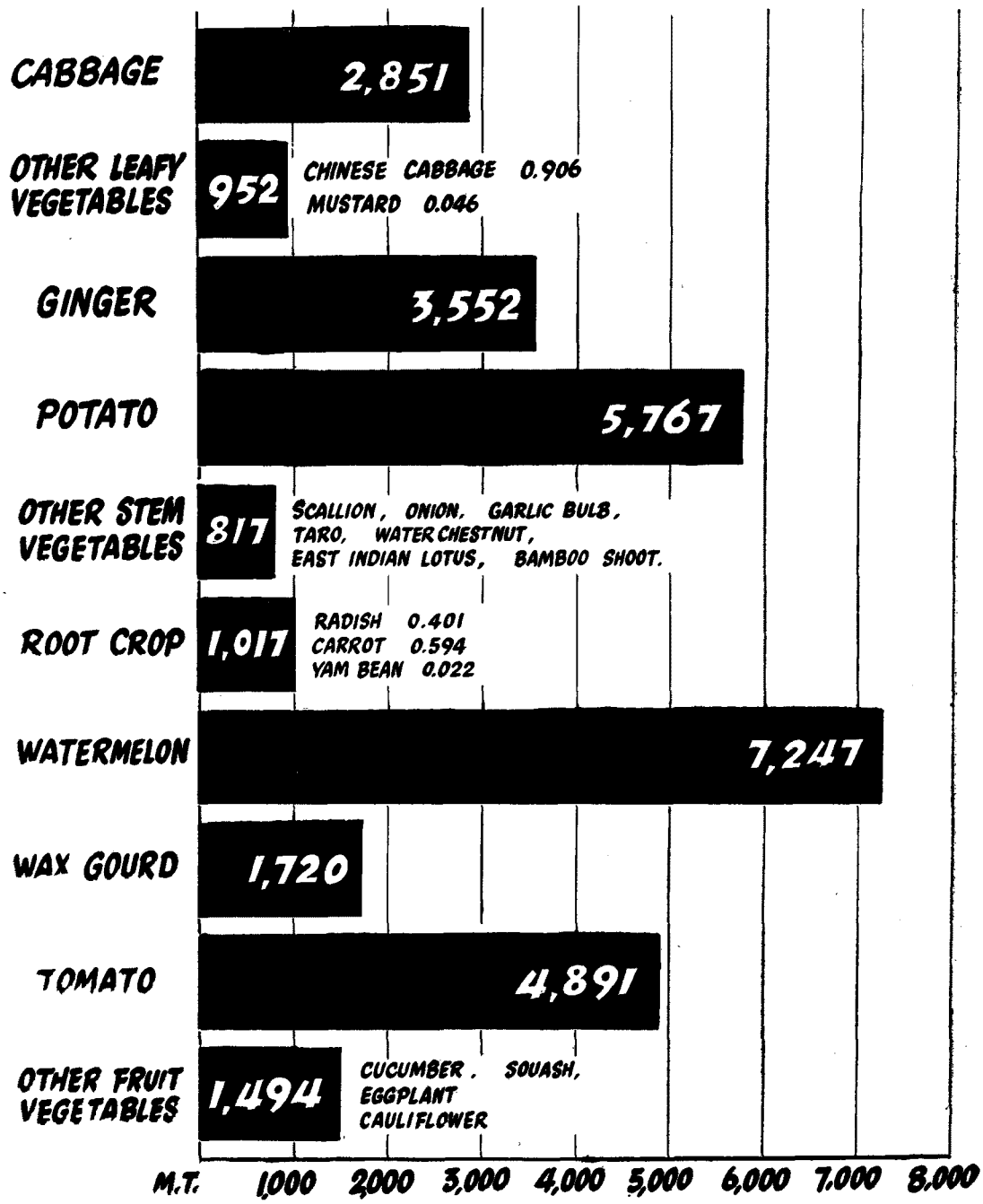
Table 3. Production of 14 Major Vegetables in Recent Years
(based on 1966 data)

Kind of Vegetable	1945	1950	1955	1960	1962	1963	1964	1965	1966	Index with 1945 as 100
Pea										
Production (MT)	3,598	10,899	9,594	7,430	8,374	8,962	8,225	11,534	11,782	328
Area (Ha.)	1,780	4,203	3,465	2,680	2,613	2,875	2,234	3,242	3,064	172
Bean (Phaseolus group)										
Production (MT)	5,313	11,297	13,018	16,447	16,876	18,372	20,461	21,513	20,943	394
Area (Ha.)	1,201	2,175	2,345	2,565	2,558	2,708	2,862	2,949	2,965	247
Cucumber										
Production (MT)	7,932	8,103	10,103	15,726	15,721	17,094	17,146	18,659	18,107	228
Area (Ha.)	663	1,127	1,300	1,748	1,670	1,801	1,692	1,872	1,920	290
Wax gourd										
Production (MT)	6,345	8,682	11,764	13,566	14,932	15,590	15,288	16,281	14,686	231
Area (Ha.)	518	870	1,111	1,288	1,322	1,329	1,256	1,287	1,293	250
Watermelon										
Production (MT)	3,168	17,127	24,772	48,315	59,562	79,770	95,143	77,329	84,161	2,657
Area (Ha.)	593	2,210	3,615	6,240	7,359	10,598	10,239	7,317	9,186	1,549
Squash										
Production (MT)	13,033	8,151	8,065	8,886	8,431	8,171	8,241	8,599	7,849	60
Area (Ha.)	1,298	976	974	970	985	938	950	963	955	73
Oriental pickling melon										
Production (MT)	10,601	27,955	28,305	35,962	29,701	34,364	29,366	28,829	25,428	240
Area (Ha.)	1,400	3,295	3,228	4,068	2,412	3,460	2,949	2,849	2,738	196
Tomato										
Production (MT)	863	5,305	11,881	23,664	27,086	25,459	27,232	30,912	31,307	3,628
Area (Ha.)	134	650	1,414	2,591	2,761	2,997	2,873	2,924	2,951	2,202
Eggplant										
Production (MT)	6,343	10,548	11,646	13,792	13,484	14,312	14,838	14,859	14,050	222
Area (Ha.)	982	1,606	1,668	1,839	1,834	1,880	1,850	1,843	1,728	176
Chinese radish										
Production (MT)	70,487	140,400	114,873	126,667	127,070	131,176	121,687	120,091	113,271	161
Area (Ha.)	7,723	15,967	13,250	12,647	12,658	13,199	11,711	11,201	10,484	136
Taro										
Production (MT)	12,870	17,565	20,717	22,577	21,486	20,285	23,595	21,613	20,827	162
Area (Ha.)	1,902	3,789	4,068	3,904	3,700	3,874	3,989	3,526	3,532	185

