A study on the guaranteed sugar price in Taiwan
by Chwei-lin Fan

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Economics
Montana State University

Abstract:
This report reveals farm survey research applying to the guaranteed sugar price in Taiwan. The minimum guaranteed sugar price is determined on the basis of survey data furnished by the Taiwan Sugar Corporation and is announced by the government prior to the period of planting of each cane crop year. Since 1957 the sugar support price in Taiwan has served as a reliable method for the government's sugar-price policy making and has also been broadly welcomed by most cane growers as a guidance for their farm planning.

Part I presents some basic facts about Taiwan's agriculture. Part II reviews the history of fluctuating income and rice-sugar cane competition in Taiwan. Part III describes the research problem from standpoints of the government , the Taiwan Sugar Corporation, and the cane producers. Part IV points out the objectives and procedures of the study. The aims of the guaranteed sugar price survey are to stabilize the local sugar industry. Part V shows the hypotheses used by the Taiwan Sugar Corporation in the study which was used as the basis for the government's announced guaranteed sugar price. The hypotheses are that as the result of the guaranteed sugar price are: (l) farmers will prefer to plant sugar cane, (2; the Taiwan Sugar Corporation might obtain enough raw cane material to operate the sugar factories, and (3) the government can maintain at least the past, level of foreign exchange earned by sugar export.

Part VI contains the presentation of data and analysis of the effect of the price program. This is the heart of the paper. This part includes the model used for computing the guaranteed, sugar price analysis of the number of sampled farm families and the acreage of planted cane, and the three years' results of the study of guaranteed sugar price for different head sugar factory areas and fields. Part VlI is a summary and conclusion of the study. The guaranteed sugar price can be used to insure a level of sugar cane production which will at least maintain the present level of sugar export. However, because one guaranteed sugar price is announced for all areas and all field types, some re-location of sugar cane production on Taiwan can be expected.

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in

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Any errors or omissions in this study are the responsibility of the author.

ABSTRACT

This report reveals farm survey research applying to the guaranteed sugar price in Taiwan. The minimum guaranteed sugar price is determined on the basis of survey data furnished by the Taiwan Sugar Corporation and is announced by the government prior to the period of planting of each cane crop year. Since 1957 the sugar support price in Taiwan has served as a reliable method for the government's sugar-price policy making and has also been broadly welcomed by most cane growers as a guidance for their farm planning.

Part I presents some basic facts about Taiwan's agriculture. Part II reviews the history of fluctuating income and rice-sugar cane competition in Taiwan. Part III describes the research problem from standpoints of the government, the Taiwan Sugar Corporation, and the cane producers. Part IV points out the objectives and procedures of the study. The aims of the guaranteed sugar price survey are to stabilize the local sugar industry. Part V shows the hypotheses used by the Taiwan Sugar Corporation in the study which was used as the basis for the government's announced guaranteed sugar price. The hypotheses are that as the result of the guaranteed sugar price are:

(1) farmers will prefer to plant sugar cane,
(2) the Taiwan Sugar Corporation might obtain enough raw cane material to operate the sugar factories, and
(3) the government can maintain at least the past level of foreign exchange earned by sugar export.

Part VI contains the presentation of data and analysis of the effect of the price program. This is the heart of the paper. This part includes the model used for computing the guaranteed sugar price analysis of the number of sampled farm families and the acreage of planted cane, and the three years' results of the study of guaranteed sugar price for different head sugar factory areas and fields. Part VII is a summary and conclusion of the study. The guaranteed sugar price can be used to insure a level of sugar cane production which will at least maintain the present level of sugar export. However, because one guaranteed sugar price is announced for all areas and all field types, some re-location of sugar cane production on Taiwan can be expected.

FORWARD

The Taiwan Sugar Corporation, under government support and in cooperation with the Chinese Rural Economics Association, has sponsored a long-run farm survey program since the 1955-56 crop year. The objective of this survey program is to collect farm data for sugar cane and its competitive crops. This data provides information needed to design an adequate support-price policy for sugar.

This writer was employed as a farm economic researcher by the Taiwan Sugar Corporation and the Taiwan Sugar Experiment Station for many years, and was assigned as one of the representatives of the Corporation participating in the study of the guaranteed sugar price for Taiwan. I visited all the sugar cane farms in every corner of the wide island, and got in touch directly with many contract farmers and each data collector to discuss farm management problems and survey techniques.

My study in the United States has been sponsored since July, 1959, by the Institute of International Education under a grant from the Council on Economic and Cultural Affairs, Inc. I believe that I am well equipped with the training I received from Louisiana State University, the University of Minnesota, and Montana State College.

This paper is a preliminary report of the largest scale farm survey in Taiwan's history. Although our research has been fruitful for our sugar price problem solving, further study in the rural economics of Taiwan should be improved and strengthened in the future by obtaining reliable knowledge through proper research methodology.

GLOSSARY OF ABBREVIATIONS AND TERMS

CREA	Chinese Rural Economics Association
ESB	Economic Stabilization Board
GSP	Guaranteed Sugar Price
ICA	International Cooperation Administration
JCRR	Sino-American Joint Commission on Rural Reconstruction
MEA	Ministry of Economic Affairs
MT	Metric Tons
NT $	New Taiwan Currency
NTU	National Taiwan University
TPCA	Taiwan Provincial College of Agriculture
TPFB	Taiwan Provincial Food Bureau
TPG	Taiwan Provincial Government
TSC	Taiwan Sugar Corporation

"Area" As used here, it means the same as district and region. Each area indicates a head sugar factory area within which are included three to six sugar factories. There are five head sugar factory areas in Taiwan from the central to the southern part--namely, Taichung area, Huwei area, Hsingying area, Tsungyeh area, and Pingtung area.

"Competitive crops" Generally, it means that sugar cane and rice are competing on the same land and at the same time; but the broad meaning is competition between sugar cane and a few kinds of crops such as sweet potatoes, soybeans, jute, cassava, peanuts, wheat, vegetables, etc., during the same period of time. However, tobacco, pineapples, bananas and other garden fruits are not included since tobacco is a monopoly with special high income and fruit crops need many years in their growth.

"Contract farmers" It means cane producers, cane planters, and/or cane growers. Their raw sugar cane material must be sent to the closest sugar factory for sugar extraction according to the contract signed between TSC and contract farmers.

"Fields" There are five kinds of fields in each area: two-crop field - double rice paddy field for producing rice twice a year; single-crop field - single rice paddy field for producing rice once a year; rotation field - crop rotation field partly irrigated; dry-plain field - plain field non-irrigated; upland field - hilly dry land.

"Guaranteed Sugar Price" There are two kinds of guaranteed sugar price: One is the suggested guaranteed sugar price which is computed by the Chinese Rural Economics Association using actual farm survey data; another is the announced guaranteed sugar price which is the minimum purchase price announced by the government prior to the sugar cane planting. The government announces one minimum price for all areas and all field types. The announced price is based principally on the suggested sugar price calculated by the Chinese Rural Economics Association. Usually the announced guaranteed sugar price is a little lower than the suggested guaranteed sugar price. If the world sugar price is less than the announced guaranteed sugar price, the farmer received the announced guaranteed sugar price.

"Intercropping" It is a special kind of crop system in which certain crops such as sweet potatoes, peanuts and beans are planted in the sugar cane field when the sugar cane is in the young stage.

"Investigator" He is the data collector, interviewer, and enumerator.

"Mud seedling" It means that sugar cane is planted in the rice field when the rice is not yet harvested.

"Period of growing" There are three different growing periods:
autumn planting, around 16-18 months;
spring planting, around 12 months;
ratooned planting, around 12 months.

"Planting period" There are three different planting periods: autumn planting, also called fall planting or early planting, which means sugar cane is planted from July to December;
spring planting, also called late planting, which means sugar cane is planted from January to March;
ratooned planting means sugar cane is reproduced by its own stubble without using a new seedling after harvesting.

"Sugar sharing". It means the sugar division between the Taiwan Sugar Corporation and contract farmers. The present ratio between contract farmers and Taiwan Sugar Corporation is 54:46.

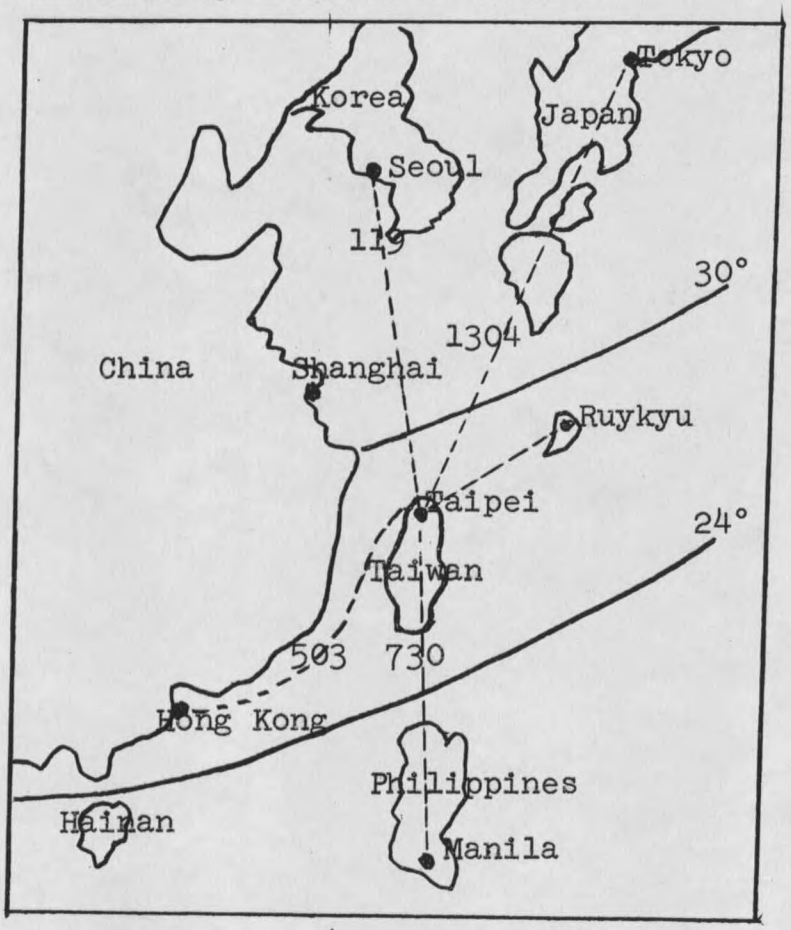
"Tai-chin" It is a unit of weight; roughly 1,000 Tai-chin equal 600 kilograms.

PART I

INTRODUCTION

Location

Taiwan, sitting astride the Topic of Cancer at the Western edge of the Pacific Ocean, is called Formosa (meaning "beautiful island"), and is separated from Fukien province of the Chinese mainland by a 100-mile strait.



Map I. Location of Taiwan[a] with Mileages to Major Points in the Far East.

a/ International Cooperation Administration, Economic Progress of Free China, Published in Taipei, Taiwan, 1958, p. 2.

Tobacco-leaf-shaped Taiwan is 240 miles long, north to south, and 85 miles at its greatest width. Its area of 13,885 square miles is about equal to that of Massachusetts, Connecticutt, and Rhode Island combined. More than two-thirds of the Island consists of rugged foothills and mountain ranges with some peaks 12,000 feet above sea level. The arable lands scattered along the western coast are planted with sugar cane, rice, sweet potatoes, and other miscellaneous crops. Steep, high cliffs plunge directly into the Pacific from the eastern coast.

Taiwan is about the same distance from Hong Kong to the southwest and Shanghai to the northwest. Four hundred miles northeast the Ryukyu Islands, of which Okinawa is the largest, lead to the Japanese archipelago, while Luzon, of the Philippines, lies 225 miles to the south.

Today Taiwan's population is estimated at ten million, including eight million Taiwan-born people and two million Chinese who have migrated from the mainland since the Communists swept over the whole China mainland in 1949.

Importance of Agriculture

The importance of agriculture in Taiwan's economy is indicated by the figures shown in Table I.

TABLE I. TAIWAN'S AGRICULTURAL BACKGROUND.*

Total land area (hectare)	3,480,000
Cultivated land (hectare)	870,000
As percent of total area	25 percent
Number of farms	770,000
Average size of farm (hectare)	1.3
Size of farm family	7 persons
Number of workers per farm	3
Total population	10,000,000
Percentage of population in agriculture	50 percent
Major agricultural products	rice, sweet potatoes sugar cane, pineapples and bananas
Percentage of agricultural income in national income	approx. 35 percent

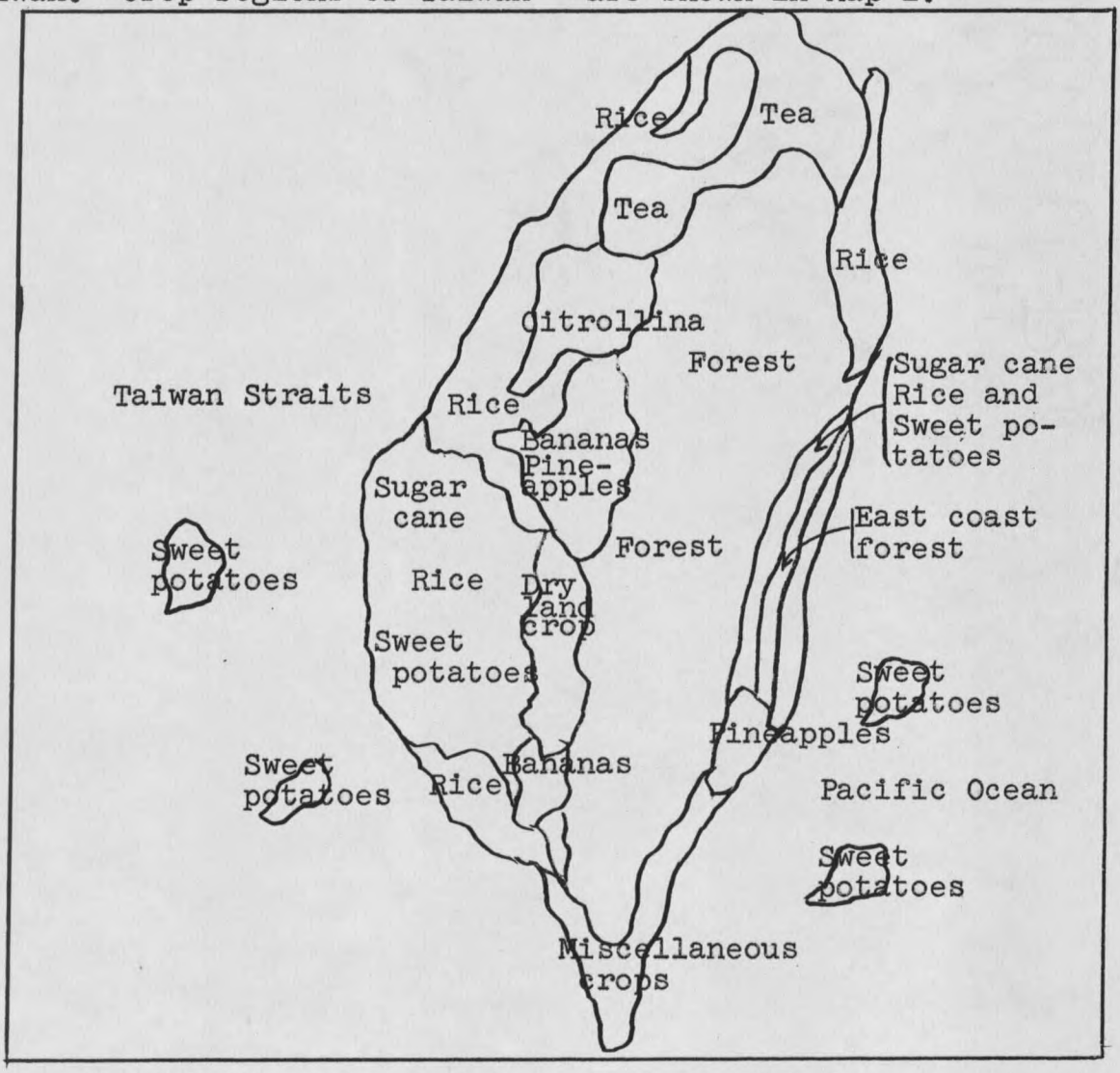
* Source: Sam-Chung Hsieh, Chief of Rural Economic Division, Sino-American Joint Commission on Rural Reconstruction, "Report to the Council on Economic and Cultural Affairs, Inc.", Mimeograph 1957, p. 5.

