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CORNELL/INTERNATIONAL AGRICULTURAL ECONOMICS STUDY

AN OVERVIEW OF THE TAIWANESE RICE ECONOMY

by

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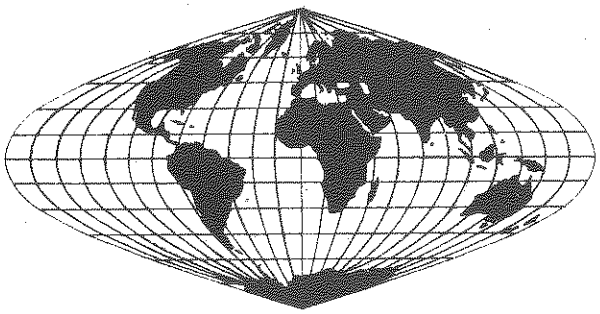

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The Department of Agricultural Economics offers training in International Economics and Development leading to the MPS, MS, and PhD degrees. A component of the Program in International Agriculture of the New York State College of Agriculture and Life Sciences, the course of study and research is flexible and designed to enable students to draw on the expertise of faculty in many disciplines and with wide-ranging international experience, as well as on a core of faculty within the Department who address themselves exclusively to international questions. The geographical focus is on the developing countries of Asia, Africa, and Latin America.

TAIWAN

I. Overview

Taiwan is a large, mountainous island located off the coast of the Chinese province of Fujian. Historically, it was subjected to numerous incursions, not only from insular Southeast Asia and China, but also by Dutch, Portuguese and Spanish explorers, traders and colonists. The indigenous aboriginal population, of Malayo-Polynesian origin, is largely mixed with the ethnic Chinese who have been migrating to Taiwan for hundreds of years. In fact, since the seventeenth century, Taiwan has served as an important refuge for surplus Chinese population from Fujian and Guangdong provinces in times of famine or other natural disasters. Beginning in 1661, the Ming general, Cheng Chen-Kung (Koxinga), used Taiwan as a base from which to wage war against the Manchu dynasty. In 1683, Qing armies established control of Taiwan. Subsequently, many Chinese peasants emmigrated to Taiwan, introducing advanced agricultural technology and important new crops.

In 1895, at the conclusion of the Sino-Japanese war, China was forced to cede Taiwan to Japan. The Japanese proceeded to develop and administer Taiwan as a colony geared to providing tropical foodstuffs and raw materials to the burgeoning Japanese economy. The Japanese paid special attention to the development of new high-yielding varieties preferred by Japanese consumers; irrigation and flood control; the introduction of chemical fertilizer; and the populatization of tropical cash crops such as sugar cane and bananas.

In 1945, Taiwan returned to China. With the fall in 1949-50 of the Kuomintang-led government on the mainland, about 2 million Nationalist soldiers,

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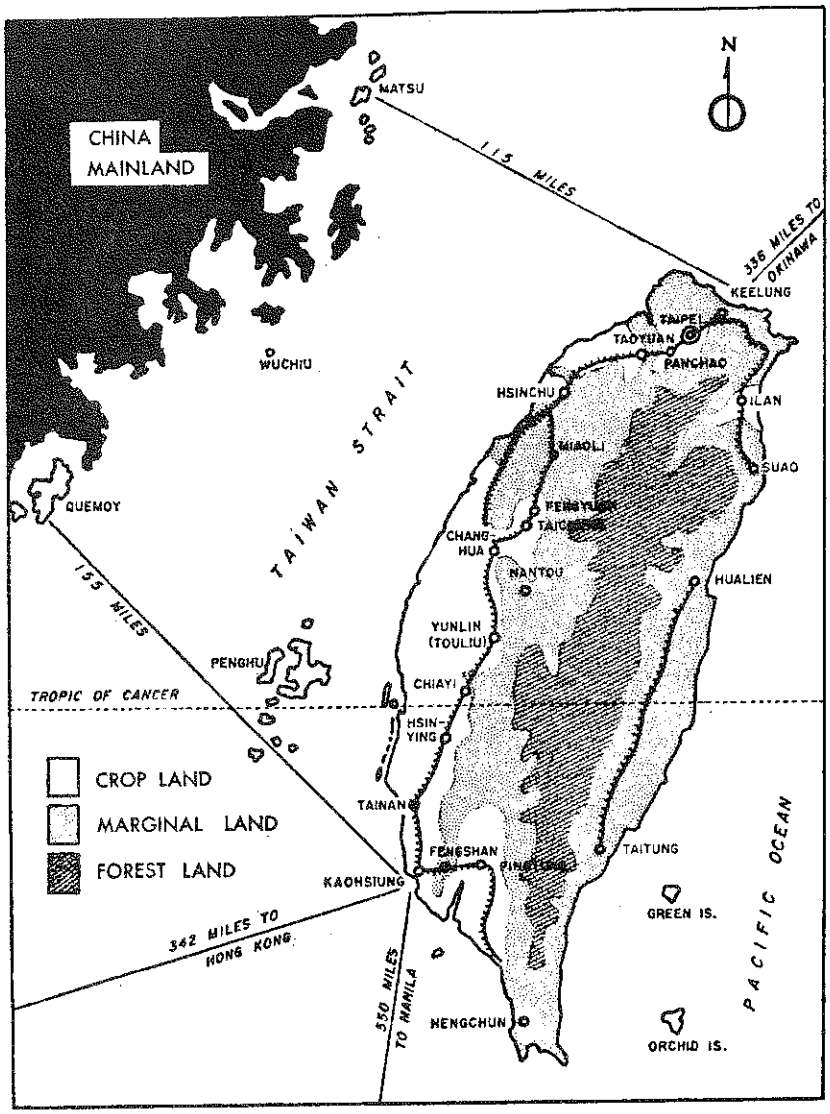
officials and dependents retired to Taiwan and set up a Chinese government-in-exile under Chiang Kai-shek.

Subsequently, with the help of substantial U.S. financial and technical aid, Taiwan made a successful transformation from an underdeveloped, agriculturally dependent colony, to an economically independent, industrialized state. The Kuomintang Party, led by Chiang Kai-shek's son, Chiang Ching-kuo, continues to control the Taiwanese government.

Taiwan is part of the extensive Asian Pacific island arc that begins with the northernmost point of Japan, extending downward through the Indonesian archipelago and fans out into the vast island territories of Polynesia, Micronesia, and Melanesia. Taiwan administers not only the main island, but also numerous small islets and the Penghu or Pescadores Islands concurrently claimed by China and the Philippines. Administratively, Taiwan is divided into 16 counties or (hsien) and six municipalities (shih). Counties are further subdivided into townships and municipalities into districts. The township is the basic administrative unit in Taiwan for statistical, as well as political purposes.

Taiwan is bisected by the Tropic of Cancer and with the exception of a few isolated mountain areas, has a 365 day frost-free growing season. The island is roughly divided in half by a north-south mountain spine that occupies roughly two-thirds of the island's 35,960 sq. km. (13,836 sq. miles). On the eastern side of the ranges the mountains drop sharply to the sea, and there is little land suitable for cultivation (Figure 1). In contrast, the western foothills tend to slope more gradually to the sea, and this is where Taiwan's most productive cultivated area is located. Only about 25 percent (896,000 ha.)

Figure 1. Province of Taiwan, Republic of China



Source: T.H. Shen, Agricultural Development on Taiwan Since World War II, (Ithaca, N.Y.: Comstock Publishing Associates - A Division of Cornell University Press, 1964).

of Taiwan's total surface is cultivatable. About 60 percent of the total cultivated area is devoted to paddy fields (537,000 ha.) that primarily grow rice, sugar cane and other tropical crops. The bulk of the remainder is dryland, where corn, beans, tobacco, vegetable crops, and some rice are grown. The southern part of the island has a tropical climate while the northern part is semi-tropical, with less sunshine and cooler temperatures. The western plains have mean temperatures ranging from 22-25° C. Rainfall is abundant, although seasonal, ranging from 1,760-3,040 mm annually and increasing from the coasts to the higher altitudes and from south to north. During the late winter months, the northeastern monsoon brings rainfall and cloudy weather to eastern and northern Taiwan. By early summer, rainy weather blankets the entire island and rainfall is especially intense in the south. Taiwan, like the Philippines, is in a region of intense typhoon activity and frequently suffers crop damage during the May-October typhoon season.

Taiwan has a very unfavorable man-land ratio, however, since the majority of its labor force is employed in the industrial and service sectors, it suffers less from the typical problems experienced by other overpopulated, primarily agrarian Asian economies. Only about 32 percent of the total population is classified as agricultural (5,572,130 in 1977), and that includes a substantial number who work off the farm. A 0.16 ha. agricultural per capita availability of cultivated land gives most farm families holdings of slightly over 1 hectare, a medium-sized farm by Asian standards. Since WW II, Taiwan has had to deal with extremely rapid increases in population, although the growth rate has fallen markedly in recent years. The influx of Nationalist Chinese in December 1949 alone caused the population to swell from 6,806 thousand persons (1948) to 7,554 thousand persons (1950). Subsequent natural

growth was still very high at 4.6 percent in the 1951-55 period and still over 3 percent by 1965.

