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JCRR

AGRICULTURAL ECONOMIC RESEARCH PAPERS

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Rural Economics Division

Joint Commission on Rural Reconstruction

TAIPEI, TAIWAN, REPUBLIC OF CHINA

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Preface

In commemorating the 30th anniversary of JCRR, the Rural Economics Division decided in the early Spring of 1978 to publish this publication. Papers contained in this publication are mainly written by senior staff members of this division. Most of these papers were prepared and presented at international seminars or workshops during the past few years. However, we are very much honored to have the permission to include articles written by Dr. Robert C. T. Lee, Chairman of JCRR; Dr. T. H. Shen, Advisor and former Chairman; Dr. Y. S. Tsiang, Advisor and former Commissioner; Dr. Joseph Kyle, former Commissioner; Dr. Y. T. Wang, Secretary-General; Dr. T. H. Lee, former Consultant. Their excellent papers have enriched this publication and made it more valuable. It is hoped that this publication will provide readers with more up-to-date information on agricultural problems, policies and development of the Republic of China. I personally believe that this publication will be a good supplementary material to the book: "Agriculture's Place in the Strategy of Development: The Taiwan's Experience" edited by Dr. T. H. Shen and published by JCRR in July 1974.

Yu-kang Mao
Chief
Rural Economics Division

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Agriculture and Economic Development in the Republic of China*

Robert C. T. Lee**

I feel greatly honored to be given the opportunity this evening to address this distinguished audience on the subject of agriculture and economic development of Taiwan, Republic of China.

Taiwan is not a large island, nor rich in natural resources. Its total area is 13,890 square miles, hardly one-tenth the size of the State of Montana, or roughly the size of Connecticut and Massachusetts combined. Approximately two-thirds of the island are mountainous, with only 25% or 2.2 million acres of the land suitable for farming.

Yet, today within this small area live over 16 million people, more than that of Australia and New Zealand combined. Another fact that is not generally known is that the Republic of China has a larger population than 32 member countries of the United Nations. The population density of Taiwan is 1,151 persons per square mile which probably is the world's highest. These people are our precious asset. They are energetic, hard working and anxious to improve. They together have built Taiwan from the postwar scratch into a so-called "Economic Miracle". In fact, it is not a miracle, but a result achieved only through hard efforts. This evening I would like to present to you briefly some of the salient points of our economic development, and I will not bore you by citing figures. I do not intend to say that our economic development could serve as a pattern for other developing countries to follow. There is, in fact, no such universal pattern. However, I do believe that our approach to economic development is worth studying, and our philosophy or principles worth considering. They are indeed basically quite simple.

For the story of our successful economic development, I will divide it, for the convenience of my presentation, into three stages.

During the 1950's, after repairing the major damage caused by the war we concentrated on strengthening the agricultural foundation and promoting the manufacture of essential consumer goods. A comprehensive Land Reform Program gave

* Speech delivered at the USAID Administrator's Development Seminar, Washington D. C., November 1976.
** Chairman of the Joint Commission on Rural Reconstruction.

our farmers an incentive to produce more. Introduction of improved crop varieties, irrigation facilities and labor-intensive diversified farming practices led to higher productivity and boosted the purchasing power of our rural people. Strengthening of farmers' organizations made our farmers more active participants in rural development activities and greatly increased their collective bargaining power. By 1952, agricultural and industrial production had reached the prewar levels. Since 1953 the government has carried out a series of Four-Year Economic Development Plans. The government's policy to develop agriculture first in the early stage played a decisive role in the course of economic development. The agricultural sector served not only as a source of food but also a source of investment, capital and raw materials required by the industrial sector. Furthermore, industry depended on the export of agricultural products for much of the foreign exchange needed to buy equipment and supplies from abroad and must look to the rural population for a market for its manufactures. Hence, the guideline to "develop industry through agriculture and expand agriculture through industry" was a well conceived policy that provided for the balanced growth of the economy. The industrial efforts during this period emphasized production of basic necessities such as fertilizer, cement, textiles and plywood to meet domestic demands as well as to reduce the need for imports at a time when our foreign exchange reserves were very low. With food and basic necessities adequately provided, public utilities restored and improved, inflation in the early period arrested, and public confidence in the government strengthened, it became apparent by the late 1950's that many of the control measures adopted in the earlier years were no longer meaningful, as were the traditional concepts, institutions and legal framework. The government was then prepared to take steps toward a more viable economy, centering its attention on the expansion of international trade.