Commercial Crops

The principal crops of Taiwan are rice, sugar cane, sweet potatoes, pineapples, bananas, tea, and citrollina. Farm income presently accounts for about 35 percent of the net national income. Agricultural products comprise more than 90 percent of all export commodities by value. Since Taiwan is a small island with limited arable land and is facing a very serious population pressure, the major part of the rice crop must be used for domestic consumption. The island's economic growth depends heavily on foreign trade, so it is very easy to understand that the foreign agricultural trade is extremely

important to Taiwan. The sugar export amounted to between 60 and 70 percent of the foreign exchange obtained from all export commodities.

Rice and sugar cane are the two principal crops of Taiwan. Crop regions of Taiwan[1/] are shown in Map 2.



Map 2. The Principal Crop Regions of Taiwan

1/ International Cooperation Administration, Economic Progress of Free China, Published in Taipei, Taiwan, 1958, p. 24.

Climatic Conditions[2/]

Since Taiwan is located between the gap of the tropic and sub-tropic areas, and the high central mountain range is scattered from the north to the south, its soil type, temperature, rainfall, and sunshine are greatly varied in the different areas.

Soil types--In the north there is primarily old leached alluvils and diluvials and some are residual. In the southwest, most of the usable soils are red and yellow laterites derived from gravel and sandy alluvil fan material. Upland soils are in most cases thin, immature, and relatively less fertile.

Temperature--The yearly average temperature is only 21.7°C in Taipei (northern part) and 24.3°C in Kaoshuing (southern part). At the same time, the temperature in the northern part during December and January is usually below 20°C.

Sunshine--The yearly sunshine total averages 1,603.6 hours in the Taipei area and 2,508.0 hours in the Kaoshuing area. The difference is 904.4 hours.

Rainfall--From April to June the total rainfall was 829.8 mm in the Taipei area, while only 689.3 mm in the Kaoshuing area. It was 149.8 mm more in the former area than

2/ Taiwan Bank, A Comparative Study on Sugar-Rice Price Ratio in Taiwan, Taipei, Taiwan Bank Press, 1953, p. 78.

in the latter area. However, from July to September, the condition was just opposite, namely, the rainfall was roughly twice as much in the Kaoshuing area as in the Taipei area. Local climatic conditions are caused by strong northeast winds in winter and milder southwest winds in summer. Typhoons always occur between June and October; heavy rainfall also visits this island in summer.

PART II

FLUCTUATING INCOME FROM SUGAR CANE AND RICE-SUGAR CANE COMPETITION IN TAIWAN

Purchasing Price of Sugar Cane During Japanese Rule

Taiwan was occupied by the Japanese for over fifty years before the Second World War. During the Japanese rule the sugar company obtained raw sugar cane material partly from its own cane plantation but mostly by purchasing from contract cane farmers.

TABLE II. PURCHASING PRICE OF SUGAR CANE UNDER JAPANESE RULE.*
(Price Unit: Per 1,000 Tai-chin Japanese dollars)

Year	Raw Material	Subsidies	Encouraged Fund	Purchasing Price
1916	----	----	----	$3.80
1917	----	----	----	5.65
1918	----	----	----	5.65
1919	----	----	----	8.50
1920	----	----	----	6.00
1921	----	----	----	5.00
1922	----	----	----	5.50
1923	----	----	----	6.50
1924	----	----	----	7.00
1925	----	----	----	6.70
1926	4.00	2.70	----	6.70
1927	4.00	1.60	----	5.60
1928	4.00	2.05	----	6.05
1929	4.00	1.86	----	5.80
1930	4.00	0.90	0.70	5.60

* See asterisk on next page.

TABLE II. PURCHASING PRICE OF SUGAR CANE UNDER JAPANESE RULE.* (Continued.)

Year	Raw Material	Subsidies	Encouraged Fund	Purchasing Price
1931	4.00	0.90	0.70	5.60
1932	2.70	1.60	0.30	4.60
1933	2.70	2.00	0.80	5.50
1934	2.70	2.00	0.80	5.50
1935	2.70	3.05	0.80	6.55
1936	3.00	3.00	0.80	6.80
1937	3.00	3.00	0.70	6.70
1938	3.50	2.50	1.00	7.00
1939	4.00	2.90	3.70	10.60
1940	4.50	2.20	2.30	9.00
1941	4.50	2.80	2.10	9.40

*Source: Southern Agricultural Problem, Japanese published, 1941. Data of 1916-1925 and 1932-1941 in this table was obtained by correspondence from Mr. Keng-Yun Huang, Agricultural Economics Division, Taiwan Sugar Corporation.

The purchasing price of sugar cane during the Japanese rule was determined by three factors: The first factor was the raw material fee-namely the cost of cane production. Until 1932 this was the major part to the total purchasing price. Second were the subsidies which were paid to cane producers for three kinds of loss: loss due to too early and too late a period of planting and harvesting; loss due to the highest cost of production in different cane fields; loss due to the income difference caused by higher price of rice during sugar cane harvesting. Third was the encouraging fund which classified of four kinds of

encouragement; Collective cane plantation-mass production for sugar cane; new cane variety and field technical improvement; earlier period of cane planting between July and August; and high sugar content, high brix and more sugar extraction.

Farmers were forced to plant sugar cane by the Japanese during their occupation. The purchase price of sugar cane went up especially after 1937. Because of the inflation from 1938 to 1941, it is not certain that real farm income increased.

Purchasing Price of Sugar After V-J Day

Since Taiwan returned to her mother country, the Republic of China, in 1945, the sugar company reorganized and became government-owned and operated. The government developed a new policy of sharing actual sugar production between the Taiwan Sugar Corporation and contract farmers. This policy replaced the policy of purchasing on a cane-raw-material basis which was used during the earlier Japanese period. The ratio of sugar sharing between the Taiwan Sugar Corporation and the farmers in 1946-47 was 52:48; later it changed to 50:50 sharing between producers and the Sugar Corporation in 1947-48; and currently it is 54:46 between contract farmers and the sugar corporation. The changes in the government sugar price policy are outlined below.

1946-47 Purchasing sugar price was the average wholesale

price in domestic market between December 1946 to April, 1947.

1947-48 Purchasing sugar price was the average wholesale price in domestic market during the grinding season.

1948-49 The purchasing sugar price was calculated by the following formula:

$$P_o = \frac{P_1 Q_1 + P_2 Q_2 + \ldots + P_n Q_n}{Q_o}$$

P_o = Purchasing sugar price.

$P_1, P_2, \ldots, P_n$ = Selling price of Taiwan sugar in foreign markets which purchased Taiwan sugar.

$Q_1, Q_2, \ldots, Q_n$ = Quantity of Taiwan sugar sold in different foreign markets.

Q_o = Total quantity of sugar sold in idfferent foreign markets which equals $Q_1 + Q_2 + \ldots + Q_n$.

If the P_o/per kg was less than the price of two kgs of rice, the government should pay the difference.

1949-50 During the grinding period, the purchasing sugar price was determined by world sugar price less domestic transportation fees from sugar factory to sea port.

1950-51 The purchasing sugar price was the world sugar price but provided that the sugar price per kg should not be less than the price of rice per kg otherwise, the government would pay the difference. The relative

profitability of rice had increased greatly since the 1948-49 period.

1951-52 Same as the 1950-51 period.

1952-53 The purchasing sugar price was the foreign sugar price for Taiwan sugar for previous six months' average, but provided that the purchasing sugar price per kg should at least equal to the price of rice of per kg; otherwise, the government guarantees to pay the difference.

1953-54 The purchasing sugar price was the foreign sugar price for Taiwan sugar for the previous three months' average, but provided that the sugar price per ton should not be less than $NT 1,400; otherwise, the government would pay the difference.

1954-55 If the purchasing sugar price per ton was less than $NT 1,800, the government would pay the difference.

1955-56 If the purchasing sugar price per ton was less than $NT 2,000 the government would pay the difference.

From the above information[3/] it can be seen that the sugar price policy between 1946-47 to 1955-56 changed from

3/ Ying-Piao Yu, Chief of Agricultural Economics Division, TSC, A Review of Sugar-sharing Regulation in Taiwan, Taiwan, TSC Press, Mimeograph, 1959, p. 1-6.

year to year. The sugar price was determined by three principle factors: First, average price of sugar sold in different foreign markets; second, the ratio of foreign exchange between Taiwan currency and foreign dollar; third, transportation fee from sugar factory to domestic sea port.

Sugar prices fluctuated and were affected very much as any one of the three factors changed so that the farmer's income from sugar was unstable. These sugar price policies did not consider the production cost of sugar cane and neglected the comparison of sugar cane with its competitive crops. The sugar price policies before 1957 were not completely satisfactory. Sugar sharing has been highly welcomed because cane producers reversed their position from sugar tenants to sugar owners.

Since the price of sugar is determined by the international sugar market, farmers shifted their production from sugar cane to rice when the world sugar price moved down. The government therefore started to announce a guaranteed sugar price in order to stabilize sugar cane production. There is one announced guaranteed sugar price for all of Taiwan. After the grinding season, 65 percent of the farmers' sugar share had to be sold to the government for export. Before 1957, the government paid the farmers the world sugar price plus an

adjustment if required, based on the local market price of rice. The complete price paid by the government to the farmers was announced once each month. In 1957 and afterwards, the government announced one guaranteed sugar price for the entire year. This price was announced in June, before planting. If, at time of sale, the world sugar price is above the guaranteed sugar price, the farmers receive the world sugar price. The government paid the difference to cane producers according to the level of the announced guaranteed sugar price. The subsidies and purchasing price of sugar after V-J Day are seen in Appendix I. The guaranteed sugar price policy was actually started in Taiwan with the 1957 crop year.

Sugar-Rice Price Ratio

The idea of a sugar-rice price ratio has long been rooted in most of Taiwan's people's minds. The ratio serves as a rough indicator of the relative profitableness of sugar and rice production.

From Table III, we can see the sugar-rice price ratio has gradually decreased. Rice has become relatively more profitable to produce. The ratio fell to 0.61 and 0.82 in 1949 and 1953 respectively. It was a very serious situation. Most farmers shifted from sugar cane to rice production at that time. The guaranteed sugar price policy was started in 1957

and since then the sugar-rice price ratio seems to have been slightly more stable than in previous years of 1953-55.

TABLE III. SUGAR-RICE PRICE RATIO IN TAIWAN (1914-1958).*

Year	Sugar (Price per 100 kg)	Rice (Price per 100 kg)	Price Ratio (Sugar/rice)
1914	$24.17	$ 9.50	2.54
1915	27.72	7.38	3.75
1916	31.50	8.25	3.82
1917	31.67	11.88	2.67
1918	32.50	17.25	1.88
1919	63.55	22.50	2.82
1920	63.67	20.13	3.16
1921	41.62	15.25	2.73
1922	32.33	16.00	2.02
1923	39.70	15.13	2.62
1924	35.73	18.38	1.94
1925	32.70	20.38	1.60
1926	30.67	19.64	1.56
1927	33.28	17.13	1.94
1928	27.83	17.00	1.64
1929	29.37	19.60	1.50
1930	26.02	17.50	1.49
1931	22.97	11.88	1.93
1932	25.48	13.63	1.87
1933	28.82	13.73	2.10
1934	27.35	15.50	1.76
1935	28.02	19.00	1.47
1936	29.35	20.00	1.47
1937	32.18	20.13	1.60
1938	33.67	20.63	1.63
1939	34.80	23.25	1.54
1940	37.42	23.50	1.59

*See asterisk on next page.

TABLE III. SUGAR-RICE PRICE RATIO IN TAIWAN (1914-1958).* - (Continued)

Year	Sugar (Price per 100kg)	Rice (Price per 100 kg)	Price Ratio (Sugar/rice)
1941	38.17	25.13	1.52
1942	42.00	18.75	2.24
1943	46.60	22.53	2.07
1944	414.40	239.00	1.75
1945	748.80	686.70	1.09
1946	3,877.82a/	2,316.26	1.67
1947	19,886.58a/	6,958.65	2.72
1948	84,412.04a/	34,726.05	2.43
1949	26.15b/	34.05	0.61
1950	128.14	117.40	1.10
1951	366.90	127.05	2.89
1952	308.90	201.70	1.53
1953	261.90	318.00	0.82
1954	289.25	293.68	1.04
1955	395.43	302.23	1.31
1956	410.15	325.64	1.26
1957	497.42	347.45	1.43
1958	336.64	352.23	1.27

* Source: Agricultural Economics Division, TSC, original data unpublished.

a/ During the Civil War, from 1945 to 1949, between the Nationalist government and the Chinese Communists, a very serious currency inflation occurred. It was the worst that had ever happened in China.

b/ The Nationalist government authorized a monetary reform in Taiwan on June 15, 1949, changing from the old into the new Taiwan dollar.