Under the Japanese, tenancy was widespread and became a rather serious rural problem. About 40 percent of all Taiwanese farm families were tenants, many paying high rents to landlords. The Nationalists instigated a progressive land reform program in three stages. In 1949 they fixed maximum land rental at 37.5 percent of the total production of the main season crop. In 1951, the government began to sell public lands, formerly the property of the Japanese government and civilians, to tenant farmers at fixed prices based on the normal yield of the main season crop. Tenants were allowed 10 years to repay the loans and were required to make their payments in kind. The redistributed area constituted about 20 percent of Taiwan's total arable hectarage.

The third and most important stage of land reform, the land-to-the-tiller program, instituted in 1953, required the sale of absentee holdings in excess of 3 ha. of paddyland or 6 ha. of dryland to government representatives. The government paid 2.5 times the value of the main crop for the land and resold it to tenants for the same price. Former tenants were required to pay for paddyland in kind, but dryland was repaid in cash. The program was very successful at reducing tenancy and improving farmer livelihood as well as increasing rice production. In 1977, only 9 percent of all farmers were tenants, while 82 percent owned all the land they farmed.

II. The Statistical System

Current Taiwanese agricultural statistical reporting is, in general, very complete. This is both because of the methodical data collection system

initiated on Taiwan by the Japanese before 1945 and because of the capacity for developed statistical collection that the Nationalists brought with them from China. The statistical system of Taiwan is organized along the same lines as the Chinese system. The Bureau of Statistics, headed by the Director-General of Budget Accounts and Statistics, is the central body around which all statistical collection is organized. This bureau is responsible for carrying out island-wide agricultural and population censuses every five years. The Bureau of Statistics also publishes periodical statistical reports, such as the annual Statistical Yearbook of Taiwan, based on material gathered by the specialized ministries. The bureau generally oversees statistical collection at all levels of the bureaucracy, although it is not responsible for actual collection of any statistical data except for census material.

The collection of agricultural statistics, with the exception of those pertaining to rice and hogs, is undertaken by the Department of Agriculture and Forestry. Under the crop reporting system, established in 1947 and later revised in 1963, the Department of Agriculture and Forestry is responsible for conducting periodic surveys and for the regular collection and compilation of crop, livestock, and fishery statistics. This information is regularly published in annual publications such as the Taiwan Agricultural Yearbook. Data is collected for most agricultural products produced in Taiwan; agricultural population; cultivated land area; the manufacture, import and use of agricultural inputs; and imports and exports. Complete time series are available for most data categories since 1903. Surveys are also made of agricultural disasters to aid government officials in making policy decisions and in distributing emergency relief. Data are collected for all townships and passed upward through the hsien to the provincial level. The government hires at least one part-time worker in each township who is responsible for the collection of

agricultural statistics. Crop reporting for all crops, including rice, is carried out six times per year in January, March, May, July, October and December. Data are reported on a calendar year basis. Statistical materials published prior to WWII use the Japanese system of reckoning time (i.e., by reign period: Meiji, Taisho, Showa), while those published after WWII use the Nationalist system (with 1912, the year the Republic of China was founded, designated as year 1). The calendar year is further subdivided into three seasons according to the planting time for all crops except rice, which is reported on a two season basis. The first crop season is January-April, the second season crop, May-September, and the third or winter season crop, October-December. Rice is grown during the first and second seasons. A high percentage of total sown area is devoted to rice during both the first and second crop seasons, but yields are, in general, much higher during the first crop season. This is probably due to a higher incidence of typhoon damage during the second season and more favorable growing conditions, especially in the south, during the first season.

The Provincial Food Bureau (PFB) is responsible for the collection and compilation of rice statistics, and the PFB publishes these statistics in its annual yearbook, Taiwan Food Statistics Book. Cultivated and sown areas are determined through visual estimation for each township. Rice area is always reported on a sown area basis and further subdivided by first or second season crop. Although both planted and harvested areas for rice are determined, only planted area was reported in statistical publications until 1977 when it was replaced by harvested area. Rice is reported in hectares, rice production in metric tons of brown (husked) rice (1 kg. paddy = 0.76 kg. brown rice). Prior to 1945, the volume measure hectoliters was used. Yields

are reported in kg. of brown rice per hectare. Crop cutting is used to determine total output and average yields. Fields are chosen at random and samples are harvested from five points in each field.

Rice area, production and yield statistics are available at hsien and township levels as well as for all of Taiwan. Data are further subdivided into wet or upland. However, currently, less than 1 percent of the total rice crop is grown under upland conditions. Paddy rice statistics are further subdivided by rice type. These include ponlai rice (蓬萊米), non-glutinous chailai rice (在來粳米), long grain indica rice (長秈米), round glutinous rice (圓糯米), and oval glutinous rice (長糯米). In 1978, almost 80 percent of the total rice crop was of the ponlai type, although Taiwan is also an important world producer of glutinous rice used in the brewing industry and in the preparation of sweets and specialty foods.

Because Taiwan's system of rice culture is very intensive, it is heavily dependent on a constant supply of inputs, particularly fertilizer and water. Post WWII chemical fertilizer statistics are disaggregated by imports and internally produced material and are reported by fertilizer type in both gross and nutrient weight terms. Series showing quantity and types of fertilizer allocated to various crops are also available. These series are especially complete in the case of rice (Table 1). Rice takes most of the nitrogen and the majority of all other fertilizers used on Taiwan, and Taiwan produces most of its chemical fertilizer needs. There are no long-term series available for organic fertilizer usage, although some older statistical materials do offer estimates. Although organic materials are still important, particularly for the improvement of soil tilth, estimates of usage levels are almost impossible to make.

Table 1. Fertilizer Distribution for Rice Crop by Nitrogen Nutrient Weight.

Year	Metric Tons
1949	17,452
1950	39,764
1951	46,261
1952	51,833
1953	
1954	64,762
1955	62,857
1956	66,878
1957	68,299
1958	70,032
1959	69,105
1960	73,837
1961	79,858
1962	92,235
1963	91,023
1964	104,759
1965	105,203
1966	117,643
1967	121,324
1968	126,827
1969	123,169
1970	61,566
1971	84,421
1972	65,229
1973	100,294
1974	104,047
1975	112,855
1976	114,598
1977	127,259
1978	115,923
1979	115,841

Sources: 1949-1963: JCRR, Taiwan Agricultural Statistics 1901-1965, Economic Digest Series: No. 18 (Taipei; 1966), pp. 264-265.

1964-1979: Taiwan. Food Bureau, Taiwan Food Statistics Book (Taipei; 1980, pp. 96-99.

Surprisingly, published irrigated area statistics are less detailed than for other data categories. Prior to 1945, irrigated area statistics refer only to the total cultivated area irrigated and drained by artificial means. Thus, it is not possible to separate out the irrigated area devoted to rice, although we can assume that this constitutes the bulk of the total. Irrigated area is broadly broken into area controlled by public irrigation associations and area controlled by private farmers, with most irrigated area managed by the former. Irrigated area statistics are collected and compiled by the Water Conservancy Bureau as part of its normal procedures, and are reported in hectares. After 1945, statistics for private irrigated area were apparently no longer collected.

The Food Bureau regularly collects price data to help it make important policy decisions. Although the present reporting system was established in 1946, price statistics were also regularly collected by the Japanese for similar reasons. Farm gate prices and official purchase prices are collected for paddy in NT$/100 kgs. in 15-17 major cities. Wholesale prices are reported in brown rice (NT$/100 kgs.) for the same areas for ponlai and chailai varieties. Retail rice prices in NT$/kg. are available for brown and polished rice, although at the retail level most rice is milled. Long-term series (since at least 1905) for all price categories are available, with the exception of official purchase prices. Government intervention in the marketing and pricing of rice did not begin until 1942, when the Japanese made compulsory collections of rice at fixed prices to aid the war effort. The subsequent Taiwanese government has also manipulated rice production and marketing in a number of ways that will be discussed later.

Taiwan has always been a net rice exporter, although export levels were

much higher prior to WWII than in the post-war period. Data series for rice exports and imports are available back to 1898. Import and export statistics are currently collected by the Inspectorate General of Customs and reported by rice type by the Taiwanese harbor of export or import, and by final destination for exports. Exports and imports are reported in metric tons of brown rice and include all rice and rice products, although processed rice products were deleted from 1972 onward.

Detailed historical series for agricultural wage rates are available by job and by sex from 1903 to WWII. Current agricultural wage rates are not available, although undoubtedly collected. However, agricultural labor is in short supply, and wages are very high, frequently forming a major portion of total costs for the farmer-owner.

III. The Rice Economy

a. Rice Production

Taiwan has passed through two distinct phases of agricultural development. In the 1930s, the Japanese introduced modern technology, including the use of chemical fertilizers and new rice varieties suited to Taiwan's agro-conditions. With increasing population growth, Taiwan shifted from a land surplus condition to the widespread use of intensive cropping systems. During this period, agriculture continued to provide an important source of capital for the development of industry.

However, by the early 1970s, with decreased population growth and the migration of rural labor to urban jobs, labor was in increasingly short supply. For the first time, the multiple cropping index began to decline, and

mechanization of agriculture became an important consideration. Recently, with the gains in rice yields from irrigation and intensive use of inputs largely exhausted and rice production declining, it has become necessary to ensure an adequate domestic supply.