With the arrival of the 1960's a number of new laws and regulations designed to improve the investment climate were promulgated and enforced. Under such favorable circumstances, the pace of industrial development soon picked up. The government, in directing economic development, spared no effort to encourage the free play of private enterprises. The main concern during this period was with the promotion of light industries and creation of more job epportunities for the people. The government purposely avoided taking hasty steps for development of heavy industries, which would have meant an economic dislocation and burden as well as a lowering of the standard of living. The light industries, which did not require as much capital investment and technical know-how in their development, served as a kind of gestation for the more sophisticated industries to come. The products of these industries, including plastics, electrical appliances, simple machinery and those

mentioned before were for both domestic and export markets. The government meanwhile actively encouraged savings and investments and strongly promoted upgrading of technology and management. Our economic base was gradually strengthened and standard of living steadily rose. Our balance of trade which had been unfavorable for many years, became favorable for the first time in 1970 and our foreign exchange reserves have been growing rapidly since. Agriculture during this stage continued to grow with the availability of improved farming techniques, better farming systems and new products for the market. As farm production increased, we were faced with the problems of marketing and pricing. How to coordinate production and marketing became one of the major issues in agriculture. On the other hand, in the late 1960's the income gap between the non-agricultural and agricultural sectors grew ever wider. The pressure was too much for the latter, and a new crisis in agriculture arose. Modernization of agriculture was urgently needed.

The stage was now set for the third and current stage of economic development, which began with the decade of the 1970's. Movement toward heavy, capital intensive and more sophisticated industries is being promoted. We have already began construction of an integrated steel mill. Nearly completed is a shipyard capable of building 450,000 ton tankers, compared with the 125,000 ton vessels from our largest existing facility. Agriculture is being given special attention. A host of measures, including abolition of the rice-fertilizer barter system, improvement of agricultural credit, marketing and rural infrastructure, extension of integrated cultural techniques, better utilization of agricultural resources, establishment of regional specialized agricultural production areas, and promotion of farm mechanization and joint farming operations have been implemented to facilitate the required farm readjustment, attain self-sufficiency in food crops, narrow the income gap between agricultural and non-agricultural families, and further strengthen the base for economic and social stability. The world-wide recession in recent years due to energy and food grain shortage has seriously disrupted our economic plans. However, the sound foundation of our agriculture and our family farm system here once again served as an effective cushion to absorb the idle labor laid off by the factories. Together with the economic stabilization program introduced by the government, the critical situation has been largely ameliorated. The economy of the Republic of China has now regained its momentum and growth. If there is no drastic disruption in the world economy, it is expected that our economy will reach a growth rate of 10% this year.

The development program of the past 25 years has brought major changes in the size and structure of our economy. Real GNP (Gross National Product) in 1975,

equivalent to US$14.4 billion, was almost seven times that of 1952. During the same period, real per capita income almost tripled, reaching US$705 in 1975. Among the various economic sectors of the Republic of China, foreign trade has shown the most dramatic growth. During the 1950's total trade was in the neighborhood of only one-third of a billion U.S. dollars. In 1975 it amounted to US$11.26 billion: 5.95 billion for imports and 5.31 billion for exports. The two-way trade in first nine months of 1976 hit US$10.4 billion with a balance of US$230 million in our favor. The marked change in the economic structure has been brought about by the faster growth of industrial output. In 1953 industry accounted for only 18% of the net domestic product and agriculture 38%. In 1975 the situation was just about reversed, with industry contributing 36% and agriculture less than 16%.

May I emphasize at this point that the purpose of economic development is not just to produce glowing financial reports but rather to improve the livelihood of the people. This has always been the basic policy of the government of the Republic of China. According to an estimate made by the US Overseas Development Council, the average income per family in the top 20% bracket was 15 times the income per family in the lowest 20% in 1952. By 1970, though income in both groups had risen dramatically, the per family income in the top 20% was only 4.5 times that of the lowest 20%. Our prosperity is thus benefiting the whole population, particularly the lowest income groups. This, I believe, is one of the most significant aspects of our achievement. Likewise, our agricultural program is not only for production of farm crops. Farmers' welfare has to be considered which includes availability of social services, medical care, education, transportation, communications, housing and electric power and so on. In fact, more than 95% of our farm families now have electric power and nearly half of all the farm houses in rural areas are built either of brick or reinforced concrete. Many country roads have been constructed and paved. Rural health centers and schools are widely distributed all over the island of Taiwan. The rural community now enjoys a balanced and harmonious growth and prosperity.