Recent Changes in the World Sugar Market

Sugar is one of the international commodities; therefore, its price in the domestic market is usually influenced or stimulated by the world sugar market situation. Since 1948, world sugar production has increased year after year while the world sugar price, on the contrary, has decreased as shown in Table IV.

TABLE IV. WORLD SUGAR PRODUCTION AND ITS PRICE FLUCTUATION (1948 - 1960).*

Year	Total Production (Unit: 1,000 tons)	Price (U.S. Cents per pd.)
1948	31,365	4.23
1949	31,944	4.16
1950	35,989	4.98
1951	38,604	5.67
1952	37,499	4.17
1953	41,634	3.41
1954	41,989	3.26
1955	43,731	3.24
1956	45,612	3.48
1957	49,073	5.16
1958	54,365	3.50
1959	53,539	2.97
1960	57,722	3.14

* Source: United States Department of Agriculture, The Sugar Situation, published annually by Agricultural Marketing Service, March, 1961, p. 24. Washington,D.C.

The total world sugar production in 1960 was 82 percent greater than that of 1948. World sugar price per pound was 4.23 cents in 1948, 2.97 cents in 1959 and 3.14 cents in 1960.

The higher price of 5.67 cents in 1951 was due to the unusual circumstances associated with the Korean War.

Rice and Sugar Cane Competition in Taiwan

Rice Production (1919-1958) -- Rice and sugar cane are the two principal crops of Taiwan. The hectare of rice planted increased from 497,211 hectares in 1919 to 784,000 hectares in 1958 (Appendix II). Since rice is customarily used as major food for farm families in China, the rice supply in Taiwan has become very important in recent years, because Taiwan faces a serious population pressure. Thus rice production is of direct concern to the Taiwan people's level of living and of indirect concern to social security.

Sugar Cane Production (1903-1958) -- The hectare of sugar cane planted on Taiwan, like rice, increased from 16,030 hectares in 1903 to 149,966 hectares in 1944. The peak year was 1940 when 169,064 hectares were planted. However, after V-J Day in 1945, the total hectare of sugar cane has been below 100 thousand hectares each year except 1953. (See Appendix III). Rice has replaced sugar cane production in some irrigated and rotation fields. In recent years sugar cane production has been moved to hillside fields and fields near the sea coast areas.

The sugar-rice competition in Taiwan started in 1920,

since at that time a large volume of rice was exported to Japan and sugar was exported to other countries. In the competitive history rice has always dominated sugar cane. Most farmers must produce rice but it is not necessary for them to plant sugar cane.

Previous production cost survey of rice and sugar cane in rotation field -- In May, 1952, a small scale farm survey of costs of production of both rice and sugar cane in the rotation field was made by the Taiwan Sugar Corporation. The results are summarized as follows:

TABLE V. COSTS OF RICE AND SUGAR PRODUCTION IN ROTATION FIELD.* (Unit: per hectare)

Item	Rice (NT $)a/	Sugar Cane (NT $)a/
Seedling	$ 63.00	$ 520.00
Fertilizer	1,276.00	988.00
Cultivation	399.00	916.00
Harvest	121.00	32.50
Farm Equipment	70.00	250.00
Rent and public	977.00	3,394.00
Gross total expenditure	$2,906.00	$6,051.20

*Source: Taiwan Bank, A Comparative Study on Sugar-Rice price-ratio in Taiwan, Taipei, Taiwan Bank Press, 1953, p.93-94.

a/ Cost: New Taiwan Dollar
Rice yield 2,400kg unhulled
1,728 hulled
Cost of rice per kg $1.68

Sugar cane yield 65,000 kg
Sugar yield (sugar content) 7,572.50
(11.65%)
Less land rent 1,533.43kg.
Sugar sharing to cane farmer
(50:50) 3,019.54 kg.
Cost of sugar per kg. $2.00

The ratio of the production costs per kg of sugar to rice is 2: 1.68 and the rice to sugar ratio was namely 1: 1.19. Here it should be pointed out that it was difficult to make an exact comparison purely from the point of view of production costs, although the above figures were obtained by interview. This is because the rice matures after a period of three months growth; and sugar cane, Taiwan, usually needs a one and one-half year period of growth. Besides, other conditions affecting the two crops are quite different. There is more risk and a slower turnover in producing sugar cane than in producing rice; but there are more by-products such as sugar cane trash in cane production. However, cane farmers are able to get more favorable types of loans than rice farmers.

Production Survey of rice and sugar cane in Taichung area.-- During the summer of 1952 another survey of net income of both rice and sugar cane in the two-crop field of the Taichung area was sponsored by the JCRR, TSC, TPFB, and the TPCA.

Table VI shows that fall planted mud seedling cane intercropped with flax was ranked fourth on the basis of net income per hectare. This ranking was lower than for three other kinds of rice systems. However, its net income per hectare was higher than that of six other kinds of rice systems.

Fall planted mud seedling cane intercropped with sweet potatoes occupied ninth position. However, both fall planted and fall planted mud seedling sugar cane were ranked lower than any other kind of rice system. In other words, under the competitive situation between rice and sugar cane, the two crop rice systems when combined with winter crops was always superior to the sugar cane system in this study. Actually, a two-crop field is certainly more profitable in the production of rice than in the production of sugar cane.

TABLE VI. A COMPARISON OF NET INCOME OF BOTH RICE AND SUGAR CANE SYSTEMS IN THE TAICHUNG AREA.*

	Crop-System	Net Income (Unit: NT$/Hec.)
(1)	Flax-rice-Shingtung cabbage	6,089.71
(2)	Tobacco-rice-rice-tobacco	5,967.96
(3)	Wheat-rice-rice-wheat	5,097.58
(4)	Fall planted mud seedling cane intercropped with flax	3,137.64
(5)	Green bean-rice-rice-green manure	3,069.24
(6)	Mud seedling sweet potato-rice-rice-green manure	2,921.02
(7)	Mud seedling sweet potato-flax-rice-cabbage	2,763.06
(8)	Rice-rice	2,502.76
(9)	Fall planted mud seedling cane intercropped with sweet potato	1,724.16
(10)	Rice-sweet potato	1,689.56
(11)	Sweet Potato-rice	1,257.22
(12)	Fall planted mud seedling sugar cane	1,201.16
(13)	Fall planted sugar cane	969.93

* Source: Sam-Chung Hsieh, Sugar-Rice Competition in Taiwan, JCRR Press, Taipei, Taiwan, 1953, p. 20.

PART III

THE RESEARCH PROBLEM

The Importance of Price Policy To the Economic System

In a modern economy based on democratic principles, price is the regulator of most economic activities. Changes in the relative agricultural prices will affect the allocation of resources among competing crops. Agricultural prices, moving up or down, are the compasses of production expansion and/or contraction. Price changes influence both the direction and magnitude of production changes. Comparatively speaking, the elasticity of supply and demand for agricultural products are generally less than for other commodities. Therefore, small fluctuations in the demand and supply for agricultural products can cause relatively large price changes. Some countries pay special attention to control over agricultural price. Price control has become an important part of modern agricultural policy.

The method of agricultural price control is varied. It has been achieved by restricting either production or consumption, raising the prices of certain agricultural commodities, protective tariff, etc. This is often done in order to stabilize agricultural price and raise farm income. Since

sugar is an international commodity, its price is determined by the world sugar market situation rather than by the market situation of any one country or one area. The Sugar Agreement enacted by the International Sugar Conference is aimed at stabilizing the world sugar price. However, a guaranteed price policy has been practiced by some countries as one of their national economic and/or agricultural policies.

The parity price is a basis for a guaranteed price which has been employed in the United States and has been an important part in agricultural policy for more than two decades.4/ It has provided a basis for measuring changes in the purchasing power of a unit of commodity, determining support level, and formulating marketing agreements and marketing order programs. There is an old formula and a new formula for computing parity prices.

The sugar industry of Taiwan is the largest public enterprise in the Far East as mentioned previously. Taiwan's sugar export earnings are usually valued at from 60 to 70 percent of the total foreign exchange earnings of the country. Therefore, the fluctuation of sugar price in the world market affects not only the income of more than 20 percent of the total farm households but also the position of international

4/ United States Department of Agriculture, Agricultural Prices and Parity, August, 1957, p. 74, Vol. 1.

balance of payments of the Taiwan government. The importance of the sugar industry has led the government to adopt an advanced sugar price support policy.

The annual output of sugar approaches 900,000 m.t. of which about 100,000 m.t. are provided for domestic market and around 800,000 m.t. made available for export. The present policy of our government seeks to maintain the present levels of production for both sugar cane and rice. The foreign exchange obtained from sugar export is used as a basic financial resource to the nation, while rice production is primarily for meeting requirements for domestic consumption.

However, the farmer's wise choice of his farm crop is determined by both the opportunity cost of production and the net income expected from a crop. The Taiwan Sugar Corporation's plantations constitute only about 20 percent of the total planted hectares of cane, while the remaining 80 percent of hectares of cane is contracted by private farms. The Republic of China joined the International Sugar Conference in 1954 and has obtained an annual export quota of sugar from the Conference's annual session. Under this condition, in order to stabilize production and export of sugar, the government has taken the necessary measures designed to keep up the production of the local sugar industry. This has been done by announcing

a reasonable guaranteed price of sugar for each crop year since the 1957 crop year.

From the Farmers' Point of View

As the average size of farm in Taiwan is only about three acres (1.21 hectare), the farmers have to cultivate their land very intensively and economically. They are quite sensitive to price changes, and the most important factor determining their choice of crop systems is the relative net income from different crops. Whenever the price of a certain crop is low relative to other crops, farmers will usually abandon that crop and shift to the production of the other crops. However, the farmers will diversify production enough to provide most of the food required for himself and his family. The resources used to produce food for home consumption are not too sensitive to price changes.

Nearly every farmer has alternative crop systems competing with each other for the utilization of agricultural resources. Sugar cane, originally planted in paddy fields has now been partly replaced by rice. Cane cultivation is shifting to dry land where sweet potatoes, peanuts, soybeans and jute are the common competitive crops. Farmers would prefer to make decisions for the most profitable crop system.

There are about 150,000 cane farmers each year in Taiwan,

who represent 20 percent of the total farmers of Taiwan. The contracted acreage is around 70,000 hectares each year. Most cane farmers operate very small farms. They seriously need a high value cash crop system. The average size of cane fields on these farms is around 0.5 hectare, so the support price is necessary for them.

From the Government's Point of View

As indicated in Table I above, the farm income of Taiwan presently accounts for about 35 percent of the net national income. Agricultural products comprise more than 90 percent of all exports by value. Among the export commodities, sugar ranks first in vital importance, followed by rice, tea, pineapples, bananas, citrollina oil, etc. Countries importing Taiwan's sugar are scattered throughout Asia, the Far East, the Middle East and Africa. This year the United States also has imported Taiwan's sugar(100,000 m.t.). The major buyers are Japan, Iran, Malaya, Ceylon, Hong Kong, Pakistan, and East African countries. Taiwan's sugar is greatly welcomed in the world market. The government wants to get major financial resources from the sale of sugar. In order to do this, it must first give support to the sugar price for contract farmers.

From the Taiwan Sugar Corporation's Point of View

The Taiwan Sugar Corporation is a government-owned enterprise. The manufacture of sugar for export is controlled by the Corporation. The Corporation owns over forty sugar and by-product factories, five sugar cane improvement stations, one sugar experiment station, 3,000 kilometers of railway for transportation, and 187 big sugar cane plantations with a total area of nearly 46,000 hectares (113,600 acres). The Corporation draws its raw materials, sugar cane, from its own farms and from contract cane farms. During the recent decade the average yearly planting of sugar cane has been about 96,870 hectares (239,269 acres) of which only about 20,000 hectares or 49,000 acres were planted on TSC's own farms. The Sugar Corporation has obtained only 20 percent of the raw material from its own farms, while 80 percent of the sugar cane comes from the contract farmers' land. Because of the growing period for sugar cane, 16 to 18 months, and the requirements of a good rotation, the Corporation cannot expand its sugar cane production above 20,000 hectares. The land owned by the Taiwan Sugar Corporation is operated as plantations by the Corporation. Land in this plantation cannot be shifted from sugar cane production to production of other crops such as rice.

Forty-five sugar factories were operated in 1937-38,

37 in 1944-45, and only 27 in 1956-57.5/ This has been a very serious situation. There was not enough raw sugar cane production to require all the mills for grinding. The Corporation wants to maintain enough sugar cane production to use its milling capacity. To achieve this, it must pay a reasonable price to sugar cane producers. It is for this reason that the guaranteed sugar price is needed. The world sugar price is often not high enough to permit sugar cane production to compete successfully with rice production.

5/ Taiwan Sugar Corporation, Taiwan Sugar Statistics, 1958, p. 6-7.

PART IV

THE STUDY MADE BY THE TAIWAN SUGAR CORPORATION

Procedure[6]

The research problem was to collect, by the survey method, the previous year's data from the sampled farm families for use as a basis of computing the suggested guaranteed sugar price for the next year.

Organization of field work -- This survey program has been sponsored and carried out since the 1955-56 crop year by the Taiwan Sugar Corporation in cooperation with the Chinese Rural Economics Association. Each organization provides the following people for the study:

Chinese Rural Economics Association

Research and technical supervisors	7	persons
Survey and statistical supervisors	8	
Hired statisticians	7	
Sub-total	22	

Taiwan Sugar Corporation

Agricultural Department and its branch agricultural Economics Division sponsors	7
Five head sugar factory district inspectors	18
Data collectors (interviewers)	126
Sub-total	151
Grand Total	173

6/ Taiwan Sugar Corporation, Production Economics Survey Handbook, TSC Press, 1947, Taiwan.

Choice of survey area -- The survey area included all five head sugar factory areas--namely, Taichung area, Huwei area, Hsingyin area, Tsungyeh area, and Pingtung area. Samples were taken within these five areas. The data collected from the Taichung and Pingtung areas were used only for reference in determining the suggested guaranteed sugar price for those areas. The data obtained from the Chainen rotation area (Huwei, Hsingyin, and Tsungyeh), was used as the fundamental computing data for the suggested guaranteed price of sugar.

Selection of sample size and scale -- Taiwan, on the basis of land utilization could be divided into five kinds of fields, namely, two-crop fields, single-crop fields, rotation fields, dry-plain fields and upland fields.