In the following section we will discuss the Taiwanese rice sector, and the interaction of rice producers with the market and the government. This should give the reader a broad impression of the position of the rice sector within the overall agricultural economy.

Although its importance in Taiwanese agriculture has diminished somewhat, rice is still by far the most important item in the everyday diet. The idea of the use of rice as a food plant was probably introduced to Taiwan by Southeast Asian immigrants, and it flourished in the lush sub-tropical climate. When the Japanese took control of the island in 1895, they found the Taiwanese growing several thousand indica varieties. Yields were relatively low, although native varieties were highly resistant to droughts, floods, and disease. The Japanese set up research stations and initiated a rice improvement program in 1905 in which they crossed native varieties with Japanese japonica varieties. They hoped to incorporate the high-yielding, input-responsive, non-photosensitive characteristics of Japanese rices with the resistance of Taiwanese varieties. The Japanese used the landlords and the pao-chia system to introduce improved varieties and to propogate them at the village level. In 1926, the Japanese made public the first of their ponlai rices. Between 1923 and 1937, agricultural output rose rapidly, with average growth rates near 4 percent per annum. Ponlai rice quickly supplanted

native rices (chailai), so that by the eve of WWII, about 50 percent of all rice area was planted to ponlai varieties.

The Japanese also helped output and yields to rise by increasing the usage of factor inputs--water and fertilizer principally--and through improvements in agricultural technology, although this did not alter the indigenous social structure or the system of marketing rice. The Japanese encouraged the opening of new lands, as the increased availability of inputs made the cultivation of marginal areas more profitable. Cultivated land as a percentage of the total surface area rose from 10.5 percent in 1901 to 23.9 percent by 1940. More intensive use of existing cultivated land made possible by labor surpluses and increased supplies of water and fertilizer also helped increase productivity. Although agricultural output showed a downward trend in the period (1937-1946), partly as a result of disastrous typhoons that struck the area during 1940-1946 and partly due to massive manpower shortages, recovery was very rapid in the postwar period. Yields continued to rise throughout the 1960s and 1970s under the influence of modern technology, so that today Taiwan has an average per hectare rough rice yield of almost 4.5 metric tons.

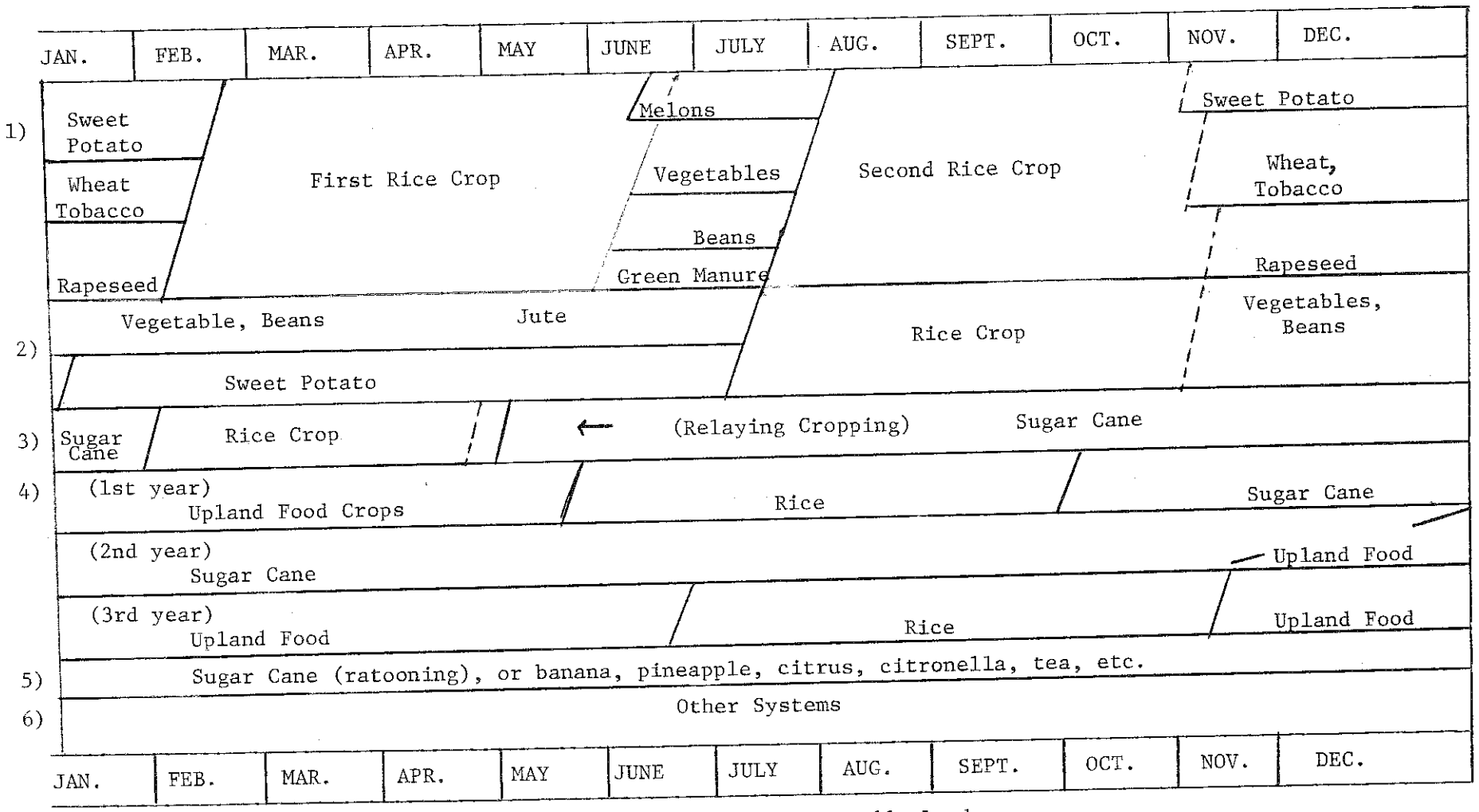
In the 1950s, the agricultural sector, and the rice growers in particular, served as an important source of capital for the development of industry. The government successfully siphoned off profits through taxes, compulsory purchases of rice, and through its control over the distribution of fertilizer. The agricultural sector also served as an important reservoir of labor. Since the late 1960s, farm labor shortages have become commonplace, and farm wages are very high.

Most of the rice that Taiwan produces is grown on family farms where at

least one or two members of the family work off the farm. Rice is generally double cropped. The first crop is grown from February to June, and the second, from June to November. Average yields for the first crop are higher than for the second, although a larger area is sown to rice in the second crop. This is partly a function of geography. Yield differences between the two crops tend to be small in central Taiwan and large in southern Taiwan where there are greater variations in solar radiation and temperature. In addition, there is a higher incidence of wind and rain damage during the second season. Figure 2 shows several common rice cropping sequences. The most common is rice--rice separated by vegetable crops that mature quickly, such as melons or beans. Where water is available only during certain seasons, rice will be grown in combination with upland crops. Rice may also be grown in a multi-year relay cropping sequence with sugar cane. Intercropping is also commonly used to increase multiple cropping, although rice is seldom part of this sequence. As labor shortages increased, the multiple cropping index fell from over 190 to less than 170 in 1977. Most of this drop can be accounted for by a reduction in area planted to winter crops (chiefly wheat, sweet potatoes and vegetables).

Most of Taiwan's rice crop is grown in central and southern Taiwan. The main rice growing hsien are Taichung, Tainan, Hsinchu, Taipei, Kaohsiung, Jiayi, Chunghua and Taitung, although all hsien grow some some rice. Rice is grown under both paddy and upland conditions, but upland rice accounts for less than 3 percent of total area. Both ponlai (japonica type) and chailai (indica type) rice varieties are grown, as well as round and oval glutinous rice used in the production of alcoholic beverages. Ponlai rice occupies the bulk of total rice area (65 percent in 1978).

Figure 2. Multiple Cropping Systems in Taiwan



1) Three or four-crop-a-year system in double-cropping paddy land.
2) Two or three-crop-a-year system in single-cropping paddy land.
3) The sugar cane-rice relaying cropping system.
4) The sugar cane/rice/upland-food-crop rotational system.
5) The year-round-growing system of long-term crops.
6) Besides the above, there are still several other systems.

Source: "Labor Absorption in Taiwan Agriculture," Teng-hui Lee, Hsi-huang Chen and Yueh-eh Chen, JCRR, (Taipei), November 1978.

Although rice is still the most important agricultural commodity produced in Taiwan, its share of total value has fallen from over one half in the period 1911-1915, to less than one third in the period 1968-1972. As consumer preferences have changed with increasing per capita income, and as the scope for profits in the production of rice have decreased, farmers have increasingly diversified their enterprises and shifted to the production of vegetables, livestock (especially chickens and hogs), feedgrains (especially corn) and specialty crops for export such as mushrooms, asparagus, pineapples, bananas and, in recent years, citrus. This shift has been accelerated by recent government reductions in the amount of rice eligible for price supports and by increased funding for the development of modern livestock facilities. Sweet potatoes, formerly the major subsistence crop following rice, have been replaced by vegetables and sugar because of low cash value and high labor costs. Sugar is still an important export crop, especially in the south, but the area sown to sugar cane tends to fluctuate with the export quota assigned to Taiwan by the International Sugar Conference.