Ginger										
Production	(MT)	4,813	5,596	6,124	8,760	14,386	14,416	11,512	15,546	12,101	251
Area	(Ha.)	834	1,005	1,083	1,188	1,552	1,586	1,586	1,629	1,599	192
Potato										
Production	(MT)	87	983	2,809	7,427	7,856	9,773	19,152	16,136	16,015	18,408
Area	(Ha.)	34	282	509	732	944	1,303	1,612	1,234	1,219	3,585
Garlic										
Production	(MT)	7,752	16,729	24,040	31,337	28,733	41,116	25,218	22,571	22,969	296
Area	(Ha.)	1,008	2,467	3,179	3,839	4,155	4,348	3,155	2,498	2,581	256
Shallot (or green onion)										
Production	(MT)	12,581	21,270	24,617	27,150	26,614	28,373	25,081	26,296	26,726	212
Area	(Ha.)	1,856	2,825	3,231	3,539	3,533	3,629	3,210	3,015	3,101	167
Chiu Tsai										
Production	(MT)	9,360	11,670	16,373	18,499	18,362	18,682	20,054	19,111	14,558	156
Area	(Ha.)	1,123	1,487	1,982	2,217	2,212	2,149	1,957	1,897	1,982	176
Cabbage										
Production	(MT)	37,277	85,404	90,184	95,972	98,529	100,953	99,520	104,864	99,044	266
Area	(Ha.)	3,060	7,497	8,863	8,631	8,658	8,819	8,578	8,759	8,930	292
Pai Tsai										
Production	(MT)	9,535	25,355	46,285	70,793	68,898	72,496	68,709	70,024	64,220	674
Area	(Ha.)	803	3,676	5,744	7,537	7,336	7,554	7,005	7,020	7,244	902
Leaf-mustard										
Production	(MT)	27,270	68,164	62,540	60,553	60,124	65,060	57,412	61,838	57,027	209
Area	(Ha.)	2,509	6,165	5,701	5,839	5,697	6,176	5,503	5,678	5,469	218
Water convolvulus										
Production	(MT)	11,508	15,351	16,404	20,483	19,805	21,678	20,815	21,681	21,765	189
Area	(Ha.)	1,169	1,748	1,942	2,335	2,240	2,404	2,342	2,338	2,529	216
Celery										
Production	(MT)	11,256	12,509	12,838	14,714	15,366	16,282	14,165	14,887	16,035	142
Area	(Ha.)	816	1,345	1,450	1,676	1,666	1,771	1,553	1,572	1,612	198



Graph 1. Percentage Increase of Vegetable Production and Planted Area in 1945 and 1965



Graph 2. Fresh Vegetables Exported from Kaohsiung Harbor in 1966

II. Improvement programs conducted in the past

A. Onion

The onion bulbs consumed in Taiwan before 1954 were totally imported from Japan at the expense of about half million U.S. dollars annually. After repeated study on the cultural method and the choice of proper varieties by the Taipei District Agricultural Improvement Station and the Fengshan Tropical Horticultural Experiment Station, the commercial-scale production of onion in Taiwan was finally started in the fall of 1954 under the sponsorship of the Taiwan Provincial Department of Agriculture and Forestry (PDAF) with the financial and techincal assistance from the Joint Commission on Rural Reconstruction (JCRR).

Fall planting as well as the planting of sets was proved very successful with varieties Early Grano and Burmuda. Harvesting is practised in March and May of the following year. The onion growing region has been moved from central Taiwan to the southern part of the Island in view of the latter's sunny and dry weather desirable to the maturity and harvesting of this crop. The average yield of dry bulb varies from 30 metric tons to 50 tons per hectare. Because of the success in trial growing of onion bulbs in Taiwan, the export of this once imported vegetable is made possible. The volume of the annual export now ranges from 0.5 million boxes to 1.2 million boxes, each box containing 30 kilograms of bulb onions, and the bulk of such export goes to Japan.

B. Watermelon

Watermelon is growing extensively in Taiwan and this fruit is marketed nearly all the year round on the local market. Evidently it is one of the most popular fruit crops. However, most of the fruit crop was of poor quality; thus how to produce a crop with uniform quality and high sugar content as well as good shipping quality naturally became the centre of our attention. In this connection, both the Fengshan Tropical Horticultural Experiment Station and the Taipei DAIS have contributed most of their efforts in developing the triploid watermelon varieties since 1956.

After years' research and trial planting, desirable combinations of

triploid and diploid have been developed by the Fengshan Tropical Horticultural Experiment Station. The commercial growing of Triploid watermelon was started in early 1960's. Fengshan No. 1 is the most outstanding seedless variety successfully bred by the Fengshan Tropical Horticultural Experiment Station. The export of Triploid watermelon to the Hongkong market in early 1960's fetched very favorable prices, thus accounting for the expended growing acreage of Triploid watermelon in Taiwan. In the year of 1966, the total acreage planted to Triploid was as high as 100 hectares and it is anticipated that 200 more hectares will be added within two or three years.

C. Mushroom

Research workers at the Taiwan Agricultural Research Institute (TARI) and JCRR have made constant effort in developing a mushroom growing technique under the climatic conditions of Taiwan since 1950. Fortunately, the scientific method of growing mushroom in the winter season was finally developed by TARI in 1955, and since then a bumper crop has been harvested annually as a fresh vegetable for the local market.