The number of sampled farm families was 1,500 for the 1955-56 crop year and 2,000 for both 1956-57 and 1957-58 crop years.7/ This number is approximately equal to 1/75 of the total cane farm families.

Suppose Sugar Factory A has a single-crop field, a rotation field, a dry-plain field and an upland field. Its average planted cane hectares in the different field types by order is 0.35, 0.45, 0.46 and 0.61 ha.

Originally, it was planned that the sample would be drawn from all farms in the area of Sugar Factory A having cane

7/ See Appendix IV.

fields between .35 and .61 ha. In order to enlarge the population, the range was increased by subtracting .05 ha. from the average size of cane field for the field type with the smallest average size and adding .05 ha. to the average size of cane field for the field type with the largest average size. For example, the population in the area for Sugar Factory A from which the sample was actually drawn included all farms with sugar cane fields between .30 and .66 ha. Approximately one out of each 75 contracted sugar cane farm families who fell within the population were interviewed. The sampling ratio varied only slightly between sugar factory areas and field types because of sampling problems arising during the interviewing. The samples were drawn by a random method. The sampling interval was determined by dividing the total farm families qualified for sampling by the sampled families.

For example, suppose the population was 800 and the sample size was 40. Then, the sampling interval would equal 20. Then, the first sampling number was drawn at random. If it is 7, the number of sampled farms would be 7, 27, 47, 67, 87, 107, ... 747, 767, 787, etc., totaling 40 sampled farm families.

Determination of the survey period.-- The survey period was broken down to twice a year in dealing with crop growth and

harvesting season. The first survey period was 40 days (August 21 -- September 30). The survey scale for this period included cost and income of competitive crops in the autumn of one year and the spring of the next year, and cost of intercrops and sugar cane in their earlier growing periods. The second survey period was 40 days (February 11 -- March 21). This survey included the cost and income of competitive crops in the summer and the cost of sugar cane harvest in the late period.

Designating of data on the survey form --

Cost part	Income part
Seeds or seedlings	Yield and value of products
Fertilizer	Yield and value of by-products
Cultivation and harvest	Subsidies
Miscellaneous	Others

Survey method -- The direct survey method was employed. Each data collector (investigator) directly interviewed cane farmers.

Training field workers -- (1) Each sugar factory assigned an agricultural technician in charge of sampling in its factory area; (2) Each sugar factory sent 2 - 4 investigators to visit cane farm families and fill out the survey forms; (3) Each investigator received three days of training before survey work started; and (4) During the survey period the TSC, CREA, and each head sugar factory jointly sent higher supervisors to

help data collectors in answering technological problems.

The steps of data processing -- After the survey was finished for each period, the data collector for each sugar factory would combine all the survey data computing the income and expenditure per hectare of each sampled farm family within seven days. The Taiwan Sugar Corporation collected all the original survey data from each sugar factory and immediately forwarded it to the Chinese Rural Economics Association within ten days for further classification and tabulating of statistics.

Tabulating and analyzing the data -- The CREA was responsible for computing of the guaranteed sugar price for different fields in each sugar factory and head sugar factory area. The CREA was supposed to present the analytical results of the guaranteed sugar price to TSC prior to April 20 of the year.

Preparation of the report -- The final report was made and presented by the Taiwan Sugar Corporation to its top-ranking governmental organizations such as the Taiwan Provincial Government, The Ministry of Economic Affairs, the Economic Stabilization Board, the Joint Commission on Rural Reconstruction, and others concerned, for discussion and the decision-making for the guaranteed price.

Objectives

The aims of the Taiwan Sugar Corporation's survey were

to find how to stabilize the sugar industry and balance the rice and sugar cane production in order to accelerate the island's economic growth and development. The principal objectives of the survey are listed as follows: (1) to collect data for sugar cane and its competitive crop system, (2) to become familiar with land use for sugar cane and its competitive crops, (3) to analyze cost structure of sugar cane and its competitive crops, (4) to analyze production costs and returns of sugar cane and its competitive crops, (5) to find factors affecting the guaranteed sugar price, (6) to facilitate the future of the sugar cane extension service, and (7) finally, to provide material for the government's guaranteed price and agricultural policy decision-making.

PART V

HYPOTHESES

Suppose the sugar price paid Taiwan farmers is guaranteed. The price paid to Taiwan farmers is no longer affected by fluctuations of the world sugar price below the guaranteed sugar price. The objective of the guaranteed sugar price is to insure that sugar cane production will be competitive with other crops. The hypotheses of this study are that the guaranteed sugar price will:

(1) Encourage farmers to plant sugar cane since their income is assured,

(2) Obtain enough raw cane material to meet the maximum requirements for sugar grinding capacity,

(3) Earn a stabilized foreign exchange from sugar export, and

(4) Balance sugar cane and rice production and further accelerate the island's economic growth and development.

PART VI

PRESENTATION OF DATA AND ANALYSIS OF THE EFFECT OF THE PRICE PROGRAM

Since 1955 the Taiwan Sugar Corporation, in cooperation with the Chinese Rural Economics Association, has been responsible for the calculation of a suggested guaranteed sugar price. In order to obtain the required data, a survey of a sample of about 2,000 contract cane farms in five principal cane production areas is conducted every year. Survey data are used for calculation of a suggested guaranteed sugar price.

Model used for Computing the Suggested Guaranteed Sugar Price 8/

In order for sugar cane production to be competitive with other crops, the net income per hectare from sugar cane production must at least equal the net income per hectare for competitive crops. The guaranteed sugar price which permits equality to hold can be derived from the statement below.

The total net income from one hectare of sugar cane and its intercrops	=	The total net income from one hectare of competitive crops at the same period

Guaranteed price of sugar	X	Quantity of sugar returning to farmer per hectare of cane	-	Production cost of one hectare of cane and its intercrops	+	Total income of one hectare of intercrops	=	Net income of one hectare of competitive crops in the cane growing period.

8/ Te-Tsui Chang, Guaranteed Sugar Price in Taiwan, Taiwan Sugar Corporation Press, Taiwan, 1959, p. 22-28.

This can be rewritten as:

$$GSP = \frac{\text{Production cost of one hectare of cane and its intercrop} - \text{Total income of one hectare of the intercrops} + \text{Net Income of one hectare of competitive crops in the cane growing period}}{\text{Quantity of sugar returned to the farmer per hectare of cane}}$$

The net income of one hectare of intercrops was subtracted from the production costs of one hectare of cane and its intercrops in order to calculate what is called the net cost of sugar cane production. The suggested guaranteed sugar price could then be calculated with the formula given below by using the survey data.

Formula A[9]

$$GSP = \frac{\dfrac{\sum_{i=1}^{n} X_{1i}}{\sum_{i=1}^{n} A_{1i}} + \dfrac{\sum_{j=1}^{m} X_{2j}}{\sum_{j=1}^{m} A_{2j}}}{\dfrac{\sum_{i=1}^{n} Y_i}{\sum_{i=1}^{n} A_{1i}}} = \left(\frac{\dfrac{\sum_{i=1}^{n} X_{1i}}{\sum_{i=1}^{n} A_{1i}}}{\dfrac{\sum_{i=1}^{n} Y_i}{\sum_{i=1}^{n} A_{1i}}}\right) + \left(\frac{\dfrac{\sum_{j=1}^{m} X_{2j}}{\sum_{j=1}^{m} A_{2j}}}{\dfrac{\sum_{i=1}^{n} Y_i}{\sum_{i=1}^{n} A_{1i}}}\right)$$

9/ Formula A is actually applied to calculate the suggested guaranteed sugar price. Formula B, given below, was also considered but was not used in actual calculations.

$$GSP = \frac{\sum_{i=1}^{n} \left(\dfrac{\dfrac{X_{1i}}{A_{1i}} + \dfrac{X_{2i}}{A_{2i}}}{\dfrac{Y_i}{A_{1i}}} \right)}{n} = \frac{\sum_{i=1}^{n} \left(\dfrac{X_{1i}}{A_{1i}} + \dfrac{X_{2i}}{A_{2i}} \right)}{n} = \frac{\sum_{i=1}^{n} \left(\dfrac{X_{1i}}{A_{1i}} \right)}{n} + \frac{\sum_{i=1}^{n} \left(\dfrac{X_{2i}}{A_{2i}} \right)}{n}$$

Where n is the number of farm families in the sample growing sugar cane in a particular field type and m is the number of farm families among the n farm families growing competitive crops. The GSP was calculated for each sugar factory area and head sugar factory area by field type on the basis of this formula. Usually the farmers produced both sugar cane and competitive crops.

X_{1i} = net cost of sugar cane produced by the ith family in the sample.

X_{2j} = the total net income from one hectare of competitive crops in the same period for the ith family in the sample.

A_{1i} = hectares of sugar cane produced for the ith farm family in the sample.

A_{2j} = hectares of competitive crop for the ith farm family in the sample.

Y_i = quantity of sugar sharing for the ith farm family in the sample.

n = total number of farm families in the survey.

The above formula indicates that the calculation of the suggested guaranteed price is based on the assumption that the total net income of competitive crops during the cane growing period is the opportunity cost for producing sugar cane and its intercrops. Therefore, the suggested guaranteed sugar price gives assurance to farmers that if they produce cane with some intercrops their net income will be no less than the total net income from the production of competitive crops.

TABLE VII. AN EXAMPLE OF CALCULATION OF GUARANTEED SUGAR PRICE IN TSUNGYEH AREA*

No. of farm families	Cane acre planted	Net cost of cane(1)	Acres of Competitive crops	Net income of competitive crops (2)	(1)+(2)	Quantity of sugar shared to farmers
1	0.87	4,480.85	0.40	1,414.25	5,895.10	2,357
2	0.57	4,002.35	0.20	4,121.50	8,123.85	2,353
3	0.63	5,928.71	0.50	6,923.60	12,852.31	4,282
4	0.50	3,841.16	1.00	13,409.00	17,250.16	3,274
5	0.29	5,192.72	0.20	7,312.50	12,505.22	3,810
6	0.30	4,450.97	0.15	5,685.33	10,136.30	3,356
7	0.36	5,598.47	0.25	7,640.48	13,238.90	4,470
8	0.18	6,110.72	0.20	2,765.00	8,875.72	4,928
9	0.24	4,996.00	0.25	4,643.60	9,639.60	3,890
Total and Avg.	3.94	4,822.24	3.15	7,681.31	12,503.55	3,436

*Source: Survey Data, 1957-58 crop year.

According to the above formula A, we get $3,638.98.

Correlation coefficient between the number of sampled farm families and the acreage of planted cane

According to the data obtained in the 1957-58 crop year, the coefficient of correlation between the number of sampled farmers and the acreage of planted cane in each sugar factory area was computed. It was 0.9531, a high degree of positive correlation. It is now known that the average hectares of cane planted by farmers does not vary greatly for different sugar factories. Therefore, the samples taken from the acreage survey represented an acceptable degree of reliability.

TABLE VIII. RELATIONSHIP BETWEEN THE NUMBER OF SAMPLED FARM FAMILIES AND THE ACREAGE OF CANE PLANTED, 1957-58.*

N[a]	y[b]	x[c]	$(Y-\overline{Y})$ y	$(X-\overline{X})$ x	$(y-\overline{Y})^2$	$(x-\overline{X})^2$	xy
1	71	25.71	- 9	- 6.41	81	41.09	57.69
2	15	2.74	-64	-29.38	4,225	863.18	1,909.70
3	52	13.01	-28	-19.11	784	365.19	535.08
4	118	43.53	38	11.41	1,444	130.19	433.58
5	156	68.26	76	36.14	5,776	1,306.10	2,746.64
6	74	30.73	6	- 1.39	36	1.93	8.34
7	125	58.86	45	26.74	2,025	715.03	1,203.30
8	94	36.18	14	4.06	196	16.48	56.84
9	29	10.41	-51	-21.71	2,601	571.32	107.21
10	156	83.25	76	51.13	5,776	2,614.28	3,885.88
11	102	44.24	22	12.12	484	146.89	226.64
12	89	37.52	9	5.40	87	29.16	48.60
13	118	63.18	38	31.06	1,444	964.72	1,180.28
14	94	39.14	14	7.02	196	49.28	98.28
15	56	18.26	-24	-13.86	576	192.10	332.64
16	60	35.92	-20	3.80	400	14.44	-76.00
17	62	18.66	-18	-13.46	324	181.17	242.28
18	80	14.59	0	-17.53	0	307.30	0
19	77	29.00	- 3	- 3.12	9	9.73	9.36
20	67	18.92	-13	-13.20	169	174.24	171.60
21	129	55.14	49	23.02	2,401	529.92	1,127.98
22	55	17.95	-25	-14.17	625	216.38	354.25
23	33	8.70	-47	-23.42	2,209	548.50	1,100.74
24	44	14.22	-36	-17.90	1,296	320.41	644.40
25	44	14.77	-36	-17.35	1,296	310.87	624.60
Total	2000	802.99			34,454	10,519.90	18,145.91

Mean $\overline{Y}$ = 80, $\overline{X}$ = 32.12

*Source: Taiwan Sugar Corporation, Survey data, Chinese Rural Economics Association.

a/ N: Number of sugar factories by order.

b/ Y: Number of sampled farm families in each sugar factory.

c/ X: Hectares of planted cane of the sampled farm families in each sugar factory.

The following calculation was used to find the relationship between the number of farm families sampled and the acreage of cane planted, 1957-58:

$$r = \frac{\Sigma xy}{\sqrt{\Sigma y^2}\ \sqrt{\Sigma x^2}} = \frac{18,145.91}{\sqrt{34,454}\ \sqrt{10,519.90}} = \frac{18,145.91}{19,038.19} = 0.9531$$

Distribution of accumulative frequency
of Guaranteed Sugar Price

Table IX shows that there are 1,042 cane farm families (52.31 percent) whose suggested guaranteed sugar price should be below $3,000, while the rest (47.69 percent) of the cane farm families suggested guaranteed sugar price should be above $3,000. If the government gave a guaranteed sugar price of $3,000 to cane farmers for the 1957-58 year, then only 52.31 percent of the farmers would gain money and the other 47.69 percent of the farmers would lose money, if they planted cane.

Suppose the guaranteed sugar price rises to $4,000; then 1,620 farm families (81.33 percent) will gain money as the result of producing sugar cane.