The impressive gains made in rice productivity, especially since the 1950s, are largely the result of a steady increase in the use of inputs. Water and chemical fertilizer, along with the introduction of improved rice strains, have had the greatest impact on yields. The use of chemical fertilizers on rice is very high. Average per hectare applications by nutrient weight rose from 156 kg/ha in 1960 to 240 kg/ha in 1976. Since 1948 and the introduction of the fertilizer-rice barter system, the government has controlled the sale of chemical fertilizers. Under the fertilizer-rice barter system, the government exchanged fertilizer with the farmers for paddy

at a fixed rate. This provided the government with a large, cheap and dependable source of rice. The exchange rate was fixed at a high level, one kg. of paddy in exchange for one kg. of ammonium sulphate in 1950, but as farmers' returns moved up the yield function, yield response declined, and further applications of fertilizer at the one-to-one exchange rate were unprofitable. Subsequently, in 1972 the exchange rate was reduced to 0.55 kg. paddy for 1 kg. of ammonium sulphate. However, the unfavorable rate continued to inhibit farmer use of fertilizer and sharply depressed yields during the world grain crisis of 1972-1975. In 1973, the system was abolished and replaced with a cash-fertilizer exchange program. At present, the use of chemical fertilizers has reached a ceiling beyond which it is unprofitable to venture, so that this option is unlikely to provide further increases in yields. In addition to chemical fertilizers, the government also bartered other agricultural necessities such as soybean cakes and cotton cloth. However, because the government did not have a monopoly on the sale of these products, it was unable to compete with lower priced commercial products.

Steady improvements in irrigation have played an important role in the rise of agricultural production. Timely availability of water has allowed farmers to grow high-yielding, input-responsive varieties, starting with the introduction of the first ponlai crosses. It has stabilized yields, allowing farmers to expand into marginal areas, and perhaps most importantly, has permitted the multiple cropping index to rise to almost 200 in the early 1970s. At present, more than 85 percent of the paddy field area has access to irrigation water on demand.

In 1901 under the Japanese, the Taiwan Governor-General's Office (GGO)

issued a set of regulations governing public irrigation areas. Subsequently, rather sizeable sums were invested in the construction and rehabilitation of irrigation and flood control facilities. In 1925, all government and public irrigation facilities were placed under the management of the new semi-autonomous irrigation associations. The associations were charged with building and managing public facilities, regulating water use, and engaging in land improvement. Members of the associations included beneficiaries, as well as government interests. Private facilities continued to exist in tandem with public facilities, but their irrigated area declined steadily in percentage terms. Between 1903 and 1940, irrigated area rose from about 150,000 ha. to 530,000 ha. Although private facilities accounted for 74 percent (111,276 ha) of total irrigated area in 1903, their share had shrunk to less than 5 percent (24,746 ha) by 1940. Presently, possibly as much as 12 percent of total irrigated area is under private control, but as the government apparently no longer monitors the privately irrigated area, we can only make rough estimates.

Research carried out in the 1950s showed that paddy fields receiving intermittent water supplies produced better yields than those continuously flooded. This system of "rotational" irrigation had the twin advantages of not only increasing yields by 1-3 percent, but also saving 25-40 percent of total water supplies. Thus, under this system, more farmers were able to make use of the available water supply. Under the rotational system, the irrigated area serviced by each system is commonly divided into three blocks. Each block receives water for three days and is deprived for six days. Obviously, this system requires a highly regulated system of water distribution to ensure that all participants receive water at the appropriate

time. Thus, reorganizations of the IAs carried out since 1950 have been necessary to distribute available water supplies to farmers effectively and equitably.

The first important reorganization took place in 1955 under the auspices of two governmental proclamations: "Regulations Governing the Improvement of Local Irrigation Associations," and "Organizational Rules of Irrigation Associations in Taiwan." IAs were reorganized into 26 associations and placed under the supervision of the county (hsien) governments and the Water Conservancy Bureau. Although IAs were responsible for the management of all facilities, they only handled the construction of projects servicing less than 500 ha., while the government managed the building of facilities servicing more than 500 ha.

The IAs were further consolidated into 14 associations in 1975. Currently, IAs are self-governing bodies with separate, member-elected, policymaking, and executive bodies. The associations are financed by members' dues. Most associations depend on low-cost government loans for capital construction and improvement costs. IAs are divided into three classes depending on the size of the area serviced: Class A - 50,000 ha.; Class B - 50,000-200,000 ha.; and Class C - 200,000 ha.

Most of the water used in the systems comes from river flows (74 percent) while the remainder is from wells (9 percent), drainage channels, and other sources (17 percent). Since the 1960s, Taiwan has made efforts to develop groundwater resources, particularly in the central and southern regions, but surface waters, especially free-flowing rivers, are still the primary source. Although improvement of water supply has fueled yield increases since the 1950s, there is little scope for future improvement here. Most fields are already irrigated adequately, and construction of additional

facilities is uneconomical. Further yield increases are likely to be based on the dissemination of improved technology, especially in the areas of plant genetics and more productive husbandry practices.

b. The Marketing of Rice

As in many other nominally free-market Asian economies, the Taiwanese government is active in the sale and distribution of rice. Historically, under Japanese domination, governmental interference in the rice market in general was minor, as the Japanese were primarily interested in controlling surplus rice destined for export to Japan. In 1940, with Japanese troops deeply committed on the China front, Japanese officials tried to bring the domestic market under direct central control to ensure adequate supplies of rice for the home market. They instigated compulsory collection of "surplus" rice and strictly rationed rice to the non-farm population. At the conclusion of the war in 1945, the Chinese government temporarily established the Provincial Food Bureau (PFB) to oversee collection and rationing of rice, which was scarce. Although the Chinese abandoned the Japanese system of market intervention in the main, the PFB was maintained due to the continuing strains placed on the rice sector by unfavorable weather and the influx and absorption of mainlanders.

Later, the PFB became a permanent institution because of the government's continued need for reliable rice supplies. It was made responsible for handling a wide variety of activities pertaining to the production, collection, distribution and export of rice. Government intervention was undertaken with the primary goal of overseeing and, in some cases, directly controlling the process. In many cases this necessitated the PFB handling

large portions of the rice crop. The focus of official rice policy has changed gradually through time, but we may roughly divide the period since WWII into two phases: "government and consumer oriented" (1950-1972) and "farmer and consumer oriented" (1974-present).

During the first phase, the most important government goals were to perpetuate economic stability, to increase government revenues, to keep consumers happy, and to generate foreign exchange for development activities. Rice played such a major role in the economy, especially during the early part of the period, that any fluctuations in supply or price tended to reverberate throughout the rest of the economy. Thus, the government tried to mediate the instability commonly found in free market situations through market stabilization sales designed to keep consumer rice prices at a low level. Initially, taxes and payment in kind from the rapidly expanding rice sector provided a very substantial portion of government revenue. In fact, agriculture, and the rice economy in particular, helped fuel the rapid development of Taiwanese industry. The Taiwanese government also used rice that it procured for export to produce revenue and during the 1950s and 1960s, exports were an important source of foreign exchange.

Since the early 1970s, the government has altered the focus of its rice program. As urban incomes have increased, changes in diet have begun to take place. Less rice is consumed per capita and there is more demand for fruit, vegetables and livestock products. Rice production has declined, and traditional markets for Taiwanese export rice (primarily Japan--now a net exporter--and Korea) are disappearing, so that export levels have fallen markedly and exports are relatively unprofitable. Rural incomes have been steadily declining relative to urban incomes, and production costs, notably

labor and fertilizer, are very high relative to output value. As this trend continued, and as rice's position in the agricultural economy has declined, the PFB has begun to run at a loss. Farmers can no longer afford to pay taxes, and many have switched from rice to higher profit items such as livestock or vegetables. Thus, the scope of activities of the PFB has narrowed considerably, and emphasis has moved towards increased support for farmers and for the production of rice. This trend is likely to accelerate in the future as yields stagnate while production costs rise.

The government has continued to maintain policies of consumer welfare through the stabilization of prices. However, it no longer expects to derive much revenue or foreign exchange from the rice sector and increasingly expects to subsidize certain aspects. Considering the shortfalls in production in Taiwan and worldwide during the early 1970s and the possible decline of world food supplies, the government has even been willing to provide subsidies to maintain rice self-sufficiency.

Government policies for interference in the production and marketing of rice have, in general, concentrated on procurements. Traditionally, since rice policy has been consumer and government oriented, the collection of large annual rice supplies is an important function of the PFB. Besides stocking government warehouses, procured rice has been used for export purposes, for market stabilization activities, and primarily as a partial wage paid in kind to the army, but also to a lesser extent to other government employees. Recently, with declining procurements, fulfillment of rice obligations to the army has placed a heavy burden on the PFB. Currently, about 140,000-150,000 metric tons of brown rice are distributed to military personnel and their dependents. This represents about 35 percent of the total rice

procured each year (50 percent or more during the early 1970s). As rice procurements have decreased, the residual amount allotted for exports has declined (although an upward trend in rice production since 1977 has increased export levels). The rice needed for market stabilization purposes is variable depending on many factors, both internal and external, so that planning is difficult. Of the total rice collected, about 50 percent is distributed to government employees and the armed forces, 30 percent is exported and 20 percent is used for stocks and market stabilization purposes, although percentages vary with current conditions. Approximately 50 percent of the total rice crop remains in the farmer's hands.