Since the application of synthetic compost, ie., rice straw enriched with chemical fertilizer, commercial growing on a large scale was made possible. After the mushroom—canning technique was introduced into Taiwan in 1958, mushroom canning industry has become one of the most important enterprices in Taiwan to-day. In 1966, the growers engaged in mushroom growing amounted to some 50,000 farm-families and the total production reached 30,000 metric tons annually.

Mushroom growing is still new to most of the farmers in Taiwan and its development is rather short compared with other crops; meanwhile, the number of research workers specializing in mushroom science is very limited, yet the history of mushroom growing is so young in Taiwan that the growers are confronting with many problems such as the method of spawning, composting as well as plant protection technique. Therefore, the problems of how to improve the growing technique and how to solve the day to day problems are becoming increasingly important every year. Along with the growing of mushroom, another crop which is getting popular especially during the summer season is the production of padi-straw mushroom.

In Taiwan the mushroom growing period fall in November through March of the next year, providing four full months' sideline production for the farmers, while the growing of padi-straw mushroom is limited to the hot summer months up to the early fall.

D. Asparagus

In face of limited arable land in Taiwan coupled with the prevailing intensive rotation system, the growing of such crop as asparagus which requires land space for a considerable length of time would theoretically not be considered either by the growers or by the agricultural workers. However, the trial planting of Mary Washington, University of Calif. No. 309 and 711 made in 1955 showed excellent results. Consequently, commercial planting of this new vegetable crop was made possible in early 1960. A rapid expansion of asparagus acreage followed when the export market was promising in 1961 through 1963. The total acreage of this crop in 1966 was over 10,000 hectares.

In fact, the trial planting was first made at the Taipei District Agricultural Improvement Station, and then the DAIS in Hsinchu, Tainan, and other areas followed the same pattern with technical assistance provided by Taipei DAIS. As a result of the Island-wide trial planting, this new vegetable crop attained wide adaptation in areas where sandy soil is available. Coastal areas as well as river beds are the most suitable places for growing this crop.

It is interesting to note that the asparagus plants show a very short period of dormancy or almost no dormancy at all under the climatic conditions of Taiwan. The high quality of spears or shoots are obtained during the season when the atmospheric temperature range is around 18-25°C. Instead of having one harvesting season as in other asparagus-producing countries, the harvesting of asparagus in Taiwan is done in two distinctive seasons, i.e. the Spring and the Fall harvesting. Cuttings made from April through June is called Spring crop and those harvested from July through September is classified as Fall crop.

Studies on the method of fertilizer application, spacing, planting and irrigation have been extensively conducted at concerned District

Agricultural Improvement Stations (DAIS) under JCRR-supported projects; while the extension programs were carried out by DAIS and Farmers' Associations at different levels under the sponsorship of the Provincial Department of Agriculture and Forestry (PDAF). Good coordination between research and extension programs is maintained among parties concerned. The annual pack of this new vegetable has aggregated slightly over one million cases of standard pack by some 130 canneries scattered all over the Island.

E. Edible Pea-pods

Taichung No. 9 was and still is the famous pea-pod variety bred by the Taichung District Agricultural Improvement Station in pre-war years. This particular variety has attained its reputation not only in Taiwan but also in the international field for the past twenty years or more for its delicate quality and early maturity. In Hawaii, several varieties have been bred by plant breeders with the introduction of Taichung No. 9 either as a mother plant or as a male plant. The edible pea-pod is still planted as a winter crop on a extensive scale in central Taiwan as a fresh vegetable as well as a green manure crop to suppliment the organic matter in the rice fields.

However, since the introduction of the modern food technology into Taiwan, especially the technique of making frozen vegetable employed in early 1960, the edible pea-pod was the first crop selected for testing. As a result, more pea-pod was demanded by the frozen plants because the frozen commondity commanded a very favorable price on the international market. In order to further improve the quality of the frozen pea-pod, the Taichung DAIS has concentrated its effort on varietal improvement through introduction. At present, introduced varieties such as 1)Prince, 2)Melting Sugar, 3)Dwarf White Sugar are judged superior in quality than Taichung No. 9 or the Native White Flower varieties.

All the improvement work on pea-pod, both varietal and cultural improvement, is currently converged in central Taiwan under the leadership of the Taichung DAIS. However, the quality of frozen products is determined by selected frozen food factories in cooperation with the Provincial Department of Agriculture and Forestry. It is

anticipated that more quality edible pea-pod suitable for the frozen industry will be produced as soon as desirable varieties and efficient cultural methods are made available to the growers in the near future.

The above mentioned improvement or development programs for the selected vegetable crops with the most outstanding results represent part of the achievement made by various PDAF's DAIS and experiment stations concerned in cooperation with JCRR. In addition to these accomplishments the JCRR-supported vegetable improvement programs may be summerized into the following categories since 1952:

A. Introduction and trial planting of newly introduced foreign vegetable varieties.

B. Regional test and extension of newly developed vegetable crops.

C. Physical, financial and technical support to vegetable seed production in an effort to build up a vegetable seed production and distribution system in Taiwan.