TABLE IX. DISTRIBUTION OF ACCUMULATIVE FREQUENCY OF THE CALCULATED GUARANTEED SUGAR PRICE FOR 1957-58 CROP YEAR.*

Up-limit of calculated guaranteed sugar price (NT $)	Accumulative Sampled Farm families	percent
Below 500	2	0.10
Below 1,000	12	0.60
Below 1,500	77	3.87
Below 2,000	291	14.61
Below 2,500	619	31.07
Below 3,000	1,042	52.31
Below 3,500	1,396	70.08
Below 4,000	1,620	81.33
Below 4,500	1,754	88.05
Below 5,000	1,848	92.77
Below 5,500	1,906	95.68
Below 6,000	1,930	96.89
Below 6,500	1,948	97.79
Below 7,000	1,956	98.19
	1,992	100.00

* Source: Taiwan Sugar Corporation Survey Data, 1957-58 Crop Year. (See Appendix V-b)

The results of three years' study

The factors affecting the suggested guaranteed sugar price are quite numerous and complicated. The most important factors which determine the suggested guaranteed sugar price are direct costs of cane cultivation, net income of intercrops, the amount of sugar returned to the farmer, and particularly the amount of total net income from cane's competitive crops. The suggested price varies directly with the total net income from cane's competitive crops and the cost of production of

sugar cane with its intercrops; but it varies inversely with the quantity of sugar which the farmer gets and the amount of net income from intercrops. All the four factors vary from area to area and also from farm to farm because of the different soil fertility, irrigation and crop systems. Therefore, the suggested guaranteed sugar prices obtained from the calculations also vary to a considerable extent. In an area where soil fertility is high and irrigation or rain water is plentiful, cane's competitive crops such as rice, wheat, soybean, etc., can be cultivated four times within the cane growing period (generally 16 to 18 months). Thus, the total net income from those competitive crops is so high that sugar cane cannot exist in that area, or it requires a very high suggested guaranteed price.

A brief summary of the calculated suggested guaranteed prices which should be offered for different cane production areas and different kinds of fields are shown in Table X.

These figures in columns one through five are the average guaranteed prices required to maintain cane production in different fields of the areas. They show that some areas and fields need higher guaranteed prices than others. If there is either any one area or particular field which demans a very high guaranteed price for maintaining cane production, this indicates there would be a tendency for sugar cane production to

be shifted from that area or field type. In other words, farmers can get a much higher income from the cultivation of competitive crops than from the cultivation of sugar cane. Comparatively speaking, from Table X, the average suggested guaranteed sugar price for three years for each area by order was $3,178.57 in Taiching, $3,017.36 in Pingtung, $2,977.77 in Huwei, $2,717.85 in Hsingying, and $2,705.44 in Tsungyeh. The suggested price for Hsinging and Tsungyeh were very close and the suggested prices for Huwei and Pingtung were also very close. The suggested sugar price for Taichung was high among all areas.

The average suggested sugar prices for three years for different fields for all areas by order was $3,169.24 in double rice paddy field, $3,105.10 in upland field, $2,829.40 in dry-plain field, $2,818.00 in rotation field, and $2,697.40 in single rice paddy field. The suggested guaranteed sugar prices for double rice paddy field and upland field were higher than that of the other three fields. The suggested guaranteed sugar price for both rotation field and dry plain field were very close. The suggested price for single rice paddy field was lowest, and it was highest in double rice paddy rice among all fields.

The difference between the average suggested prices and the average government announced price of three years' average

TABLE X. GUARANTEED SUGAR PRICE FOR DIFFERENT AREAS AND FIELDS THREE CROP YEARS. UNIT DOLLAR PER TON OF SUGAR.a/

Area	Crop Year	1	2	3	4	5	6	7	8
		Fields							
		Double Rice Paddy Field	Single Rice Paddy Field	Rotation Field (Partly Irrigated)	Dry Plain Field	Upland Field	Avg. Price Suggested.	Gov. Price guaranteed 1957-58, 1958-59, 1959-60	Difference Between Required & Guaranteed
Taichung Area	1955-56	2,875.45	--	3,204.71	2,886.45	3,777.28	3,185.41	2,375.00	-810.41
	56-57	2,990.54	--	3,675.27	2,566.39	3,586.90	3,204.80	2,400.00	-804.80
	57-58	3,368.93	--	3,430.78	3,028.90	2,628.86	3,139.35	2,750.00	-389.35
	Average	3,078.32	--	3,436.92	2,827.24	3,331.01	3,178.57	2,508.33	-670.19
Hsingying Area	1955-56	--	2,727.12	2,392.90	2,481.53	2,682.86	2,570.10	2,375.00	-195.10
	56-57	--	2,705.81	2,623.51	2,640.75	2,747.52	2,679.39	2,400.00	-279.39
	57-58	--	2,923.59	2,931.97	2,840.89	2,917.73	2,903.45	2,750.00	-153.45
	Average	--	2,785.51	2,648.46	2,654.39	2,782.75	2,717.85	2,508.33	-209.52
Tsungyeh Area	1955-56	--	2,666.78	2,332.06	2,554.38	2,451.96	2,501.29	2,375.00	-126.29
	56-57	--	2,202.36	2,384.12	2,539.31	3,355.71	2,620.38	2,400.00	-220.38
	57-58	--	3,045.14	2,544.34	2,749.24	3,639.85	2,994.65	2,750.00	-244.65
	Average	--	2,638.09	2,420.17	2,614.31	3,149.17	2,705.44	2,508.33	-197.11
Huwei Area	1955-56	3,548.29	2,369.83	2,384.12	2,780.40	2,815.16	2,779.56	2,475.00	-404.56
	56-57	3,593.69	3,083.98	2,949.35	2,996.33	2,514.45	3,027.56	2,400.00	-627.56
	57-58	3,561.32	2,850.32	2,966.68	3,103.05	3,149.69	3,126.21	2,750.00	-376.21
	Average	3,567.77	2,768.04,	2,766.72	2,959.93	2,824.16	2,977.77	2,508.33	-469.44
Pingtung Area	1955-56	2,711.15	2,336.19	--	2,886.79	2,872.47	2,701.65	2,375.00	-326.65
	56-57	2,567.15	2,420.16	--	2,974.45	3,172.59	2,783.59	2,400.00	-383.59
	57-58	3,306.65	3,034.83	--	3,413.63	4,512.28	3,566.84	2,750.00	-816.84
	Average	2,861.65	2,597.65	--	3,091.62	3,438.63	3,017.36	2,508.33	-509.03
Area Average for Three Years		3,169.24	2,697.40	2,818.00	2,829.40	3,105.10	2,919.30	2,508.33	-420.97

a/ Columns 1-5 of this table were compiled by T. T. Chang, Guaranteed Price of Sugar in Taiwan, Proceedings of Agricultural Economics Seminar, National Taiwan University Press, Tapei, Taiwan, 1959, p. 107. Columns 6-8 of this table are added by the author.

for each area by order was-$670.19 in Taichung, -$509.03 in Pingtung, -$469.44 in Huwei, -$209.52 in Hsingying, and -$197.11 in Tsungyeh. The difference between suggested prices of area average and the average government price of three years was -$420.97. The lowest average suggested guaranteed sugar price for the three years was for the rotation field (partly irrigated) in the Tsungyeh area.

Many factors affecting guaranteed sugar prices should be discussed here. First, generally speaking, the temperature is lower in the northern part than in the southern part of Taiwan. The climate is not suitable for sugar cane growing in the north. The suggested guaranteed sugar price was higher in the northern and central parts than in the south.

Second, the more fertile the land and the larger the sugar shares, the lower the guaranteed sugar prices.

Third, the ratooned sugar cane may shorten its growing period, decreasing the net income of its competitive crops, which therefore should have the effect of decreasing the suggested sugar price.

Fourth, the suggested guaranteed price is determined partly by the size of samples. The smaller the sample size, the greater the possibility of error. Therefore, an optimum sized sample would be helpful if adequate finances are available.

Fifth, in some sufficiently irrigated areas, the guaranteed sugar price is usually a little high as a result of influence by the competition between sugar cane and other crops.

Finally, on the dry-land in either hillside or plain field, the guaranteed sugar price was set too high as a result of a low sugar yield and a low sugar share.

The announced guaranteed sugar prices were less than the suggested sugar price for all area. The reasons were as follows: First of all there is a conflict between the production of sugar cane and rice. If the guaranteed sugar price is set too high, land will be shifted from rice to sugar cane production. If this occurs the supply of rice will decrease and the price of rice will increase. With respect to rice, the Taiwan Provincial Food Bureau, complying with the basic food policy of the Taiwan government, seeks to (1) increase the supply of rice as domestic demand increased, and (2) prevent the price of rice from increasing. Therefore, an announced guaranteed sugar price which would be high enough to cause a marked shift from rice to sugar cane production would not be consistent with the basic food policy of the Taiwan government. The wages and salaries of the government employee of Taiwan are comparatively low. Rice is the major food for home consumption. The price of rice in Taiwan is absolutely not allowed to be increased since it might effect the national welfare and cause social

unrest. The government has a policy of stable and comparatively low food prices in Taiwan. Second, since the Nationalist government has had a deficit budget. They prefer not to set a high guaranteed sugar price in order to avoid the heavily financial burden and the resulting inflation of such a policy.

Test of Hypotheses

The percent of the farmers who would require a higher price than the announced price in order to cover their costs of production of sugar cane and to maintain their level of farm income from sugar cane at the level of its competitive crops are given below.

TABLE XI. RELATIONSHIP BETWEEN ANNOUNCED SUGAR PRICE AND THE PERCENT OF SAMPLED FARM FAMILIES.*

Year Guaranteed	Announced Price (NT $ per ton)	Percent of sampled farm families receiving adequate percent	Percent of farmers requiring higher price
1957-58	2,375.00	--	--
1958-59	2,400.00	36.30	63.70
1959-60	2,750.00	41.47	58.26

*Source: See Appendix Va and Vb.

These simple figures clearly point out the fact that most farmers need a higher guaranteed sugar price than that of the announced sugar price. However, many farmers benefit from the present price policy, the stability of the price policy is

particularly important. With the level of the announced guaranteed sugar price, why do farmers with a higher required price still produce sugar cane? There are several reasons. First, they obtain favorable kinds of loans such as seedling loans, fertilizer loans, and production loans from Taiwan Sugar Corporation. Second, they obtain the considerable technical assistance from the Taiwan Sugar Corporation. Third, some have insufficient irrigation for rice but enough for profitable sugar cane growing. Fourth, cane trash and leaves could be used for feeding fuels, fences, and farm house-roof covering.

The Taiwan Sugar Corporation does not want a shift in the location of sugar cane production. The reasons are as follows: First, the grinding capacity is fixed in each sugar cane producing area. Factory operation is inefficient if the grinding facilities are not used to capacity. Second, the workers and personnel who work for the Taiwan Sugar Corporation cannot be moved easily from area to area. Some workers have served in a single factory all their life-time. Third, transportation facilities are fixed such as railroad, etc. Now, the sugar production in each area has become a traditional industry.

Because of the differences in the suggested guaranteed sugar price for different areas and field types as pointed out in Table X, a stable policy of announcing one guaranteed sugar price for the entire island will bring about some relocation of

sugar cane production. Therefore, the Taiwan Sugar Corporation has followed the policy of making favorable loans and considerable technical assistance available to farmers in areas with a high suggested guaranteed sugar price. However, the present price policy has stabilized the level of sugar cane production in Taiwan, a fact the Corporation appreciates.

From Table XII, it can be seen that the acreage of planted sugar cane and total sugar production between 1946 to 1955 fluctuated every year. The farmer's income was not stable. However since the farm survey began in 1955 and the guaranteed sugar price program started in 1957, the sugar cane acreage planted and the total sugar production has been increased and stabilized year after year since 1955. This can be taken as evidence that the program has been successful from the standpoint of the government. As can be seen from Table XII, the average yield per acre of sugar cane has increased since 1946. However the yield after the war was very low. The average yield per hectare for the five-year period 1936 to 1940 was 7.7 M.T. The average yield per hectare for the five-year peiod of 1955-1959 was 9.2 M.T., an increase of 20 percent over the 1936-40 average. During the period this increase occurred, there has also been a general shift of sugar cane production to poorer soils. This increase in yield makes it easier for the government

TABLE XII. PRODUCTION OF SUGAR CANE AND RICE IN TAIWAN SINCE 1946.*

Year	Planted Sugar Cane (Hectare)	Index of planted area (Base Year 1946-100)	Total Sugar Yield (M.T.)	Index of Sugar Yield	Ave.. Sugar Yield (ton/Ha)	Planted Rice (Hectare)	Total Rice Yield (M.T.)
1946	78,489	100.00	86,074	100.00	1.1	564,016	894,021
1947	32,937	41.96	30,883	35.88	.9	667,557	999,012
1948	85,055	108.37	263,597	306.24	3.1	717,744	1068,421
1949	120,289	153.25	631,346	733,49	4.9	747,675	1214,523
1950	118,452	150.91	612,332	711.40	5.2	770,262	1421,436
1951	78,812	100.41	350,761	407.51	4.5	789,075	1484,792
1952	95,703	121.93	520,453	604.65	5.4	762,000	1570,115
1953	108,522	138.26	882,141	1024.86	8.1	778,384a/	1641,557
1954	93,151	118.68	701,155	814.59	7.5	777,000	1695,107
1955	76,312	97.23	733,160	851.77	9.6	751,000	1614,953
1956	87,642	111.66	767,327	891.47	8.8	784,000	1789,829
1957	94,110	119.90	832,749	967.48	8.8	783,267a/	1889,009
1958	95,820	122.08	893,987	1038.62	9.3	778,189a/	1894,127
1959	99,219a/	126.41	939,778	1091.82	9.5	776,050a/	1856,315

*Source: This Table is abridged from Appendix II and III.

a/ Provincial Government of Taiwan, Taiwan Agricultural Yearbook, 1960 edition, pp. 1-8.

to achieve its goal of adequate foreign exchange and adequate rice production. Again, the acreage planted and total production of rice since 1946 was much stabilized. The slight increase in acreage and yield were a result of field technical improvement and the urgent requirement for dealing with the increasing population pressure. There was no year with great decrease of rice production since 1946.

Since sugar processing in Taiwan is the largest agricultural industry with more than 30 sugar factories and by-product factories and more than 3,000 kilometers of railroad scattered widely over the island, the sugar industry provides employment opportunity, transportation facilities, and rural economic prosperity.9/ The major financial resource of the government is derived from sugar export. The foreign exchange from sugar sales each year represents around 60-70 percent among all the total export commodities so that the island's economic resources rely mainly on agricultural export. Balanced development, because of the inter-relationship of crops, depends heavily on rice and sugar cane production in Taiwan. Under the sugar price support program, the competition between sugar cane and rice will be decreased because the farm income from both will not be greatly different. The guaranteed sugar price system will accelerate the island's economic growth and development in the future. However, the impact of such price policies on the over-all allocation of resources should not be ignored.