The share that the PFB collects of total rice production has been declining (Table 2). In 1956, the PFB procured 520,000 metric tons of brown rice. This represents about 30 percent of total production. By 1968, procurements had risen to 697,000 metric tons of brown rice, while the percentage remained at 30 percent. In the 1970s, procurements and the percentage share dropped rapidly. In 1975, the government procured 495,000 tons of brown rice, which represents only 20 percent of total production. It is also clear that government procurement as a percentage of total off-farm marketed rice has declined (Table 2).

The government has relied on seven programs to supply its rice needs. These are the fertilizer-rice barter system; the paddy land tax; compulsory purchases of paddy; rent on government-owned farmland; paddy repayments from sales of public farmland; paddy repayments from tenants receiving land under the land-to-the-tiller program; and repayment of rice production loans.

As already discussed, until the early 1970s, the fertilizer-rice barter

Table 2. Off-farm Marketing of Rice and Government Procurements in Taiwan, 1950-75.

Year	Total off-farm marketing '000' tonnes	Government Procurement '000' tonnes	Off farm marketing as percent of total production	Government collection as percent of total production	Government collection as percent of off-farm marketing
			'000' metric tons		
1950	701	388	49.3	27.3	55.3
1954	848	554	50.0	32.7	73.2
1958	882	545	46.6	28.8	61.8
1962	1,067	596	50.5	28.2	55.9
1966	1,263	636	53.1	26.7	50.4
1970	1,361	499	55.3	20.3	36.7
1972	1,339	309	54.9	12.7	23.1
1974	1,099	385	44.8	15.7	35.0
1975	1,175	495	47.1	19.8	42.1

* All figures expressed in brown rice. Total off-farm marketing includes government production.

Sources: 1950-1966 - T.H. Lee, "Government Interference in the Rice Market in Taiwan," April 20, 1971, p.5 (mimeo).

1970-1975 - H.Y. Chen, W.F. Hsu and Y.K. Mao, "Rice Policies of Taiwan," paper presented at the Workshop on "Political Economy of Rice" sponsored by Food Research Institute, Stanford University at IRRI, Los Banos, Philippines, July, 1974, p. 17 (mimeo).

system provided the government with its single largest source of rice. Land taxes now provide the most important source of paddy, although they used to rank second behind the fertilizer-rice barter scheme. Land taxes are assessed in kind on paddy fields based on the average productivity of the land. Compulsory purchases are computed like land taxes and account for about half as much rice. The government used to pay for compulsory purchase rice at only about 70-80 percent of the free market price. This placed another hidden tax on farmers. In 1973, the PFB raised the compulsory price to the free market price in order to stimulate farm income. In 1972, the farm harvest price was 4,903 NT$/mt (rough), while the compulsory price was 4,495 NT$/mt (brown rice). By 1975, however, the farm harvest price of 110,800 NT$/mt (rough) was below the compulsory price of 115,000 NT$/mt (brown rice). Part of the reason that the government was able to maintain high compulsory prices was because of the establishment of the Rice Stabilization Fund in 1974, which provided the PFB with 3 billion NT$.

Rent on government owned farmland, paddy repayments from sales of public land, paddy repayments from tenants receiving land under the land-to-the-tiller program, and repayment of rice production loans also supplied the PFB with paddy, but the percent of the total collected was small, and had disappeared at the conclusion of these programs in the 1970s. In particular, the rice production loans, repaid in paddy, proved to be a disappointing source of rice since most farmers preferred to borrow funds through other avenues with more favorable terms.

As we mentioned, rice can move through any one of three channels. The farmer may consume it at home, sell it to the PFB, or market it to consumers, processors and middlemen either directly or through local farmers' cooperatives.

The PFB seldom handles the collection, storage or milling of paddy itself. It depends primarily on local farmers' associations (FA) and, to a lesser extent, on rice merchants, especially millers, who are designated as agents of the government. The FAs were originally formed in about 1900 under the Japanese to improve the dissemination of new technology, and farmers were compelled to join them. Later, the function of the FAs broadened. They offered a variety of services including cooperative marketing and processing of agricultural products, cooperative purchasing of farm supplies, farm loans, and extension activities. The FAs were also a convenient link between the farmers and the PFB. They administered the distribution of fertilizer under the now defunct rice-fertilizer barter scheme, and they buy and store paddy at the instigation of the PFB. Many FAs have constructed their own storage and milling facilities with loans and funds from the PFB.

Rice is commonly stored long-term in paddy form on the farm or in government storehouses and is husked (brown rice) before it is moved to market to save transport costs. The PFB, through its agents, generally procures rice in paddy form and pays a milling fee to designated millers or FA milling facilities to husk the paddy. Before being marketed, milled rice is usually roughly graded on the basis of general locality (central is considered better than the south or north), first or second crop, and degree of milling.

In the long term, rice prices in Taiwan have been remarkably stable at all levels since WWII. Seasonal fluctuations are minimal, and the spread between farm-gate and retail prices is small. This stability is partly due to government schemes--a minimum support price, the injection of rice onto the free market during shortages, the purchase of rice in times of surplus--and

partly due to the general good health of the Taiwanese economy. In a few years, notably 1953, 1960, and 1974-1976, rice prices rose rapidly, reflecting world economic trends.

Rice exports and imports are monopolized by the PFB with the Central Trust of China as its sole agent. Rice for export is supplied by government stocks. Formerly, the major importers of Taiwanese rice were Japan and South Korea, but Japan's self-sufficiency and Korea's movement toward other exporters have removed these traditional customers as potential markets. Recently, the government has decreased total rice exports as paddy land has shifted to more profitable export crops (asparagus, mushrooms), and sold export rice to other parts of Asia and the Middle East.

Rice exports increased rapidly from the introduction of input-responsive rice varieties in 1926 (310,000 mt) to the eve of the second World War (655,000 mt-1938). After a considerable decline, exports gradually recovered after the war, reaching a high in 1966 of 224,000 mt. Typhoon damage and the high cost of fertilizer depressed yields during the world grain crisis. Taiwan fertilizer exports dropped precipitously: 26,000 mt in 1973; 5,000 mt in 1975; 1,000 mt in 1976; and in 1974 and 1977 Taiwan became a net importer. Export levels bounced back again in 1978, and by 1980 had reached a post-war high of 476,000 mt. Taiwan is likely to continue to run a surplus, at least for the near future, as consumer preferences move from rice to other foods, and as the government continues to emphasize self-sufficiency as an important goal of its rice policy.

Since 1956, the PFB has regularly surveyed the consumption of basic foods. Rice is the most important single food item in most Taiwanese daily diets, with most still consuming rice three times a day. A 1972 survey

indicated an annual per capita consumption of rice of 131 kg. (milled). However, consumption varies according to the degree of urbanization. Rural areas tend to consume rice rather than more expensive items such as livestock products. In the 1972 survey, urban per capita consumption of rice was only 96 kg., while rural consumption was 151 kg. Average per capita daily caloric intake was 2,700 kcal in 1973, with rice accounting for 1,280 kcal, or 47 percent of the total. The per capita domestic rough rice availability column shows us that overall rice availability has been decreasing over time due to the stagnation of production coupled with continued population growth. However, as the population has become more affluent, consumer preferences have shifted away from rice to vegetables and meats. Per capita availability reached a high of 328 kg/capita/yr. 1936, fell precipitously during the war, and rose to a new plateau in 1953 at 255 kg/capita/yr. Availability continued to slowly decline throughout the 1950s and 1960s, dropping sharply in 1972 to 202 kg/capita/yr. The decline in domestic availability has continued (184 kg/capita/yr, 1979) with no sign that it has bottomed out.

Country Sources of Basic Data

Taiwanese agricultural statistics are very complete and thorough for most data areas. Data sources published prior to WWII are in Japanese, and those dating after the war are in Chinese, or Chinese and English. In addition to regular annual or monthly statistical journals, Taiwan has also published several compendiums of agricultural statistics. Only a sampling of the most important statistical material is listed here.

Compendiums

Taiwan Province. Governor-General Directorate of Statistics, 臺灣省五十一年來統計提要 (Summary of Statistics for 51 Years) (Taipei: 1946).

Joint Commission on Rural Reconstruction, Rural Economics Division, Taiwan Agricultural Statistics 1901-1965, Economic Digest Series: No. 18 (Taipei: 1966).

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Taiwan Province. Department of Budget, Accounting and Statistics, Statistical Abstract of Taiwan (Taipei).

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Kwano, Shigeto, 臺灣米穀經濟論 Taiwan Beikoku Keizai Ron (Treatise on the Rice Economy of Taiwan) (Tokyo: Yuhikaku, 1941).

Shen, T.H., Agricultural Development on Taiwan Since World War II (Ithaca, New York: Comstock Publishing Associates - A Division of Cornell University Press, 1964).