From the success story of our economic development, you may note that it is the effort of the people and the government together that has made it possible. It is also the result of good judgement and sound planning on the part of the government which has played a leading role in directing our national development, plus the hard work of the people desiring to improve their livelihood under the free enterprise system.

The U.S. aid program played also a very crucial role particularly in the early stage of Taiwan's economic development. U.S. aid funds were allocated mainly

for the improvement of electric power supply, transportation and communications. The trade deficits in the early years were largely met by the U.S. aid. The wise use of this aid as a source of long term low interest loans helped mobilize domestic savings and channel them into industrial development through the requirement of matching funds for U.S. aid financed projects. The operation of the Sino-American Joint Commission on Rural Reconstruction as the leading organization in utilizing the U.S. aid funds and helping develop agriculture, the first stepping stone to Taiwan's economic success, is particularly worth mentioning.

A unique feature of the Joint Commission on Rural Reconstruction, or JCRR in abbreviation, is the spirit of jointness that has always prevailed among its Chinese and American commissioners and personnel, who work closely together for the rural prosperity of Taiwan. Technical divisions staffed with well trained professionals form the main work force of JCRR which operates on a problem-oriented project basis in the context of the national agricultural policy. JCRR also advises the government on policy matters and on program planning in agriculture while working energetically in helping implement the planned projects. All projects supported by JCRR are put into operation after signing of contracts or agreements with their sponsors, which are usually farmers' organizations and government agencies. JCRR's program is flexible in content but firm in basic policy which is to meet the felt needs of the farmers and to benefit the majority of people. This could be interpreted as the incentive and social justice approach. JCRR functions as a pioneer in introducing and demonstrating new agricultural methods and techniques, and it is continuously moving to new frontiers after the old projects are successfully completed and turned over to the sponsors. Both agriculture technology and the integrated rural development approach are stressed and the family farm philosophy strictly adhered to in the JCRR operation.

JCRR has been fairly successful in promoting agricultural development in Taiwan. Its responsibility is growing heavier as the problems to be solved are becoming increasingly complex and sophisticated. Rural development is not a static phenomenon but a dynamic process. In the transformation of the economy from a traditional one to an internationally-oriented modern society, we need constant alertness, sound judgement and continued preparedness in order to meet the future challenges. With limited natural resources in Taiwan and an urgent demand for modernization, we surely have a difficult task ahead. But we are determined to make further improvement, and we will get there.

Ladies and Gentlemen, as the Chairman of the Joint Commission on Rural Reconstruction, I am indeed very much honored to talk to you about the economic

development of the Republic of China. I sincerely hope that our experience could be useful to some other developing countries in mapping out their strategy of development.

A New Direction for Agriculture in Taiwan*

Yien-si Tsiang**

I. A REVITALIZED AGRICULTURE

Under the auspices of various incentives such as land reform and production-promoting measures and a series of four-year economic plans, agricultural production in Taiwan averaged a growth rate of 5.3% per year between 1953 and 1968. In the fifth four-year plan period (1969-1972), industry began to surge ahead leaving agriculture behind with a mere 2.2% in its growth. Farm income as a result was relatively low compared with that in non-farm sectors.

To check the slowing-down trend in the agricultural sector, the government announced in 1970 an Outline for Rural Reconstruction and set aside a yearly special appropriation of NT$100 million in the following two years to invigorate agricultural growth. The agricultural sector was further given a shot in the arm in the form of the Accelerated Rural Development Program (ARDP), which between its initiation in January 1973 and June 1977 received a total of over NT$6,930 million in subsidies. This together with NT$2,480 million in matching funds from local governments and other organizations drastically improved agricultural production and the livelihood of the farming population.

Under the ARDP, agricultural growth from 1972 to 1976 rose to an annual 3.7% and the annual per capita farm family income also climbed from NT$7,540 to NT$17,076, resulting in a smaller income gap between farm family and non-farm family. The per capita farm family income amounted to 67.75% of the per capita non-farm family income in 1976, *vs.* 66.48% in 1972.