Picture 3. Commercial Vegetable Fields in Taiwan

Asparagus field

Watermelon field

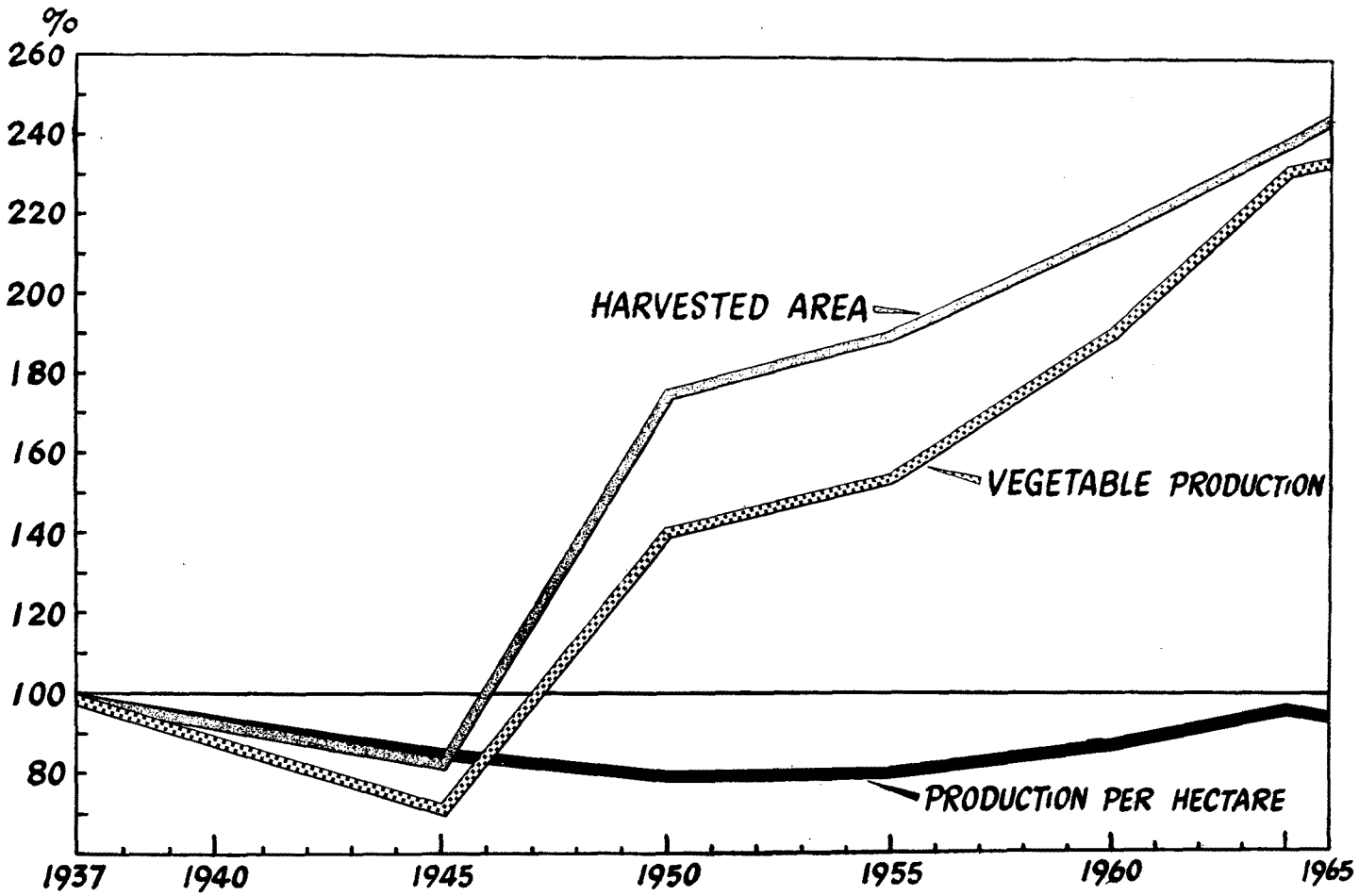
Cauliflower field

Cabbage field

Tomato field

Eggplant field

Sketch 1. Multiple Cropping System of Paddy Fields in Taiwan, China



Craph 3. Changes in Vegetable Production

YEAR	ACREAGE		PRODUCTION		UNIT YIELD	
	HA.	INDEX	M.T.	INDEX	KG/HA	INDEX
PRE-WAR RECORD 1937	42,093	100	417,361	100	9,915	100
RESTORATION 1945	35,319	83.9	302,575	72.5	8,567	86.4
1950	74,299	176.4	590,981	141.6	7,954	80.2
1955	80,442	191.0	648,211	155.4	8,058	81.2
1960	91,600	217.6	802,801	192.1	8,764	88.3
1964	101,106	240.2	973,875	233.3	9,642	97.2
1965	103,872	246.7	982,744	235.4	9,460	95.4