Analysis in Correlation Coefficient of Different Factors Related to Guaranteed Sugar Price

Simple Correlation -- Computing models of correlation coefficient. Two kinds of correlation coefficient were

9/ See Appendix V.

computed. First, simple correlation coefficient was computed between the guaranteed sugar price and all factors. The formula used was:

$$r = \frac{\Sigma x_1 x_j}{\sqrt{\Sigma x_i^2}\sqrt{\Sigma x_j^2}} \quad \ldots\ldots$$

r = simple correlation coefficient:

$x_1 = X_{1i} - \bar{X}_i$ $\quad$ $\bar{X}_1$ is mean of X_1

$x_j = X_{ji} - \bar{X}_j$ $\quad$ $\bar{X}_j$ is mean of X_j $\quad$ $j = 2, 3, 4, \ldots.$

Partial Correlation -- Next, the net correlation (or partial correlation) was computed by the following formula:

$$r_{12.34} = \frac{r_{12.3} - r_{14.3}\, r_{24.3}}{\sqrt{1-r^2_{14.3}}\,\sqrt{1-r^2_{24.3}}}$$

X_1 = dependent variable (guaranteed sugar price).

X_2 = independent variable (quantity of sugar shared).

X_3 = independent variable (net income of cane's competitive crops.

X_4 = independent variable (net cost of production of sugar cane).

All the correlation coefficients between the guaranteed sugar price and its influencing factors were compiled (Appendix VII).

Coefficients of particl correlation measure the correlation between the dependent factor and each of the several

independent factors, while eliminating any (linear) tendency of the remaining independent factors to obscure the relation. Thus the coefficient of partial correlation was useful in the problem where the guaranteed sugar price was correlated with the quantity of sugar shared, the net income of cane's competitive crops and the net cost of production of sugar cane. The coefficient partial correlation of guaranteed sugar price with the quantity of sugar shared indicates, while holding constant the net income of cane's competitive crops and net cost of production of sugar, what the average correlation would probably be between guaranteed sugar price and the quantity of sugar shared. The partial correlation coefficient indicates about what an average correlation in selected subgroups would be, if computed from a larger sample drawn from the same universe. Therefore the coefficient of partial correlation may be defined as a measure of the extent to which that part of the variation in the dependent variable (guaranteed sugar price) which was not explained by the other independent factors can be explained by the addition of the new factor.

Relationship Between Guaranteed Sugar Price and Various Factors Affected

r_{12} represented the correlation coefficient between the guaranteed sugar price and the quantity of sugar shared. It shows and should be, a negative correlation (column 3, Appendix

VII) -- that is, the more sugar shared the lower the sugar price to be guaranteed. A few samples which appear as positive correlations in the column are either unreasonable or errors.

r_{13} represented the correlation coefficient between the guaranteed sugar price and the total net income of cane's competitive crops. Both show positive correlation, that is, the higher the income from cane's competitive crops, the higher the guaranteed sugar price needed; and the lower the net income from competitive crops, the lower the guaranteed sugar price needed. A few negative correlations in column 4 are special examples which probably are due to some unusual circumstances.

r_{14} represented the correlation coefficient between the guaranteed sugar price and the cost of sugar cane production. As common sense would indicate there is a positive correlation. There is no doubt that the higher the production cost of sugar cane, the higher the calculated guaranteed sugar price. However, in column 5, some negative correlations are found. This, of course, is an unreasonable phenomenon and is affected by many unusual factors such as sampling error (too little samples in a certain area) and other variables which could not be controlled.

From Appendix VII it can be seen that, indeed, the partial correlation coefficients are more reasonable than simple correlation coefficients. In column 6, $r_{12.34}$, except for one +0.112, are all negative correlations between the guaranteed sugar price and the quantity of sugar shared. In column 7, $r_{13.24}$, all are positive correlations between the guaranteed sugar price and cane's competitive crops. Again, in the last column of Appendix VII, except for three unreasonable negative numbers, all the others are positive correlations between the guaranteed sugar price and the net product cost of sugar cane.

A few unusual sampling errors might be due to the reports of both respondents and interviewers.

PART VII

CONCLUSION AND SUMMARY

Guaranteed Sugar Price is a Key Matter in Taiwan

The sugar industry is vitally important to Taiwan since it is related to the development of agriculture, industry, transportation, fiscal policy, finance, and rural civilization of the island. The foreign exchange from sugar sales represents approximately 60-70 percent of the total exports and is the major financial resource of the government. Due to the serious competition between sugar cane, rice and other crops on Taiwan and the world sugar price depression, the acreage of sugar cane started decreasing rapidly from 1953-1955.[10/] In order to maintain a stable sugar production, the fundamental matter is to have the sources of raw sugar cane material, and therefore, a minimum support price for contract cane farmers should be assured in advance. The forward pricing of farm products has in recent years become one of the important agricultural policies in modern countries. As indicated in the preceding formula, the calculation of a suggested guaranteed sugar price has been based on the assumption that the total net income of competitive crops during the same period of sugar cane growing is the opportunity cost for sugar cane and its intercrop products. The study of schedules has

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10/ See Table XII.

been carried out according to the computing model. The calculated guaranteed sugar price for the past three years' survey was based on the computing model and survey data.

Guaranteed Sugar Prices are Varied In Different Areas and Fields

The guaranteed price in Taiwan is a kind of purchasing sugar price guaranteed by the government to the cane producers. This is a minimum guaranteed price but not an actual purchasing price. When the world sugar price is above the announced guaranteed sugar price, then the purchasing sugar price will be the world sugar price. Only during the period when the world sugar price is below the announced guaranteed price is the government's announced price the actual purchasing price. The government, under such conditions, pays the difference between the announced guaranteed sugar price and the purchasing price which is based on the level of the world sugar price.

The suggested guaranteed sugar prices, according to the survey data, are varied in different areas and different fields. Generally speaking, both the Taichung area and the Pingtung area have higher suggested guaranteed sugar prices than Huwei, Hsingyin, and Tsungyeh areas. In each area, both upland fields and two-crop fields have higher suggested guaranteed sugar prices than the dry-plain fields, single-crop fields, and

rotation fields. The announced guaranteed sugar price covered approximately 50 percent of the contract farmers whose net income from sugar cane was at least equal to the net income of cane's competitive crops. In view of this fact, the Taiwan Sugar Corporation has made the necessary adjustment in the forces determining the level of production by different ways and means to the Taichung and Pingtung areas (such as using productive loans and technical assistance in encouraing and helping contract farmers in cane production in both areas). Economically, it is easy to set multiple guaranteed sugar price systems according to the survey data in different areas and fields; but politically, it is hard to carry out two or more price systems for different areas since the factors are too complicated. A multiple price policy might also have an undesirable influence on resource allocation.

Outlook for the Future

During the past years the guaranteed sugar price policy has produced a stabilizing function, particularly to the contract farmers' psychology, since the guaranteed price protects from both sugar cane production from unfavorable price risk and uncertainty. Under such a price program, farmers don't worry about sugar price fluctuation in the world market, since their price for sugar cane will not be less than the announced

guaranteed sugar price.

The policy is established safely; but much more should be done in the future because the factors affecting the announced guaranteed sugar price are quite numerous. Perhaps we can find other ways for decreasing the guaranteed sugar price and increasing farm income by further study. For example, extending intercrop systems might increase net income; investment and technological improvement might be able to diminish the guaranteed sugar price. Again, increasing the application of fertilizer will increase the production cost but also increase the quantity of sugar sharing. There are many phenomena and problems before us to be studied and solved by different means and ways.

APPENDICES

APPENDIX I. SUBSIDIES AND PURCHASING PRICES OF FARMER'S SUGAR AFTER V-J DAY, 1947-48 to 1956-57.*

Revisions	1947-48 Purchasing Price	1948-49 Purchasing Price	1949-50 Purchasing Price	1950-51 Purchasing Price	1951-52 Purchasing Price	1951-52 Sum of Subsidy	1952-53b/ Purchasing Price	1952-53b/ Sum of Subsidy	1953-54 Purchasing Price	1953-54 Sum of Subsidy	1954-55 Purchasing Price	1954-55 Sum of Subsidy	1955-56 Purchasing Price	1955-56 Sum of Subsidy	1956-57 Purchasing Price	1956-57 Sum of Subsidy	1956-57 Subsidy to Fert. Price Incr.
1st	Jan. $250 1948	$1880.00 Dec. 1, 1948	$0.45 Dec. 12, 1949	$1.60 Dec. 20, 1950	$1.58 Dec. 20, 1951	----	$1.603 Dec. 20, 1952	0.630	$1.2536 Dec. 20, 1953	0.1464	$1.2193 Dec. 1, 1954	0.5807	$1,8057 Dec. 1, 1955	0.1943	$1.7663 Nov. 1. 1956	0.3837	0.1200
2nd	Mar.10, $275 1948	$2256.00 Jan.11, 1949	$0.63 Feb. 24, 1950	$2.18 Feb. 1, 1951	$1.58 Jan. 1, 1952	----	$1.603 Jan. 1, 1953	0.630	$1.1290 Jan. 1, 1954	0.2710	$1.2337 Jan. 1, 1955	0.5663	$1.6239 Jan. 1, 1956	0.3761	$1.7857 Dec. 1, 1956	0.3643	0.1200
3rd	Mar.20, $300 1948	$2632.00 Feb. 1, 1949	$0.70 Apr. 20, 1950	$2.18 Mar. 1, 1951	$1.65 Feb. 1, 1952	0.1467	$1.560 Feb. 1, 1953	0.840	$1.1508 Feb. 1, 1954	0.2492	$1.2421 Feb. 1, 1955	0.5579	$1.6336 Feb. 1, 1956	0.3664	$1.9063 Jan. 1, 1957	0.2437	0.1200
4th	Apr. 5, $350 1948	$3008.00 Feb.11, 1949	$0.81 June 23, 1950	$2.12 Apr. 1, 1951	$1.65 Mar. 1, 1952	0.9620	$1.441 Mar. 1, 1953	0.959	$1.1469 Mar. 1, 1954	0.2531	$1.2514 Mar. 1, 1955	0.5486	$1.6282 Mar. 1, 1956	0.3718	$2.1208 Feb. 1, 1957	0.2920	0.1200
5th	----	$3384.00 Feb.21, 1949	$0.855 July 1, 1950	$1.96 May 1, 1951	$1.65 Apr. 1, 1952	0.2860	$1.270 Apr. 1, 1953	1.130	$1.1621 Apr. 1, 1954	0.2379	$1.2544 Apr. 1, 1955	0.5496	$1.6499 Apr. 1, 1956	0.3501	$2.3511 Mar. 1, 1957	----	----
6th	----	$3760.00 Mar.11, 1949	$0.81 July 12, 1950	$1.75 June 1, 1951	$1.65 May 1, 1952	0.4260	$1.175 May 1, 1953	1.225	$1.1891 May 1, 1954	0.2109	$.2240 May 1, 1955	0.5760	$1.7159 May 1, 1956	0.2841	$2.5095 Apr. 1, 1957	----	----
7th	----	$4880.00 Apr.21, 1949	$0.95 Aug. 7, 1950	$1.75 July 1, 1951	$1.65 June 1, 1952	0.2960	$1.143 June 1, 1953	1.257	$1.2229 June 1, 1954	0.1771	$1.2134 June 1, 1955	0.5866	$1.7547 June 1, 1956	0.2453	$2.6190 May 1, 1957	----	----
8th	----	$5640.00 May 11, 1949	----	$1.58 Aug. 1, 1951	$1.65 July 1, 1952	0.1420	$1.090 July 1, 1953	1.310	$1.2235 July 1, 1954	0.1765	$1.2196 July 1, 1955	0.5804	$1.7521 July 1, 1956	0.2479	$2.9459 June 1, 1957	----	----
9th	----	$6768.00 May 21, 1949	----	$1.58 Sept. 1, 1951	$1.65 Aug. 1, 1952	0.2540	$1.090 Aug. 1, 1953	1.310	$1.2219 Aug. 1, 1954	0.1781	$1.2350 Aug. 1, 1955	0.5650	$1.7335 Aug. 1, 1956	0.2465	$2.9170 July 1, 1957	----	----
10th	----	$0.378 a/ June16, 1949	----	$1.58 Sept.20, 1951	$1.65 Sept. 1, 1952	0.5450	$1.903 Sept. 1, 1953	1.307	$1.1789 Sept. 1, 1954	0.2211	$1.2509 Sept.1, 1955	0.5491	$1.7450 Sept.1, 1956	0.2550	$2.9182 Aug. 1, 1957	----	----
11th	----	----	----	$1.58 Oct. 20, 1951	----		----		$1.2193 Dec. 1, 1954	0.5807c/	----	----	----	----	$2.5705 Sept.1, 1957	----	----
12th	----	----	----	$1.58 Nov. 20, 1951	----		----		$1.2337 Jan. , 1955	0.5663c/	----	----	----	----	----	----	----

* Source: Taiwan Suguar Corporation, Taiwan Sugar Statistics, TSC Press, Tapei, Taiwan, 1958, pp. 72-73.

a/ The government authorized the monetary reform on June 15, 1949. Since the 10th authorized purchasing price of sugar of 1948-49, based on N.T. $.

b/ Before 1952-53, the quotations are on B.W.C. basis, while afterthat on S.W.C.

c/ The 11th and 12th purchasing prices and subsidies of crop 1953-54 are the same as the purchasing prices and subsidies of the 1st and 2nd of 1954-55 respectively. Since March 1, 1957, all the subsidies were cancelled while the purchasing price was higher than the guaranteed sugar price.