The living standard of the farm families improved as a result of increased income. The annual farm family expenses per capita also jumped to NT$13,009, compared with NT$6,291 in 1972. The number of TV sets per 100 households increased from 11 to 80 and that of refrigerators from 2 to 53 during the same period. These two items testified to the material amenities in rural areas.

Agricultural production has become less and less labor-intensive since around 1968 when the farm labor force began to undergo noticeable cuts. To assure sustained progress, efforts should be directed toward further developing biological production

* A Speech Delivered at the 1978 Taiwan Crop and Livestock Production Conference held in December 1977.

** Advisor and former Commissioner of the Joint Commission on Rural Reconstruction.

technique and promoting mechanization and management skills. To mechanize all farming operations is the main means of raising labor productivity, but it has to be proceded by adequate planning and organization to overcome obstacles in the form of small farming scale and other limitations. Such preparatory measures include resources planning, specialized production areas and custom farming.

II. INTEGRATED RESOURCES PLANNING—PREREQUISITE TO SPECIALIZED PRODUCTION AREA

Regional resource planning will serve as a basis for the full and reasonable exploitation of land resources and the establishment of specialized production areas. Guided by such principles as planting the right crops in the right soils, zoning for centralized production and taking into account domestic and foreign demand, regional planning aims to: 1) take an inventory of the current utilization and potentialities of agricultural resources for the purpose of serving as a guide in formulating medium- and long-range agricultural plans; 2) make the best use of available resources with the aid of various improvements; 3) usher in integrated and planned production; and 4) give support to the comprehensive development of national lands.

Regional planning has proceeded county by county. A total of 3,772 sheets of maps (3,222 at 1 : 5,000 for plains and 550 at 1 : 10,000 for mountainous areas) will be produced on the basis of aerial survey data collected for such different categories as paddy fields, dry-lands, sloping lands, and forests. Besides, information on the yield, labor requirements and production costs for various farmland categories will be processed by computer models to work out optimum cropping patterns for different areas, which will further serve as a basis on which ideal land-use models will be framed. Preliminary planning for Pingtung, Kaohsiung, Tainan, Chiayi and Yunlin counties has been completed, while that for the rest of Taiwan is scheduled for completion by the end of next year.

Zoning for specialized production aims at growing the right crop in the right soil, centralizing production and facilitating mechanized farming and joint operations to enable the small farms to enjoy benefit usually available in large-scale farming. Under the Accelerated Rural Development Program, specialized production areas are mostly set up on coastal and sloping land areas, which are less favorably endowed for agricultural development. Such areas that have so far appeared on the scene total over 102,000 ha. belonging to 24 categories for the production of bananas, mangoes, asparagus, silk, hogs, dairy cattle, fish, etc.

There is still much room for improvement in regard to the specialized production program. Its coverage has to be expanded, the cropping systems have to be

improved, more public facilities have to be added, joint farming and marketing have to be strengthened.

III. MECHANIZED FARMING AND ENLARGED FARMING SCALE—ESSENTIAL TO AGRICULTURAL MODERNIZATION

The government launched its "Guidelines for Accelerating Mechanized Farming" in 1970 for the purpose of boosting agricultural labor productivity and stepping up the modernization of the agricultural sector. By last June, farm machines had totaled over 70,000 sets bringing mechanization up to 86% in land preparation, 23% in rice transplanting, 8% in harvesting and 13% in grain drying.

Measures adopted over the years to promote agricultural mechanization include: 1) long-term and low-interest loans which totaled over NT$2.6 billion (at an interest rate of 8.5% per annum) between 1973 and 1977; 2) subsidies for purchasing farm machines, which at 10-20% of the price totaled over NT$270 million in the same period for the purchase of locally manufactured transplanters, harvesters, and dryers; 3) strengthening agricultural extension by setting up farm mechanization promotion centers, nursery centers and custom farming teams; and 4) assisting the research and development of suitable machines and the training of the farmers in the use of farm machines.

To meet the rising demand for loans in recent years, the government has decided to start an Agricultural Mechanization Fund with a total of NT$8 billion to be raised in four years. Accompanying measures will include simplifying lending procedures and providing more loans in terms of both kind and amount. This fund is expected to raise the degree of mechanization to over 1 h. p. per hectare by 1981.