Table 4. Evolution of Vegetaale Production

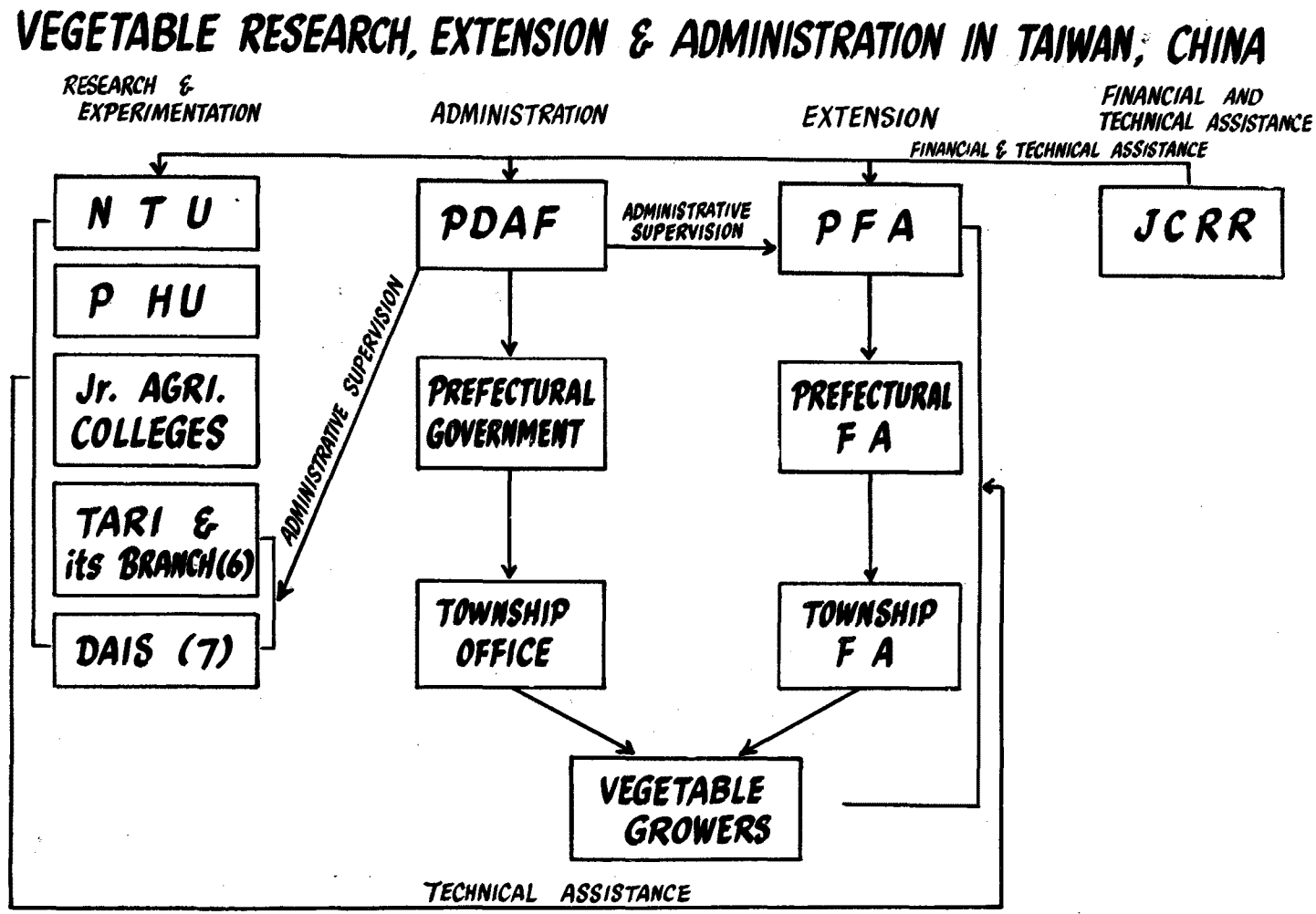


Chart 1. Vegetable Research, Extension and Adminstration in Taiwan, China

III. Problems of Today

A. Inadequte supply of fresh vegetable during summer months

The shortage of fresh vegetables during summer in Taiwan is due mainly to the fact that most of the rice fields which are used for growing vegetables in the winter are occupied by rice or other crops and hence no longer available for growing vegetables. Futhermore, in spite of the high prices of vegetables during the summer months, most vegetables, especially the leafy ones, are poor land competitors in the summer, as they are subject to frequent damages from typhoon, rain storm, high temperature and pest infestation.

The problem of vegetable shortage in summer-time is basic in nature and cannot be solved overnight. There should be two ways of approach to gradually improve the situation. Vegetable forcing should be encouraged for the growers to raise vegetable at higher altitudes where the summer climate is more tolerable to most vegetable crops. A past survey indicated that areas suitable for such purpose may be found in Yangmingshan, Ali-shan and a number of spots along the Cross-Island Highway. With the progress of modern technology as well as the improved transportation facilities, we shall be able to know more about the whereabouts of other places where summer vegetable forcing may be developed.

Furthermore, in order that more vegetable could be grown in the summer, varieties tolerant of the local summer weather must be developed. When the yield of the summer vegetable becomes more stabilized, the farmers will automatically be attracted to grow more vegetables. Notable results have already been produced in the recent year's development of the Fenghan Paitsai, a Chinese cabbage variety and summer cabbage varieties. When more varieties like these are developed, the summer vegetable production in Taiwan is bound to increase.

When summer varieties with reliable yields are made available, farmers will be willing to invest in the application of more fertilizers, pesticides, and more intensive cultural method, which will result in further increase in both the yield and the land competitive power of the vegetables.

B. Production of quality vegetable seeds

The work that can bring immediate results to the vegetable growers is to improve the supply of seeds through improved seed technology. But the improvement of vegetable seed production has to be started almost from scratch.

To provide the local farmers with quality seeds is especially difficult, for the vegetable growers have been producing seeds by themselves for years or generations in Taiwan. The problem is how to make them produce more seeds of pure reliable quality and to establish a sound marketing channel between the seed producers and the growers. For those imported seeds, studies should first be made as to the feasibility of producing them locally by overcoming specific limiting factors.

Some simple but effective regulations for the inspection of vegetable seeds should be promulgated to ascertain the quality of both locally produced and imported seeds. The production and supply of quality vegetable seeds should be promoted and supervised by government agencies at first in order to establish a rational supply system, but eventually it should be commercialized and made into a regular trade, when the importance of producing, selling and using pure and quality seed is widely recognized.

The great majority of seedsmen or seed dealers in Taiwan did not and still do not operate any seed farm of their own, nor do they know any thing about uniformity and purity of seed. Consequently, seed lots marketed varied greatly from time to time and also varied widely from one seed grower to another. Moreover, the method of storage and the technique of handling vegetable seeds as well as the facilities involved are inadequate, thus resulting in low germination of vegetable seeds when marketed after a long period of storage under the warm and humid weathr conditions of Taiwan. These problems could not be solved at a stroke nor by technical improvement alone, it must call for concerted efforts, provided that adequate financial support is available to the coordinated improvement program.

C. Primitive post-harvest handling technique resulted in heavy loss

The grading, packing, handling and storage of vegetables in Taiwan are still handled in a crude way today. They tend to devalue the fresh vegetables and induce spoilage and are a loss sustained by not only the growers but also the middlemen consumers. Standardization of these practices should be the goal to be achieved, for once standardized improved measures could be introduced and widely adopted. Here we are again faced with the lack of researches on these important subjects. However, at this early stage, for improving this type of practices, we may be satisfied with some practical trials without going into elaborate research projects. The first objective should be to seek and eliminate the most obvious and prevailing malpractices and, in their places, standard measures to be easily adopted by the local farmers should be recommended.

Based on a rough estimate, a minimum of over 20 per cent of loss was commonly experienced by the wholesale and retail market. This loss if calculated in terms of tonnage would amount to more than 200,000 metric tons of fresh vegetable at an stimated value over NT$400,000,000 annually. Moreover, in addition to the heavy loss, the quality of the remaining 80 per cent of the fresh vegetable when shiped to the market would also be greatly affected. Although no survey or study has ever been made on the weight loss, effect of freshness, changes in the food value or composition of crops, this safe to say that there must be a significant lowering of the quality of the fresh vegetable as a whole.