Hsieh, S.C. and Lee, T.H., Agricultural Development and its Contribution to Economic Growth in Taiwan--Input-Output and Productivity Analysis of Taiwan Agricultural Development, Economic Digest Series: No. 17 (Taipei: JCRR, April 1966).

Chen, Hsu and Mao, "Rice Policies of Taiwan," mimeo of paper presented at the workshop on the "Political Economy of Rice," sponsored by the Food Research Institute, Stanford University, at IRRI, Los Banos, Philippines, July 1974.

Mizoguchi, Toshiyuki, 台湾朝鮮の経済成長(物価統計を中心として) Taiwan Chosen no keizai seicho: Bukka tokei o chushin toshite (Economic Growth in Taiwan and Korea with Special Reference to Price Statistics) (Tokyo: Iwanami, 1975).

Kikuchi, Masao, "Irrigation and Rice Technology in Agricultural Development: A Comparative History of Taiwan, Korea and the Philippines," Ph.D. thesis, University of Hokkaodo, 1975.

Acronyms/Conversion Factors

JCRR: Joint Commission on Rural Reconstruction. Name changed to Council for Agricultural Planning and Development (CAPD) in 1979.
Provincial Food Bureau (PFB).

Important Chinese Terms

糙米 Brown Rice
躉售 Wholesale Price
水稻田 Paddy Land
陸稻田 Dryland Land
零售 Retail Price
在來粳米 Chailai Rice
蓬萊米 Ponlai Rice

Prior to June 14, 1949 Taiwan dollar (yuan) used.
Since June 15, 1949 New Taiwan dollar (NT$) in use.

1 kg. paddy rice	= 0.76366 kg. brown rice
1 kg. ponlai brown rice	= 0.93 kg. polished rice (domestic)
1 kg. chailai brown rice	= 0.94 kg. polished rice (domestic)

1 hectare	= 1.03 chia(甲)
1 chia	= 0.9699 ha.
1 old catty (舊斤)	= 0.5968 kg.
1 shih catty (市斤)	= 0.5 kg.

TAIWAN	Cultivated area 000 ha	Rice prod'n. paddy 000 mt	Rice area planted 000 ha.	Yield paddy mt/ha
Year				
	1	2	3	4
1900	347(A)	384(B)	326	1.18
1901	376	574	353	1.63
1902	437	528	345	1.53
1903	534	688	395	1.74
1904	625	778	435	1.79
1905	625	815	447	1.82
1906	634	743	459	1.62
1907	654	844	472	1.79
1908	650	871	479	1.82
1909	662	866	479	1.81
1910	674	784	456	1.72
1911	687	840	479	1.75
1912	690	757	481	1.57
1913	691	959	494	1.94
1914	693	862	500	1.72
1915	700	895	491	1.82
1916	716	870	472	1.84
1917	721	905	466	1.94
1918	732	867	483	1.80
1919	738	921	497	1.85
1920	749	906	500	1.81
1921	753	931	495	1.88
1922	751(J)	1019	511	1.99
1923	752	911	508	1.79
1924	762	1137	531	2.14
1925	776	1206	551	2.19
1926	790	1163	567	2.05
1927	797	1291	585	2.21
1928	804	1272	585	2.17
1929	805	1213	568	2.14
1930	808	1379	614	2.25
1931	810	1400	634	2.21
1932	814	1675	664	2.52
1933	820	1565	675	2.32
1934	826	1701	667	2.55
1935	831	1707	679	2.51
1936	846	1789	682	2.62
1937	857	1728	658	2.63
1938	858	1837	625	2.94
1939	860	1713	626	2.74

TAIWAN	Area irrig. and drained 000 ha.	Rice imports milled 000 mt	Rice Exports milled 000 mt	Popu-lation year end 000 persons
Year	5	6	7	8
1900		2	43	
1901		8	35	
1902		10	55	
1903	150(E)	16	76	
1904	192	16	81	
1905	194	8	91	3123(G)
1906	200	4	107	3157
1907	219	10	79	3186
1908	217	4	146	3214
1909	227	5	138	3250
1910	227	6	95	3299
1911	232	12	85	3369
1912	234	17	83	3435
1913	233	27	144	3502
1914	237	10	77	3554
1915	242	9	113	3570
1916	247	11	428	3596
1917	262	16	105	3647
1918	278	44	140	3670
1919	302	50	151	3715
1920	305	23	91	3758
1921	311	18	131	3836
1922	315	44(K)	96	3905
1923	327	14	160	3976
1924	333	17	235	4042
1925	350	110	304	4147
1926	371	63	310	4242
1927	379	121	371	4337
1928	388	43	299	4438
1929	438	86	288	4549
1930	441	13	270	4679
1931	450	2	357(N)	4804
1932	450	34	448	4930
1933	457	7	554	5061
1934	461	11	678	5195
1935	465	1	603	5316
1936	486	1	643	5452
1937	511	1	650	5609
1938	527	2	655	5747
1939	524	1	551	5896

TAIWAN Year	Farm harvest price brown rice Yuan/mt	Pro-cure-ment price paddy Yuan/mt	Wholesale price brown rice main market Taipei Yuan/mt.
	9	10	11
1900		-	
1901	40(C)	-	
1902	50	-	
1903	58	-	
1904	40	-	
1905	46	-	56(H)
1906	57	-	66
1907	77	-	81
1908	58	-	65
1909	52	-	58
1910	60	-	67
1911	79	-	86
1912	94	-	107
1913	89	-	99
1914	67	-	76
1915	55	-	61
1916	64	-	70
1917	94	-	100
1918	141	-	146
1919	188	-	192
1920	158	-	168
1921	124	-	124
1922	104	-	122
1923	123	-	123
1924	151	-	152
1925	177	-	175
1926	162	-	162
1927	133	-	131
1928	138	-	145(L)
1929	138	-	151
1930	102	-	129
1931	80	-	89
1932	106	-	120
1933	105	-	102
1934	127	-	128
1935	151	-	158
1936	157	-	166
1937	158	-	171
1938	170	-	174
1939	185	-	199

TAIWAN Year	Retail price brown rice main market Taipei Yuan/mt	Farm wage rate Yuan/day	Domestic per capita availability paddy kg/cap/year
	12	13	14
1900			
1901			
1902			
1903		0.40(F)	
1904		0.30	
1905	66(I)	0.35	261
1906	77	0.40	235
1907	97	0.40	265
1908	76	0.40	271
1909	68	0.40	266
1910	81	0.40	238
1911	111	0.40	249
1912	126	0.60	220
1913	117	0.50	274
1914	96	0.50	243
1915	74	0.50	251
1916	83	0.50	242
1917	120	0.50	248
1918	174	0.80	236
1919	227	1.80	248
1920	203	1.60	241
1921	154	1.00	243
1922	162	1.00	261
1923	153	0.77	229
1924	186	0.80	281
1925	206	0.90	291
1926	198	1.00	274
1927	173	1.20	298
1928	172	1.25	287
1929	198(M)	1.50	267
1930	173	1.20	295
1931	117		291
1932	135	1.20	340
1933	137	1.20	309
1934	153	1.20	327
1935	188	1.48	321
1936	198	1.40	328
1937	198	1.10	308
1938	203	1.15	320
1939	230	1.80	291

TAIWAN Year	1st crop rice area planted 000 ha	1st crop rice prod'n. paddy 000 mt.	1st crop rice yield paddy mt/ha
	15	16	17
1900			
1901	178(D)	348(D)	1.96(D)
1902	163	278	1.71
1903	192	350	1.82
1904	198	379	1.91
1905	210	408	1.94
1906	215	377	1.75
1907	217	368	1.70
1908	226	405	1.79
1909	224	427	1.91
1910	213	376	1.77
1911	218	430	1.97
1912	218	374	1.72
1913	224	462	2.06
1914	224	356	1.59
1915	224	406	1.81
1916	215	442	2.06
1917	211	438	2.08
1918	213	431	2.02
1919	225	430	1.91
1920	223	424	1.90
1921	220	448	2.04
1922	228	489	2.14
1923	225	464	2.06
1924	235	532	2.26
1925	242	567	2.34
1926	250	506	2.02
1927	258	581	2.25
1928	261	571	2.19
1929	233	509	2.18
1930	267	622	2.33
1931	274	648	2.36
1932	283	754	2.66
1933	286	703	2.46
1934	288	806	2.80
1935	297	773	2.60
1936	302	846	2.80
1937	295	788	2.67
1938	282	872	3.09
1939	267	720	2.70