Measures to coordinate with the mechanization program will consist of farmland consolidation, custom farming, and joint operations. The pilot regional planning project currently underway in five townships in Pingtung county has its aim organizing the 200 ha. or so of farmlands around a rice seedling nursery center into a sort of big farm operated jointly by the farmers involved. On such a consolidated farm there will have a nursery team led by the owner of the nursery center responsible for breeding and distributing seedlings and a farm-machine team composed of machine owners to assume responsibility for conducting mechanized farming operations.

All farming operations in the paddies will be managed in accordance with the irrigation systems to make the best use of farm machines and nursery facilities.

This well-organized farm management will not only assist in promoting agricultural machanization but also expand the farming scale.

IV. TO UPGRADE AGRICULTURAL SCIENCE AND TECHNOLOGY—THROUGH TEAMWORK

Despite consistent government emphasis, the budgets of various agricultural research institutes have been lean and these organizations have been understaffed. Still admirable progress has been made over the years in almost every aspect of agricultural science and technology: crop breeding, cultural technique, pest and disease control, irrigation, processing, animal husbandry, fishery, forestry. Especially remarkable is the production of black salsify and oyster mushrooms which though introduced only recently have the potential to develop into important export items. Garlic and potatoes have greatly improved in both production and quality because of the adoption of virus free seed. As for animal production, excellent hybrid hogs rise to over 80% of all the hogs raised and permission has been obtained for our pork products to be exported to the U. S. Finally, artificial propagation for some fish and shellfish has won international notice and a breakthrough in Taiwan's fisheries has also been achieved with the successful krill-fishing trip of the research vessel *Hai Kung* to the Antarctic Ocean.

To coordinate the research efforts of various agricultural institutions and resolve difficulties encountered in staffing and budgets, a coordination team was formed last March.

With overall planning as its guiding principle, agricultural science and technology in the future will focus on:

1) Well-rounded planning to maximize resource utilization—Besides securing the reasonable utilization of productive farmland, efforts will also be made to exploit sloping land, lands idled in winter, water resources, solar and geothermal energy, Antarctic krill, etc.

2) Agricultural mechanization—The existing farm machine models will be improved and energy-saving and multi-purpose machines will be developed in addition to the continued effort at expanding the farming scale and promoting custom farming.

3) Developing processed products for export—Efforts in this regard will center upon improvements in grading, packing, storage and transportation to reduce losses in process of marketing and redress the supply and demand imbalance and the development of Chinese foods and fruit concentrates.

4) Reducing damage caused by natural disasters—Research will be directed to the control and forecast of pests and diseases, and the reduction of residual pesticide and industrial pollutants to conserve agricultural resources.

V. TO INCREASE INVESTMENT IN AGRICULTURAL INFRASTRUCTURE

Government investment in infrastructural facilities such as sea and river dikes, irrigation and drainage projects, windbreaks, fishing harbors, water supply systems, rural health improvements, milk collection stations, vegetable wholesale markets, etc. will provide a solid foundation upon which agricultural productivity and rural living conditions will be drastically improved.

As the foremost category in the Accelerated Rural Development Program, public investment has incurred over one-third of the grants or more than NT$5.32 billion. It has financed the repair and construction of 61 km of sea dikes and 21 km of river dikes, the building of 600 km of drainage mains, the construction of the Shihkang Dam irrigation project, the water and soil conservation treatment of over 14,000 ha of farmland, the installation of simple water supply systems for 24 villages, and the physical improvement of 64 villages.

Although the bulks of the agricultural budgets in recent years have been invested in public facilities, the percentages for some items however did not reach the targets specified in the 6-year economic plan. In view of this fact, the government has decided to set aside in the years to come more funds for the construction of more dikes required for the protection of farmland and for the improvement of drainage systems in areas still plagued with floods in the rainy season.

To keep all public facilities in good repair, maintenance regulations have been enacted for most of them but their enforcement has not been strict because of deficiencies in budget and personnel. To remedy this situation, sufficient funds must be raised to maintain the public facilities in good condition so as to prolong their service life.

VI. A BRIGHT OUTLOOK FOR THE AGRICULTURAL SECTOR

While the biological production techniques in Taiwan's agriculture have achieved advanced levels since World War II under correct government policy, continued growth in the future will have to depend upon improvements in mechanical production and management skills. To derive the best possible benefit out of the limited resources, overall integrated planning and orderly implementation has to be

exercised in the utilization of water and soil resources, the promotion of mechanized farming, the construction and repair of public facilities, and the research and development of agricultural science and technology. Economic incentives like income and price should be enlisted to induce growing the right crop in the right soil and concentrated production in the favorable areas. Farmers' organizations should be used to form various teams to facilitate joint farming operations so that the fruits of large-scale farming may be enjoyed by the small farmers.