All the improvement work in this field would require specific training in chemistry, physics, plant physiology, biochemistry and other sciences related to plant science. Unfortunately, there is no such a training program or courses offerd by the college of Agriculture in Taiwan today. Therefore, to develope the post-harvest handling technique in addition to training the people would be the only way to cope with the present situation. In this connection, government assistance in making constant inspection and providing guiding lines for application of proper post-harvest handling treatment would naturally improve the situation.

D. Increasing demand for salad crop and processed vegetables

Comparatively speaking, the salad crop is not popular in Taiwan, yet its market demand is increasing in recent years due to the fact that more tourists are visiting this Island and more people from other countries are staying for a certain length of time in Taiwan than it was ten year ago. In spite of the expansion of the chemical fertilizer industry, the supply of fertilizers is still somewhat limited due to the complicated allocation system as well as the stiff prices to be paid by the growers. Consequently, vegetable growers are applying efficiently the farm manure supplemented with chemical fertilizers, thus rendering the production of salad crop by clean cultivation more or less affected.

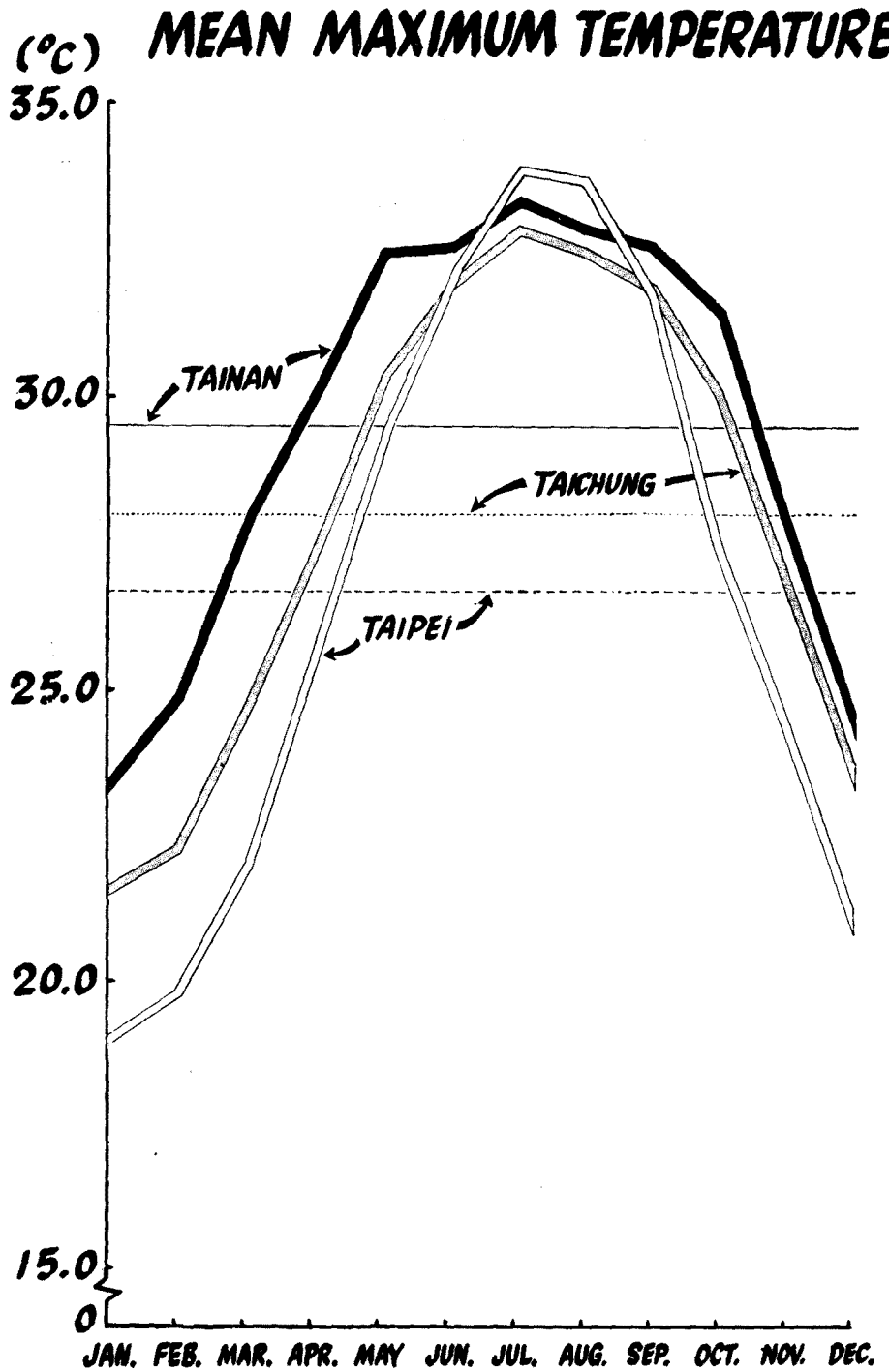
After the completion of the Cross-Island Highway and several years' trial planting of the vegetable at the selected high altitude, the growing of salad crops in these areas has been both successful and profitable. Efficient use of chemical fertilizers become the only way out for growing vegetables in these areas because the supply of other types of fertilizer is neither available nor economical. Clean cultivation for the growing of salad crops could be developed gradually at high altitudes as long as the market demand remains stable.

On account of the recent development of food processing industry in Taiwan and the increasing demand on the world market, the production of quality fresh vegetables for processing is becoming an urgent task. After a careful study it was found that the type and variety of several kinds of vegetables are not suitable for processing purposes. Therefore, to understand the market demand as well as the market preference, especially the variety of each specific vegetable crop for a particular foreign market, would be the first problem to be solved before making any attempt at extension and processing. For instance, the garlic variety having high soluble solid content is desirable for making garlic powder and the snow white cauliflower variety is preferable to the cream white ones by the U.S. frozen food importers.