APPENDIX II. RICE PRODUCTION (1919-1957) IN TAIWAN.*

Year	Hectare Planted	Index of Hectare (1936=100)	Total Yield (m.t.)	Index of Total Yield	Yield Per Ha.	Index of Yield/ ha. (1938=100)
1919	497,211	72.95	703,320	50.15	1,415	63.11
1920	500,169	73.39	691,764	49.33	1,383	61.68
1921	495,426	72.69	710,899	50.69	1,435	64.01
1922	511,241	75.01	777,831	55.46	1,521	67.84
1923	507,829	74.51	695,155	49.57	1,369	61.06
1924	531,451	77.98	868,090	61.90	1,633	72,84
1925	550,835	80.82	920,452	65.63	1,671	74.53
1926	567,172	83.22	887,739	63.30	1,565	69.80
1927	585,011	85.84	985,524	70.27	1,685	75.16
1928	584,918	85.82	970,715	69.22	1,660	74.04
1929	567,952	83.33	925,824	66.02	1,630	72.70
1930	614,390	90.15	1,052,931	75.08	1,714	76.45
1931	633,726	92.98	1,068,549	76.19	1,686	75.20
1932	664,325	97.47	1,278,459	91.16	1,924	85.82
1933	675,476	99.11	1,194,549	85.18	1,768	78.86
1934	666,979	99.86	1,294,412	92.58	1,947	86.84
1935	678,629	99.57	1,303,164	92.92	1,920	85.63
1936	681,584	100.00	1,365,484	97.32	2,004	89.38
1937	657,685	96.50	1,319,018	94.05	2,006	89.47
1938	625,398	91.76	1,402,414	100.00	2,242	100.00
1939	626,131	91.87	1,307,391	93.22	2,088	93.13
1940	638,622	93.70	1,128,748	80.49	1,768	78.85
1941	646,927	94.92	1,199,006	85.50	1,853	82.65
1942	616,529	90.46	1,171,182	83.51	1,900	84.75
1943	610,051	89.51	1,125,804	80.28	1,845	32.29
1944	600,688	88.14	1,068,121	76.16	1,778	79.30
1945	502,018	73.66	638,828	45.45	1,273	56.77
1946	564,016	82.76	894,021	63.61	1,585	70.69
1947	667,557	99.41	999,012	71.08	1,474	65.74
1948	717,744	105.31	1,068,421	76.02	1,489	66.41
1949	747,675	109.70	1,214,523	87.77	1,624	72.44
1950	770,262	113.02	1,421,436	102.65	1,845	82.29

*See Asterisk on next page.

APPENDIX II. RICE PRODUCTION (1919-1957) IN TAIWAN.* (Continued)

Year	Hectare Planted	Index of Hectare (1936=100)	Total Yield (m.t.)	Index of Total Yield	Yield Per Ha.	Index of Yield/ Ha. (1938=100)
1951	789,075	115.78	1,484,792	105.87	1,882	83.94
1952	762,000	------	1,570,115	112.00	1,998	89.00
1953	-------	------	1,641,557	117.00	2,106	94.00
1954	777,000	------	1,695,107	121.00	2,103	97.00
1955	751,000	------	1,614,953	115.00	2,151	96.00
1956	784,000	------	1,789,829	128.00	2,284	102.00
1957	-------	------	1,889,009	131.00	2,347	105.00

*Source: Figure of 1919-1951, from JCRR's Special Issue, No. 7, 1953, p. 66. Figure of 1952-57, from Taiwan Provincial Food Bureau. Total hectares in column 2 after 1951, from FAO's Yearbook-Prodiction, 1957.

APPENDIX III. SUGAR PRODUCTION IN TAIWAN.*

Year	Planted Sugar Cane (Hectare)	Index of Planted Area (1903-100)	Sugar Yield (M.T.)	Index of Yield/m.t. (1903-100)
1903	16,030	100	30,408	100
1904	20,946	131	45,501	149
1905	24,227	151	49,579	163
1906	34,103	213	76,433	251
1907	29,479	184	63,876	211
1908	27,842	174	65,521	215
1909	37,863	236	122,327	402
1910	61,508	384	204,241	672
1911	86,761	541	270,339	889
1912	73,069	456	175,587	577
1913	65,337	408	71,489	235
1914	73,988	462	150,767	495
1915	82,595	515	208,467	685
1916	111,017	693	321,082	1,056
1917	125,772	785	458,094	1,506
1918	145,936	910	344,123	1,131
1919	116,797	729	291,814	959
1920	105,124	656	223,210	734
1921	116,291	727	252,734	831
1922	137,771	859	352,655	1,160
1923	113,121	706	355,392	1,169
1924	119,536	746	452,210	1,487
1925	126,461	789	479,540	1,577
1926	120,238	750	499,925	1,644
1927	96,699	603	411,140	1,352
1928	104,955	655	580,116	1,908
1929	116,444	726	789,328	2,596
1930	106,115	662	810,483	2,666
1931	96,121	600	979,278	2,622
1932	106,225	663	989,049	3,253
1933	81,800	510	633,724	2,084
1934	88,428	552	647,043	2,128
1935	117,979	736	965,652	3,176

*See Asterisk on next page.

APPENDIX III. SUGAR PRODUCTION IN TAIWAN.* (Continued)

Year	Planted Sugar Cane (Hectare)	Index of Planted Area (1903-100)	Sugar Yield (M.T.)	Index of Yield/m.t. (1903-100)
1936	124,479	777	901,678	2,966
1937	120,818	754	1,007,352	3,313
1938	130,181	812	990,159	3,257
1939	162,312	1,013	1,418,730	4,666
1940	169,064	1,055	1,132,768	3,726
1941	157,210	981	799,694	2,630
1942	156,560	976	1,084,011	3,565
1943	156,507	976	1022,196	3,362
1944	149,966	936	880,267	2,895
1945	107,683	673	323,594	1,064
1946	78,489	490	86,074	283
1947	32,937	206	30,883	101
1948	85,055	531	263,597	874
1949	120,289	752	631,346	2,077
1950	118,452	740	612,332	2,014
1951	78,812	492	350,761	1,154
1952	95,703	598	520,453	1,112
1953	108,522	678	882,141	2,902
1954	93,151	582	701,155	2,306
1955	76,312	477	733,160	2,412
1956	87,642	548	767,327	2,524
1957	94,110	588	832,749	2,739
1958	95,820	599	893,987	2,940

*Source: (1) Taiwan Sugar Corporation, Taiwan Sugar Statistics, published by Japanes before World War II.
(2) Taiwan Sugar Corporation, Taiwan Sugar Statistics, 1958, p. 64-65.

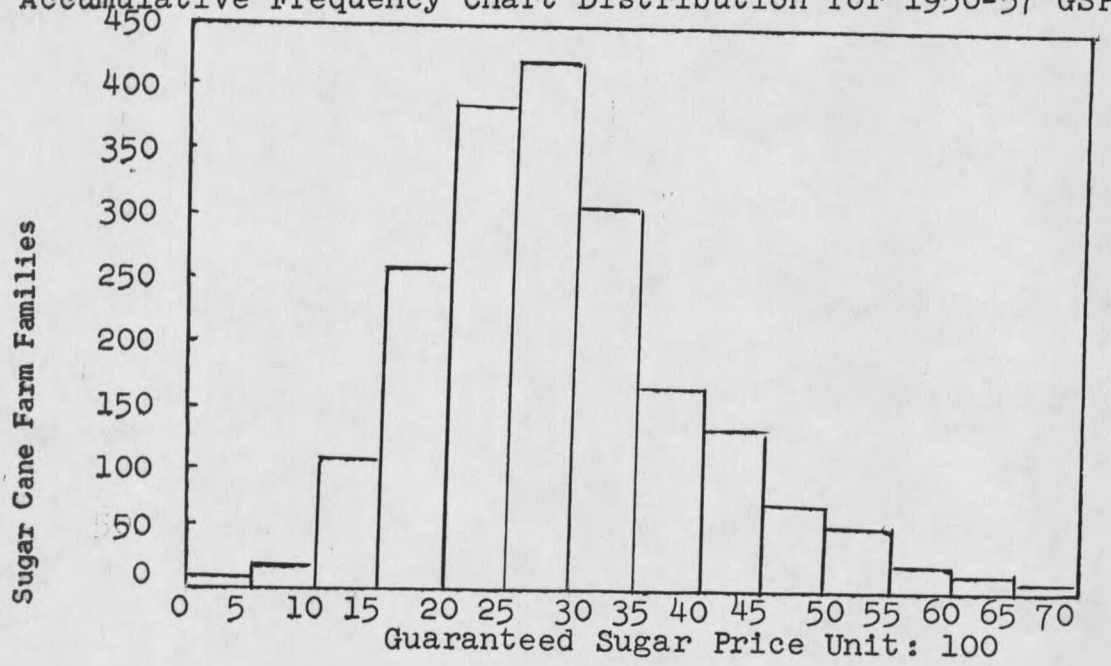
APPENDIX IV. SAMPLING DISTRIBUTION IN DIFFERENT SUGAR FACTORY AREAS BY FIELDS.*

Areas	Two-Crop Field			Single-Crop Field			Rotation Field			Dry-Plain			Up-Land			Total Survey Farm Families		
	1955-56	1956-57	1957-58	1955-56	1956-57	1957-58	1955-56	1956-57	1957-58	1955-56	1956-57	1957-58	1955-56	1956-57	1957-58	1955-56	1956-57	1957-58
Taichung Head-Sugar Factory Areas																		
Taichung	18	23	25	0	0	0	0	0	0	14	26	25	20	29	21	52	78	71
Yuehmei	6	9	12	0	0	0	0	0	0	0	0	0	4	5	3	10	14	15
Nantow	5	8	8	0	0	0	10	10	10	5	7	5	30	37	29	50	62	52
Chihu	50	83	87	0	0	0	0	0	0	34	38	31	0	0	0	84	121	118
Sub-total	79	123	132	0	0	0	10	10	10	53	71	61	54	71	53	196	275	256
Huwei Head-Sugar Factory Area																		
Huwei	5	12	12	8	14	14	75	116	112	22	21	15	0	0	0	110	163	153
Lungyen	0	0	0	0	0	0	48	79	60	12	14	13	0	0	0	60	93	73
Peikang	0	0	2	0	0	0	64	121	116	10	11	8	0	0	0	74	132	124
Talin	5	3	3	16	32	33	0	5	5	33	37	40	12	14	11	66	91	91
Towlin	4	4	0	12	22	20	0	0	0	8	5	4	6	6	6	30	37	33
Sub-total	14	19	17	36	68	67	187	321	293	85	88	80	18	20	17	340	516	474
Hsingyin Head-Sugar Factory Area																		
Hsingyin	0	0	0	4	4	7	54	77	100	32	39	42	6	8	6	96	128	155
Wushulin	0	0	0	8	12	17	17	24	32	26	36	42	9	13	10	60	85	101
Nantsing	0	0	0	10	17	20	12	20	26	30	42	38	6	6	5	58	85	89
Suantow	0	0	0	0	2	3	63	90	92	23	32	22	0	0	0	86	124	117
Annei	0	0	0	0	0	0	43	65	68	31	30	28	0	0	0	74	95	94
Sub-total	0	0	0	22	35	47	189	276	316	142	179	172	21	27	21	374	517	556
Taungyeh Head-Sugar Factory Area																		
Tsungyeh	0	0	0	0	0	0	33	42	44	11	14	12	0	0	0	44	56	56
Yutsing	0	0	0	4	4	6	0	0	0	46	44	45	8	12	9	52	60	60
Chaluchien	0	0	0	4	3	3	0	0	0	50	59	59	0	0	0	54	62	62
Sankantien	0	0	0	0	0	0	55	55	62	11	15	18	0	0	0	66	70	80
Wanli	0	0	0	2	3	2	26	35	35	26	34	33	6	8	7	60	80	77
Shiallung	0	0	0	0	0	0	47	62	61	5	7	4	0	0	0	52	68	67
Sub-total	0	0	0	10	10	11	161	193	204	143	173	171	14	20	16	328	396	402
Pingtung Head-Sugar Factory Area																		
Pingtung	10	9	6	22	25	31	0	0	0	84	91	81	0	0	0	116	125	118
Chioatou	0	3	1	6	6	12	0	0	0	35	42	37	5	5	4	46	56	55
Shiaokang	8	10	8	4	4	4	0	0	0	8	8	9	8	9	7	28	31	28
Nanchow	2	0	0	2	0	2	0	0	0	30	38	37	0	0	2	34	38	41
Chiwei	2	4	1	2	4	5	0	0	0	30	32	31	4	6	5	38	46	42
Sub-total	22	26	16	36	39	54	0	0	0	187	211	195	17	20	18	262	296	283
GRAND TOTAL	115	168	165	104	152	179	547	800	823	610	722	679	124	158	125	1500	2000	1971

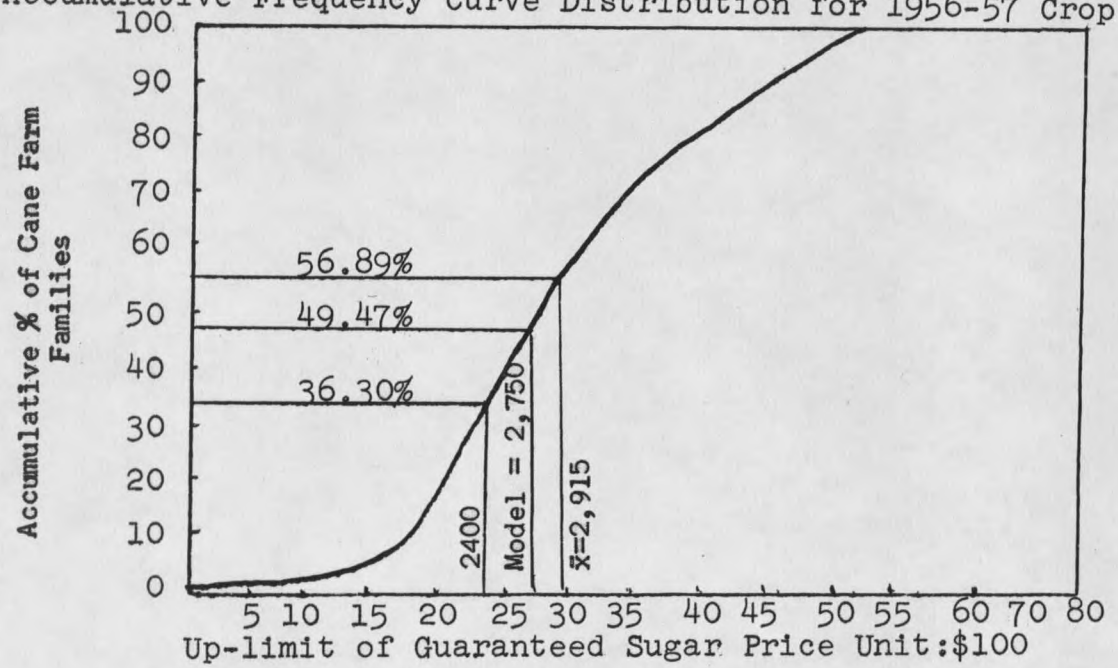
*Source: Taiwan Sugar Corporation, Chinese Agricultural Economics Association, "Survey Data", 1956-57-58 crop years, Taipei, Taiwan, (Mimeographed).