Despite the attacks of a spring drought, the torrential rains in June and the typhoons in July, there were still bountiful harvests, which enabled this year's agricultural production to log a 3.3% growth as compared with the projected 2.4%. Several bumper harvests in a row have greatly improved self-sufficiency in foodstuffs -- rice output has so outpaced demand that storage has become a serious problem. The rice production target for the next year is therefore reduced to 2.5 million m.t. to alleviate the shortage of granary space and raise the low paddy prices in the domestic market. Because of this projected reduction in next year's rice yield, some paddy farmers will be encouraged to grow corn and soybeans with various economic incentives and organizational efforts.

Agricultural production in the following year is projected to grow at the rate of 1.7%, but it does not necessarily follow that farm income will also rise by a mere 1.7%. The farmers will benefit not only from rising paddy prices resulting from reduced production but also from guaranteed government purchase prices for corn and soybeans. Improvements in various production and marketing mechanisms are also bound to contribute to increased farm income. The factor best likely to ensure continued agricultural growth however lies in the smoothly coordinated teamwork of all agricultural workers. I expect that our concerted efforts will guarantee the realization of all our targets for the next year and for all the years to come.

The Importance of the Taiwan Market to the U. S. Farmers*

Joseph B. Kyle**

Good Morning. I am honored to be present at the inauguration of this Workshop on Agricultural Foreign Trade Problems of Taiwan. This is indeed an important subject given the importance of agricultural exports to the economy of Taiwan, and I am confident that those who participate in this workshop will benefit greatly from the discussions.

Gentlemen, if all of the people in the world today bought US farm products at the same rate as the people of Taiwan buy them, US exports of farm products would be approximately 140 billion US dollars a year instead of the 22 billion US dollars worth we now export. If every person in the world consumed US soybeans at the same rate as the people of Taiwan do, we would need 7 billion bushels to supply the world demand. That is more than five times our total production of soybeans and 15 times our present export volume. If the people of every nation in the world ate foods made from US wheat like the people of Taiwan do, world import demand for US wheat would be more than 7 times greater than our current exports of wheat and would exceed last year's production of wheat in the US by 250 percent.

The US supplies more than 50 percent of Taiwan's total agricultural imports. In 1976 imports from the US amounted to 474 million US dollars. In 1977 imports will probably exceed 600 million US dollars for the first time and could go as high as 700 million US dollars. You might be interested in some comparative per capita imports of US farm products by our major customers. In 1975, which is the latest year for which I have both export and population figures, per capita imports of US farm products were as follows: Taiwan - 35 US dollars, Japan - 28 US dollars, German Federal Republic - 25 US dollars, South Korea - 23 US dollars, Spain - 22 US dollars, Singapore - 19 US dollars, Italy - 14 US dollars and the United Kingdom - 10 US dollars. Oh yes, for the PRC the figure was 9 US cents.

I have presented the above figures to illustrate the importance of the Taiwan market to the US farmer. It is a market which we have worked hard to develop and one in which we hope to increase our share by active promotional efforts.

* Text of speech delivered at the Workshop on Agricultural Foreign Trade Problems of Taiwan, September 9, 1977

** Former Commissioner of the Joint Commission of Rural Reconstruction.

Just as you hope to increase exports of Taiwan's farm products to the US, from the 1976 level of 109 million US dollars, or about 14 percent of your total agricultural exports. Barring major upheavals on the world economic scene I am confident that the objectives of both of us will be realized.

The paramount necessity of our time is the maintenance of peace. But history has shown that international political stability requires international economic stability. Order cannot survive if economic arrangements are constantly upset by crises or if they fail to meet the aspirations of nations and peoples for progress.

The US cannot be isolated - and never has been isolated - from the international economy. We export 23 percent of our farm output and 8 percent of our manufactures. We import far more raw materials than we export. American enterprise overseas constitutes an economy the size of Japan's. America's prosperity could not continue in a chaotic world economy. Conversely, what the United States does - or fails to do - has an enormous impact on the rest of the world. With one-third of the output of the non-Communist world, the American economy is still the great engine of world prosperity. Our technology, our food, our resources, our managerial and financial expertise are unmatched. Without us there is no prospect of solution. When the US is in recession, it spreads; without US expansion, the world economy tends to stagnate.