TAIWAN	Cultivated area 000 ha	Rice prod'n. paddy 000 mt.	Rice area planted 000 ha	Yield paddy mt/ha
Year				
	1	2	3	4
1940	860	1479	639	2.31
1941	859	1571	647	2.43
1942	854	1534	617	2.49
1943	847	1475	610	2.42
1944	808	1399	601	2.33
1945	816	837	502	1.67
1946	832	1171	564	2.08
1947	834	1309	678	1.93
1948	863	1400	718	1.95
1949	865	1591	748	2.13
1950	871	1862	770	2.42
1951	874	1945	789	2.47
1952	876	2057	786	2.62
1953	873	2150	778	2.76
1954	874	2221	777	2.86
1955	873	2116	751	2.82
1956	876	2345	784	2.99
1957	873	2409	783	3.08
1958	883	2481	778	3.19
1959	878	2432	776	3.13
1960	869	2505	766	3.27
1961	872	2641	783	3.37
1962	872	2768	794	3.49
1963	872	2763	749	3.69
1964	882	2943	765	3.85
1965	890	3076	773	3.98
1966	896	3117	789	3.95
1967	902	3162	787	4.02
1968	900	3299	790	4.18
1969	915	3041	787	3.86
1970	905	3226	776	4.16
1971	903	3031	753	4.03
1972	899	3197	742	4.31
1973	896	2954	724	4.08
1974	917	3213	778	4.13
1975	917	3267	790	4.14
1976	920	3554	788	4.51
1977	923	3470	779(AA)	4.45
1978	918	3202	753	4.25
1979	915	3209	722	4.44

TAIWAN Year	Area irrig. and drained 000 ha	Rice imports milled 000 mt	Rice exports milled 000 mt	Population year end 000 persons
	5	6	7	8
1940	530	12	397	6077
1941	543	13	268	6249
1942	545	3	259	6428
1943	547 (P)	-	247	6586
1944	540	-	159	
1945	520 (Q)	-	18	
1946	498 (R)	-	2	6091
1947	483	-	40	6495
1948	503	-	30	6806
1949	504	60	36	7397
1950	508	1	73	7554
1951	495	-	70	7869
1952	474	5	105	8128
1953	497	-	84	8438
1954	473	-	84	8749
1955	476	-	157	9078
1956	490	-	107	9390
1957	491	-	247	9690
1958	496	-	171	10039
1959	483	(V)	(V)	10431
1960	502	30	88	10792
1961	469	104	45	11149
1962	495	13	88	11512
1963	528	2	37	11884
1964	532	23	175	12257
1965	532	2	221	12628
1966	536	-	224	12993
1967	543	4	208	13297
1968	551	4	90	13650
1969	535	5	50	14335
1970	535	4	48	14678
1971	496	7	5	14994
1972	563	6	78(X)	15289
1973	565	3	26	15565
1974	487	133	75	15852
1975	533	18	5	16150
1976	473	4	1	16450(Z)
1977	447	9	5	16788
1978		6	307	17118
1979		-	248	17456
1980		-	476	

TAIWAN Year	Farm harvest price paddy NT$/mt	Procure-ment price paddy NT$/mt	Wholesale price brown rice main market Taipei NT$/mt
	9	10	11
1940	189	—	203
1941	205	—	221
1942	212	(O)	233
1943	228		238
1944	299		251
1945	794		1688
1946			20968
1947		31000(S)	61373
1948		214350	207577
1949	(T)	240(T)	300(T)
1950		560	1104
1951	600	750	1175
1952	1100	985	1806
1953	1700	1460	2857
1954	1500	1460	2511
1955	1500	1530	2702
1956	1700	1600	2910
1957	1800	1685	3105
1958	2457(U)	1800	3182
1959	3093	1920	3655
1960	4189	2565	4883
1961	3933	2830	5204
1962	3785	2905	4963
1963	3996	2965	5040
1964	4092	3040	5214
1965	4128	3105	5318
1966	4150	3220	5368
1967	4390	3410	5694
1968	4630	3655	5938
1969	4530	3815	5940
1970	4720	4065	6400
1971	4650	4285	6205
1972	4930	4495	6619
1973	5690	6225(Y)	7553
1974	10200	10750	13324
1975	11080	11500	14545
1976	10620	11500	13857
1977	8900	11500	12120
1978	9080	11500	12420
1979	10980	13250	14780
1980	13400	15550	

TAIWAN Year	Retail price brown rice main market Taipei NT$/mt	Farm wage rate NT$/day	Domestic per capita availa-bility paddy kg/cap/ year
	12	13	14
1940	242	2.10	243
1941	258	2.20	251
1942	272	2.20	239
1943	278		224
1944	293		
1945	2050		
1946	24520		192
1947	71780		202
1948	242780		206
1949	340(T)	(T)	215
1950	1250		246
1951	1330		247
1952	2070		253
1953	3290		255
1954	2920		254
1955	3150		233
1956	3370		250
1957	3640		249
1958	3690		247
1959	3970		233
1960	5500		232
1961	5890		237
1962	5830		240
1963	5920		232
1964	5960		240
1965	6030		244
1966	6120	45.00(W)	240
1967	6410	50.00	238
1968	6850	65.00	242
1969	7050	80.00	212
1970	7330	71.00	220
1971	7610	70.00	202
1972	8120	77.00	209
1973	9140	101.00	190
1974	17030	186.00	203
1975	18010	200.00	202
1976	17900	230.00	216
1977	16200	268.00	207
1978	16700	311.00	187
1979	19600		184
1980			

TAIWAN	1st crop rice area planted 000 ha	1st crop rice prod'n. paddy 000 mt	1st crop rice yield paddy mt/ha
Year			
	15	16	17
1940	278	754	2.71
1941	293	747	2.55
1942	268	686	2.56
1943	272	683	2.51
1944	269	694	2.58
1945	232	428	1.84
1946	205	479	2.34
1947	287	589	2.05
1948	312	642	2.06
1949	320	722	2.26
1950	337	848	2.52
1951	347	895	2.58
1952	349	947	2.71
1953	344	925	2.69
1954	354	1046	2.95
1955	306	889	2.91
1956	339	1133	3.34
1957	346	1165	3.37
1958	344	1168	3.40
1959	341	1163	3.41
1960	331	1127	3.40
1961	339	1227	3.62
1962	343	1322	3.85
1963	315	1270	4.03
1964	332	1377	4.15
1965	330	1409	4.27
1966	340	1379	4.06
1967	337	1441	4.28
1968	340	1525	4.49
1969	342	1549	4.53
1970	341	1600	4.69
1971	334	1573	4.71
1972	330	1516	4.59
1973	324	1403	4.33
1974	345	1613	4.68
1975	358	1653	4.62
1976	362	1760	4.86
1977	359(AA)	1728	4.81
1978	352	1695	4.82
1979	339	1596	4.71
1980			

Footnotes to Appendix: Taiwan

A. 1900-1979: Figures refer to cultivated land area, which includes dryland and all types of paddy land.

B. 1900-1979: Production figures recorded in brown rice in the original source and changed to paddy using a constant conversion factor of 1.25.

C. 1901-1945: Farm harvest price is calculated on a metric ton basis from the total gross value of the rice crop in yuan, including first and second crop, in brown rice. The column in the original source, labeled "value" (chia chih 價值) is taken to mean value of the rice crop for farmers, and thus is used to calculate an average farm harvest price. However, it is unclear how the "value" column was tabulated in the original source, so that "value" may indicate a wholesale, rather than farm-gate value.

D. 1901-1979: Data obtained from Provincial Food Bureau. "First crop" refers to rice planted between January 1 and April 30 and harvested within that calendar year. "Second crop" refers to rice planted between May 1 and September 30 and harvested within that calendar year. The second crop occupies a larger area than the first crop, but yields are, on average, much lower. First and second crop include wet and dryland rice culture although wetland, or paddy rice culture, accounts for the vast majority of total rice area. Production figures recorded in brown rice and changed to paddy using a constant conversion factor of 1.25.

E. 1903-1945: Irrigated area numbers refer to total cultivated area irrigated and drained by man-made means for all crops. Rice is grown on most of the irrigated area, but some sugar cane is also irrigated. Irrigated area figures include all cultivated areas with irrigation and drainage facilities controlled by the irrigation associations, and all cultivated area under small-scale private irrigation systems. Although total irrigated area has risen steadily, with the clear exception of the period 1943-1945, the relative portion of land devoted to public and private irrigation systems has changed drastically. In 1903, 26 percent of total irrigated area was under public control, while 74 percent was under private systems. Area under public control rose rapidly and steadily while area under private control declined, both as a percent of total, and numerically. By 1945, private irrigated area had shrunk to only one percent of total irrigated area. Figures supplied by the Water Conservancy Bureau.

F. 1903-1942: Male paddy worker wage rate for Taipei. Female wage rates are available for selected years. The disparity between male and female wage rates is large--usually, on average, women made half or less than their male counterparts. For example, in 1932 the average male wage rate was 1.2 yuan per day, while the average female wage rate was 0.5 yuan. Paddy worker wage rate series are also available for Taichung and Tainan. Wage rates for Taichung and Tainan tend to be lower than those for Taipei, with less disparity between male and female wage rates.

G. 1905-1975: The result of the first population census taken by the Japanese in 1905 was 3,310,000 persons. Population on a calendar year basis.

H. 1905-1927: Wholesale main market (Taipei City) brown rice price for chailai rice (在來米). Chailai rice includes an amalgam of all the indigenous indica rice varieties grown in Taiwan until the introduction of "ponlai rice" (蓬萊米) in 1926.

I. 1905-1928: Retail main market (Taipei City) polished rice price is for chailai rice, the predominate native varieties used until the introduction and popularization of japonica X native crosses (ponlai rice) by the Japanese in the late 1920s.