Appendix V-a Accumulative Frequency Curve and Chart Distribution for 1956-57 Crop Year

Accumulative Frequency Chart Distribution for 1956-57 GSP

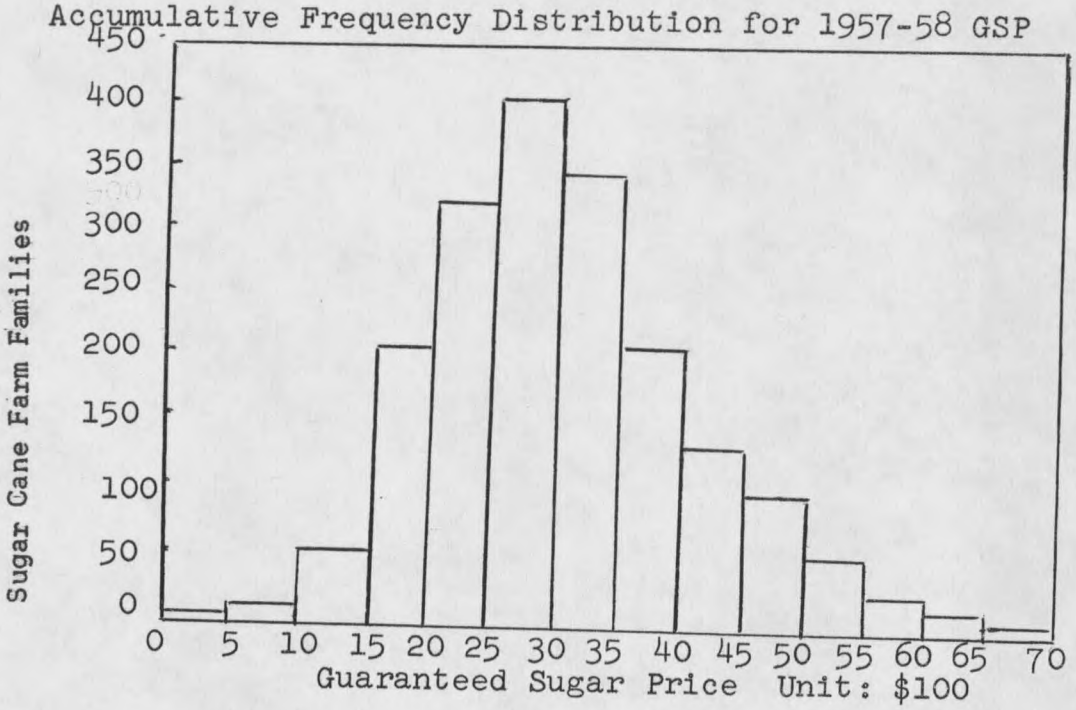


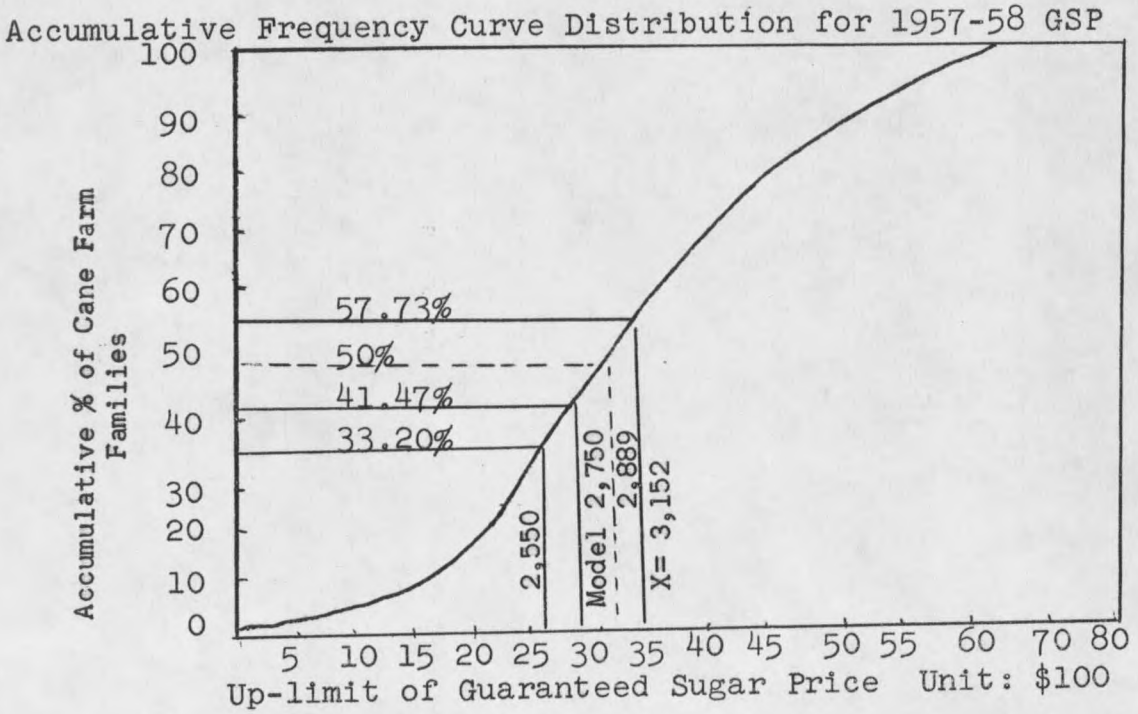
Accumulative Frequency Curve Distribution for 1956-57 Crop Year



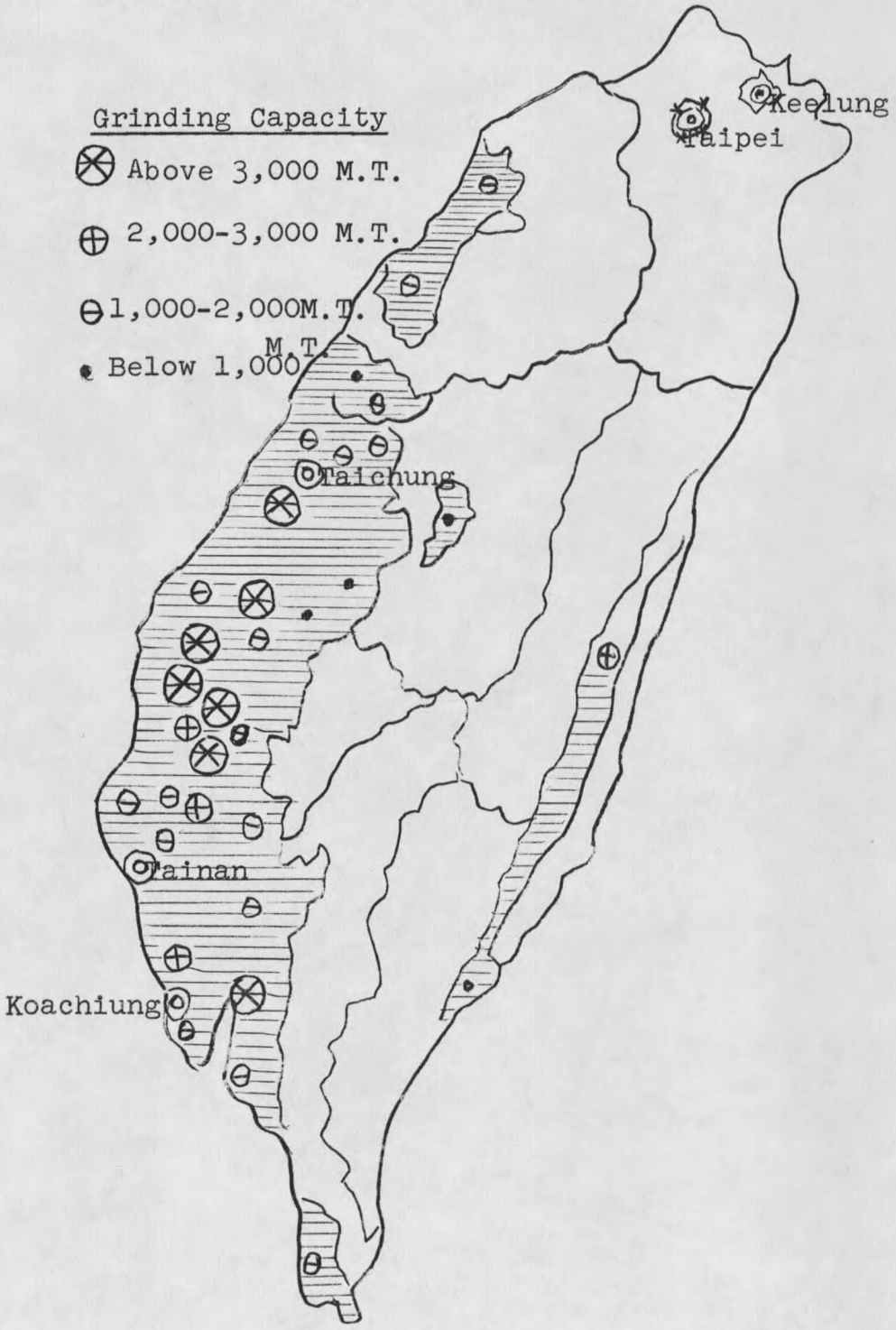
These charts and curves in AppendixVa & Appendix V-b are abridged from T. T. Chang, Guaranteed Price of Sugar in Taiwan, TSC Press, 1959, pp. 45-47.

Appendix V-b Accumulative Frequency Curve and Chart Distribution for 1957-58 Crop Year





Appendix VI Sugar Factory Distribution on Taiwan



Map 3. Showing Grinding Capacity Per Day in Different Sugar Factories.

APPENDIX VII. COEFFICIENT OF CORRELATION BETWEEN GUARANTEED SUGAR PRICE AND VARIOUS FACTORS FOR THREE CROP YEARS.*

Field Planting Time	Year	Simple Correlation Coefficients r^{12} (-)	r^{13} (+)	r^{14} (+)	Partial Correlation Coefficients $r^{12.34}$ (-)	$r^{13.24}$ (+)	$r^{14.23}$ (+)
Two-crop field							
Spring	1955-56	-0.844	+0.007	-0.521	-0.904	+0.492	+0.667
	56-57	+0.024	+0.857	+0.220	-0.021	+0.989	+0.957
	57-58	0.457	+0.362	+0.076	-0.955	+0.903	+0.927
Ratoon	1955-56	-0.627	+0.268	-0.963	+0.112	+0.162	-0.736
	56-57	-0.533	+0.798	+0.750	-0.960	+0.912	+0.859
	57-58	-0.754	+0.530	-0.124	-0.894	+0.794	+0.351
Fall	1955-56	-0.673	+0.416	-0.580	-0.877	+0.904	+0.659
	56-57	-0.634	+0.614	+0.137	-0.957	+0.956	+0.821
	57-58	-0.300	+0.296	+0.539	-0.703	+0.973	+0.983
Single-crop field							
Spring	1955-56	-0.594	+0.984	-0.328	-1.000	+1.000	-1.000
	56-57	-0.375	+0.319	-0.244	-1.000	+0.999	-0.999
	57-58	-0.994	+0.731	+0.629	-1.000	+0.999	+0.999
Ratoon	1955-56	-0.640	+0.623	+0.462	-0.952	+0.845	+0.818
	56-57	-0.628	+0.876	-0.064	-0.719	+0.817	+0.353
	57-58	-0.437	+0.608	+0.676	-0.848	+0.671	+0.799
Fall	1955-56	+0.029	+0.800	+0.611	-0.985	+0.995	+0.937
	56-57	-0.459	+0.610	+0.191	-0.639	+0.784	+0.072
	57-58	-0.209	+0.399	-0.130	-0.923	+0.934	+0.805
Rotation field							
Spring	1955-56	-0.608	+0.193	+0.420	-0.921	+0.744	+0.431
	56-57	+0.763	+0.820	+0.901	-1.000	+1.000	+1.000
	57-58	-0.888	+0.824	+0.291	-0.999	+1.000	+1.000
Ratoon	1955-56	-0.970	+0.962	+0.334	-0.772	+0.772	+0.102
	56-57	-0.299	+0.668	+0.755	-0.916	+0.851	+0.606
	57-58	-0.149	+0.698	-0.390	-0.783	+0.882	+0.645
Fall	1955-56	-0.664	+0.441	-0.142	-0.917	+0.877	+0.777
	56-57	-0.676	+0.812	-0.637	-0.939	+0.970	+0.945
	57-58	-0.518	-0.027	+0.503	-0.568	+0.632	+0.721

* See asterisk on next page.

APPENDIX VII. COEFFICIENT OF CORRELATION BETWEEN GUARANTEED SUGAR PRICE AND VARIOUS FACTORS FOR THREE CROP YEARS.* (Continued)

Field Planting Time	Year	Simple Correlation Coefficients			Partial Correlation Coefficients		
		$r^{12}(-)$	$r^{13}(+)$	$r^{14}(+)$	$r^{12.34}(-)$	$r^{13.24}(+)$	$r^{14.23}(+)$
Dry-plain field							
Spring	1955-56	-0.404	+0.558	-0.189	-0.877	+0.855	+0.548
	56-57	-0.595	+0.869	-0.071	-0.979	+0.970	+0.677
	57-58	-0.813	-0.240	-0.382	-0.984	+0.947	+0.810
Ratoon	1955-56	-0.431	+0.548	-0.068	-0.719	+0.762	+0.384
	56-57	-0.344	+0.670	+0.332	-0.880	+0.899	+0.609
	57-58	-0.633	+0.112	+0.337	-0.718	+0.371	+0.440
Fall	1955-56	-0.563	-0.218	-0.202	-0.809	+0.740	+0.384
	56-57	-0.402	+0.137	+0.305	-0.479	+0.320	+0.325
	57-58	-0.633	+0.265	+0.194	-0.779	+0.905	+0.853
Upland field							
Ratoon	1955-56	-0.794	-0.425	+0.514	-0.529	+0.172	+0.600
	56-57	-0.652	-0.215	+0.676	-0.776	+0.720	+0.948
	57-58	-0.772	+0.697	+0.378	°0.886	+0.873	+0.093
Fall	1955-56	+0.193	+0.653	-0.290	-0.529	+0.741	+0.006
	56-57	-0.110	+0.770	+0.267	-0.776	+0.720	+0.463
	57-58	-0.499	+0.483	-0.303	-0.886	+0.881	+0.492

*Source: Survey Data, Computed by Chinese Rural Economics Association.

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