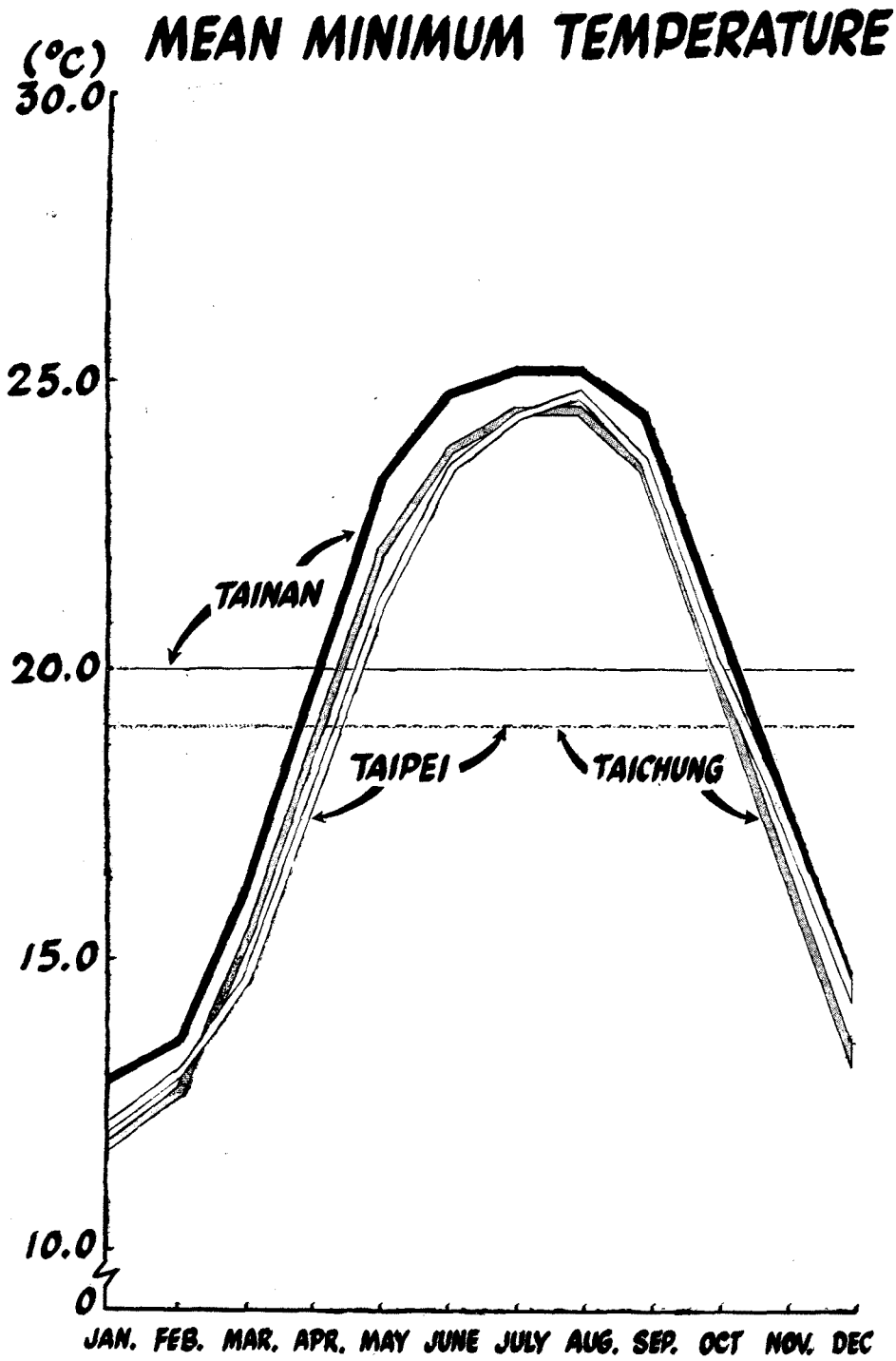
IV. Conclusion

The acreage and production of many vegetables have been expanded rapidly in recent years, sheer from the increasing demand of the growing population and the general elevation of the people's standard of living. The demand for more vegetable of more even seasonal distribution is still growing. On the order hand, due to the general limitation of arable land, as with many other crops, vegetable production in the future must strive for higher yield per unit area and fit into the existing rotation system with the major farm crops.

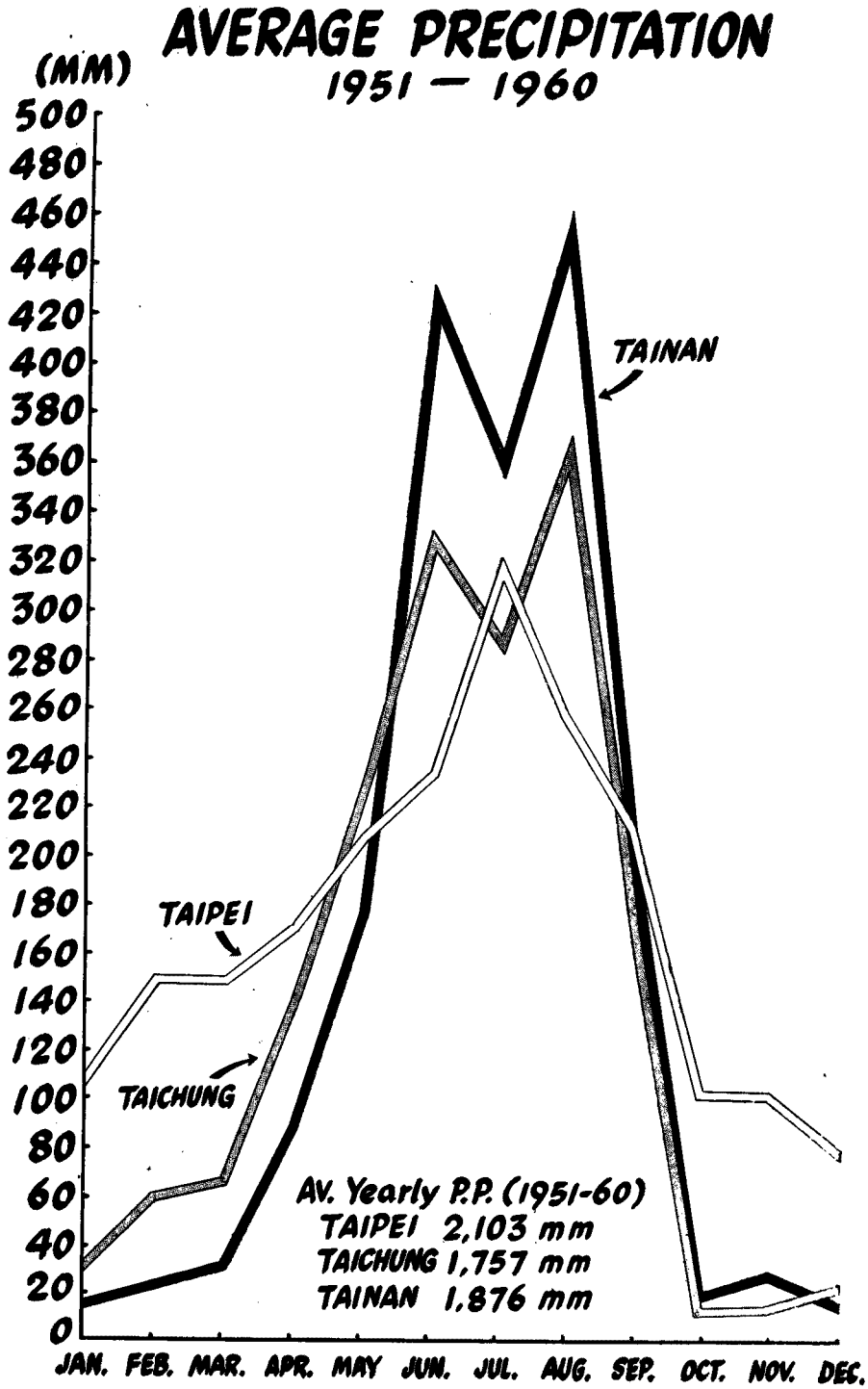
Some pioneer work on the improvement of vegetable crops done by a few agricultural improvement stations, horticultural experiment station and farmers' associations concerned has produced promising results, attracting the attention of government officials, packers, exporters and the general consumers as well as the vegetable growers. It is now time for looking ahead and striving for the futher improvment of vegetable production in Taiwan both quantitatively and qualitatively, thereby providing a balanced diet for the general populace.