J. 1922-1979: Based on data supplied by the Provincial Department of Agriculture and Forestry.

K. 1922-1980: Rice imports recorded in brown rice and changed to milled rice at the ponlai rate of .94.

L. 1980-1979: Wholesale main market (Taipei City) brown rice price for ponlai rice (蓬萊米) is continous with the proceding chailai series. In 1926 the Japanese introduced ponlai rice, which is a cross between native varieties and Japanese japonica varieties. Ponlai rice, inherently much more productive than native varieties, although it requires increased use of inputs, rapidly came to dominate rice area in Taiwan. This was both because of Japanese consumer preference for this type, and because of the relative profitability of ponlai types. Today almost all rice area is planted to ponlai varieties. In the marketplace, ponlai rice costs a little more than chailai rice. For example, in 1939, in Taipei, ponlai rice cost 199 yuan/mt while chailai rice cost 185 yuan/mt.

M. 1929-1979: Retail main market (Taipei City) polished rice price is for ponlai rice, the most predominant variety.

N. 1931-1980: Recorded in brown rice--changed to milled rice at the ponlai rate of .94.

O. 1942: Government interference in the rice market began in 1942 when the Japanese tried to ration rice supplies and make compulsory collections of rice to aid food-short Japan.

P. 1943-1977: Since 1943 irrigated area under Public Irrigation System (公共埤圳) has been included under Water Conservancy Association area (水利協會).

Q. 1945-1977: Since 1945 the government has not collected figures for irrigation systems without official recognition or for irrigated area under private control not connected to the association area. Thus the area of irrigation and drainage presented here appears proportionately smaller. The question as to what percentage private area may make up of the total is moot, although by the 1940s private area was less than five percent of total irrigated and drained area. A Ph.D. thesis by

Teng-hui Lee, "Intersectoral Capital Flows in the Economic Development of Taiwan, 1895-1960," Cornell University, 1968, suggests that privately irrigated land makes up 15 percent of the total irrigated area (p.94), but no documentation is presented. Undoubtedly irrigated area may not have increased in the post war period as much as one might suspect because effort has been concentrated on more rational and timely use of existing facilities, rather than on the construction of new facilities. Figures supplied by the Water Conservancy Ministry.

R. 1946-1977: By 1946 irrigated and drained area was subdivided by types of area irrigated (double-cropping fields, single-cropping fields, etc...) and types of area drained (paddy fields and dry-farmed fields). From this breakdown it is obvious that area of drained land makes up a substantial portion of total area irrigated and drained, ranging from 6 percent to over 20 percent depending on the year under consideration.

S. 1947-1972: Procurement price refers to the official purchase price of paddy rice, first and second crop prices averaged. The purchase price for second crop paddy rice is set a little higher than the first crop paddy rice.

T. 1949: Since June 15, 1949 New Taiwan Dollar in use (NT$).

U. 1958-1980: Farm harvest price is for ponlai paddy rice.

V. 1959: No number listed for 1959 in the source used.

W. 1966-1978: Represents the average wage paid to unskilled laborers for construction work in Taipei.

X. 1972-1980: From 1972 rice processed products not included.

Y. 1973-1980: Procurement price refers to the official purchase price for first and second crop ponlai rice averaged.

Z. 1976-1979: Population figures are for July 1 of the year in question. 1979 is projected estimate based on December 16, 1975 census and subsequent registrations of births and deaths.

AA. From 1977 area refers to harvested area, not planted area.

Sources of Data: Taiwan

1. Cultivated Area

1900-1921: Taiwan Province, Governor-General Directorate of Statistics, 臺灣省五十一年來統計提要 (Summary of Statistics for 51 Years), (Taipei: 1946).

1922-1979: Taiwan Province. Food Bureau, Taiwan Food Statistics Book (1980).

2. Rice Production

1900: Hsieh, S.C., and Lee, T.H., "Agricultural Development and Its Contributions to Economic Growth in Taiwan," Economic Digest Series: No. 17 (Taipei: Joint Commission on Rural Reconstruction, 1966), p.15.

1901-1921: JCRR, Rural Economics Division, Taiwan Agricultural Statistics 1901-1965, Economic Digest Series: No. 18 (Taipei: 1966).

1922-1979: Taiwan Province. Food Bureau, Taiwan Food Statistics Book (1980).

3. Rice Area

1900: Hsieh, S.C., and Lee, T.H., "Agricultural Development and Its Contributions to Economic Growth in Taiwan," Economic Digest Series: No. 17 (Taipei: Joint Commission on Rural Reconstruction, 1966), p. 15.

1901-1921: JCRR, Rural Economics Division, Taiwan Agricultural Statistics 1901-1965, Economic Digest Series: No. 18 (Taipei: 1966).

1922-1979: Taiwan Province. Food Bureau, Taiwan Food Statistics Book (1980).

4. Rice Yield

1900-1979: Yields are calculated by dividing rice production (2) by rice area (3).

5. Area Irrigated and Drained

1903-1945: Bank of Taiwan, 臺灣水利問題, Taiwan Shuili Wenti (Questions of Water Management in Taiwan), Economic Series No. 4 (Taipei: 1950).

1946-1968: Taiwan Province, Department of Budget, Accounting and Statistics, Statistical Yearbook of Taiwan, (Taipei).

1969-1977: Taiwan Province. Department of Agriculture and Forestry, Taiwan Agricultural Yearbook (1947-1978).

6. Rice Imports

1900-1933: Foreign Trade of Japan: A Statistical Survey (日本貿易結覽), ed. by Tanzan Ishibashi (Tokyo: Toyo Keizai Shimposha, 1975).

1922-1980: Taiwan Province. Food Bureau, Taiwan Food Statistics Book (1980).

7. Rice Exports

1900-1933: Foreign Trade of Japan: A Statistical Survey (日本貿易結覽), ed. by Tanzan Ishibashi (Tokyo: Toyo Keizai Shimposha, 1975).

1931-1980: Taiwan Province. Food Bureau, Taiwan Food Statistics Book (1980).

8. Population

1905-1910: Taiwan Province. Governor-General, Directorate of Statistics, 臺灣省五十一年來統計提要 (Summary of Statistics for 51 Years), Taipei: 1946).

1911-1965: JCRR, Rural Economics Division, Taiwan Agricultural Statistics 1901-1965, Economic Digest Series: No. 18 (Taipei: 1966).

1966-1975: JCRR, Rural Economics Division, Taiwan Agricultural Statistics 1961-1975, Economic Digest Series: No. 22 (Taipei: 1977).

1976-1979: U.S., Department of Commerce, Bureau of the Census, International Population Dynamics 1950-1979) (Washington, 1980).

9. Farm Harvest Price

1901-1945: Taiwan Province. Governor-General, Directorate of Statistics. 臺灣省五十一年來統計提要 (Summary of Statistics for 51 Years) (Taipei): 1946).

1951-1957: FAO, World Rice Economy in Figures, 1965 as quoted in Palacpac, Adelita, World Rice Statistics, Los Banos, Philippines: International Rice Research Institute, 1980, pp 85-86.

1958-1980: Taiwan Province. Department of Agriculture and Forestry, Taiwan Agricultural Prices Monthly (Taipei).

10. Official Purchase Price

1947-1979: Taiwan Province. Food Bureau, Taiwan Food Statistics Book (1980).

1980: Taiwan Province, Department of Agriculture and Forestry, Taiwan Agricultural Prices Monthly (Taipei).

11. Wholesale Brown Rice Price (main market, Taipei City)

1905-1927: Taiwan Province. Governor-General, Directorate of Statistics, 臺灣省五十一年來統計提要 (Summary of Statistics for 51 Years) (Taipei: 1946).

1928-1979: Taiwan Province. Food Bureau, Taiwan Food Statistics Book (1980).

12. Retail Rice Price (main market, Taipei City)

1905-1929: Taiwan Province. Governor-General, Directorate of Statistics, 臺灣省五十一年來統計提要 (Summary of Statistics for 51 Years) (Taipei: 1946).

1930-1979: Taiwan Province. Food Bureau, Taiwan Food Statistics Book (1980).

13. Farm Wage Rate

1911-1942: Hsieh, S.C., and Lee, T.H., "Agricultural Development and Its Contributions to Economic Growth in Taiwan," Economic Digest Series: No. 17 (Taipei: Joint Commission on Rural Reconstruction, 1966), p. 97.

1966-1978: Taiwan Province, Bureau of Budget, Accounting and Statistics, Commodity-Price Statistics Monthly Taipei City (Taipei).

14. Domestic Per Capita Paddy Availability

1905-1979: Calculated by dividing paddy production (2) by population (8) on an annual basis.

15. First Crop Rice Area

1901-1921: Taiwan Province, Governor-General, Directorate of Statistics, 臺灣省五十一年來統計提要 (Summary of Statistics for 51 Years) (Taipei: 1946).

1922-1979: Taiwan Province. Food Bureau, Taiwan Food Statistics Book (1980).

16. First Crop Rice Production

1901-1921: Taiwan Province, Governor-General, Directorate of Statistics, 臺灣省五十一年來統計提要 (Summary of Statistics for 51 Years) (Taipei: 1946).

1922-1979: Taiwan Province. Food Bureau, Taiwan Food Statistics Book (1980).

17. First Crop Rice Yield

1901-1979: Calculated by dividing rice production (16) by rice area (15) on an annual basis.

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