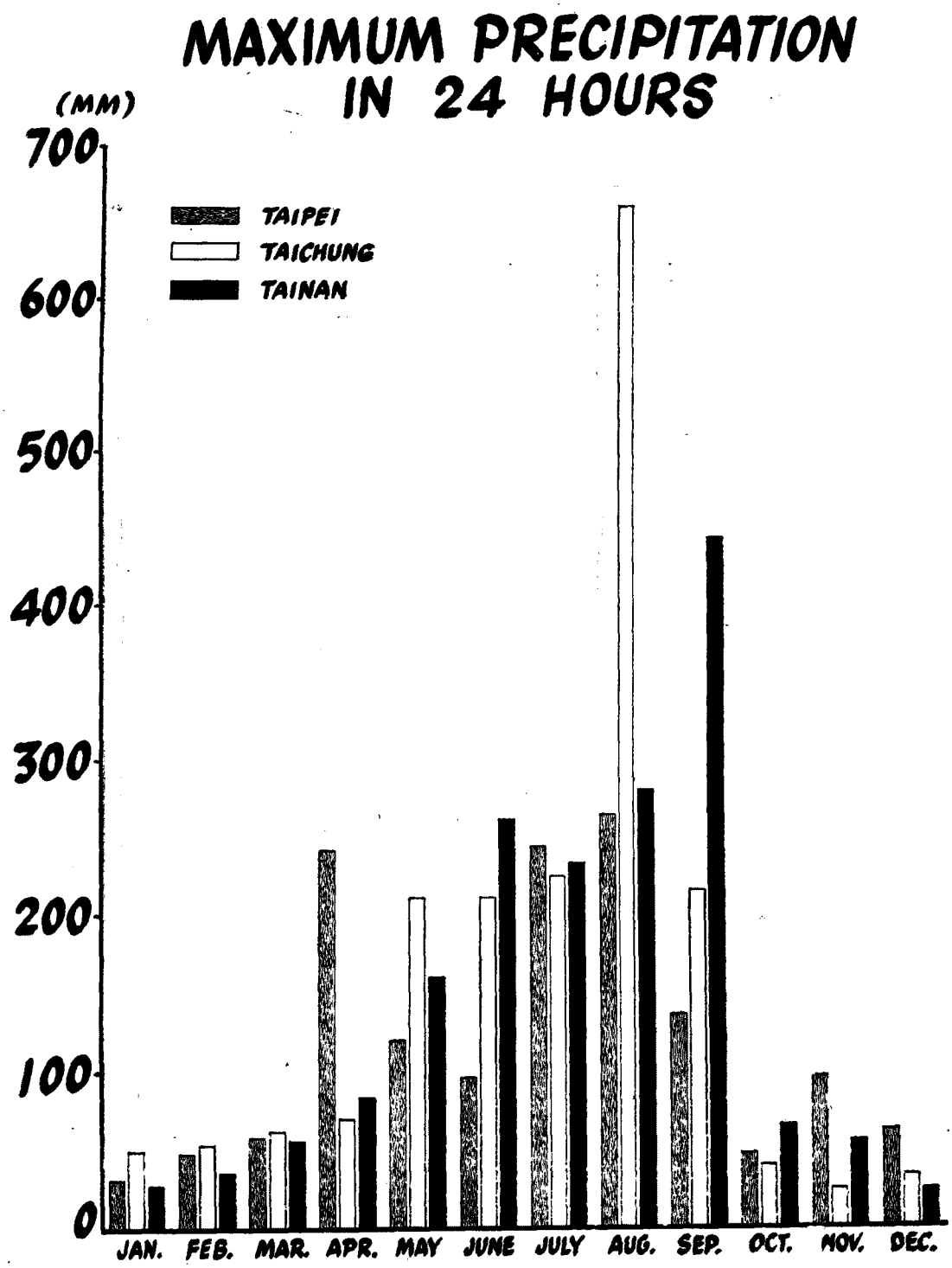
Graph 4. Mean Maximum Temperature



Graph 5. Mean Minimum Temperature



Graph 6. Average Precipitation



Graph 7. Maximun Precipitation in 24 Hours