The international economic system has been built on the following central elements: open and expanding trade, free movement of investment capital and technology, readily available supplies of raw materials, and institutions and practices of international cooperation. Within this framework, over the past quarter century, the industrialized countries of the world have maintained an almost continuous record of economic growth. The developing countries also have made unprecedented advances, although their progress has been uneven.

The world's economic growth within this framework has been simultaneously the cause and the result of growing interdependence among nations. Revolutions in communications and transportation have shrunk the planet. The global mobility of capital, management and technology, and materials has facilitated the growth of industry. World trade has encouraged specialization and the efficient division of labor, which in turn have stimulated further expansion. The recession and inflation of the past few years - which spread around the world - have reminded us that nations thrive or suffer together. No country can solve its economic problems in isolation. These problems of the economic structure represent, in their scope and implications, a basic challenge to the economic system of the past generation. This economic system has served the world well but future prosperity in the US and throughout

the world depends on its continued good performance. We must all work together to strengthen the system in areas where it does not work well.

This workshop will be focusing its attention on one of the critical areas in which improvements are needed: trade in agricultural exports. As growers, processors and exporters of farm products you know far better than I, the problems you face daily in trying to sell those products in the international market place. In order to protect inefficient or high-cost domestic producers, many countries impose quota restrictions or high tariff barriers as means to limit imports. In other countries non-tariff barriers have been erected. I refer particularly to complex and confusing labeling and packaging requirements and sanitary regulations. As you have learned from bitter experience, to compete for markets against other producers of like or similar farm products is difficult. Only the most efficient producers will be successful or, for that matter, should be successful.

During my four years in Taiwan, I often have been asked to express my opinions about the future of the economy of Taiwan. I have expressed optimism that you will be able to make the transition successfully from an economy based essentially on an abundance of relatively inexpensive and productive labor to an economy based on the judicious application of capital and technology. I have always qualified my optimism, however, by pointing out certain problems, solutions to which must be found if the economy is to be able to withstand the shocks created periodically by a decline in demand for your exports as a result of downturns in the economies of your major trading partners. For like it or not, if Taiwan is to continue the process of economic and social development which began so successfully in the 1950's it will have to continue to rely on a strong demand for its exports. The domestic market is just too small to justify the investment in plant, equipment and know-how necessary to reach the goals contained in the current Six Year Economic Development Plan.

The problems I can identify are in the following areas: personnel and financial management, marketing, research and development, and quality control. Now some of you may say that these problems are of concern to the industrial sector of the economy but do not apply to the agricultural sector. To this I would merely answer: agriculture already is a major industry in Taiwan and if it is to make a significant contribution to the future economic viability of the island, it must become even more industrialized. I recall that during the 1930's in the United States many were predicting the decline of American agriculture. But those prophets of doom were wrong. American agriculture today is thriving, and it is thriving because it adopted and adapted the techniques and methods of industry. The small family farm has

been replaced by large farm units which can take advantage of economies resulting from mechanization. The American farmer today is just as likely to have a degree in business administration as a degree in animal husbandry or agronomy. Food processing has become a major industry, encompassing hundreds of companies, thousands of products and employing hundreds of thousands of people. Many companies have become highly efficient industrial giants. In many cases they own the farms on which are grown the products they process. They devote millions of dollars a year to advertising, to developing new markets, to creating new and better products and to ensuring that each and every product on which the company name appears is of uniformly high quality.

I realize that agriculture in Taiwan is totally different than agriculture in the United States. You do not have the arable land to realize the economies of scale American agriculture is capable of. Almost 10 Taiwans would fit into my home state of Montana. This does not mean, however, that your agriculture cannot be efficient, productive and profitable. Much more could be done in the way of mechanization, even though this might require a stepped-up program of land consolidation, which is politically sensitive. Much more could be done to promote cooperation among small farmers in purchasing farm machinery, seeds, fertilizers, pesticides, etc., and in marketing the products of the small farms. Also, the food processing industry could become more efficient by adopting modern management and financial methods, by aggressively seeking new markets, by reinvesting a share of profits into the search for better products and by ensuring that when a housewife enters a supermarket in San Francisco, Sao Paolo or Singapore and sees an item marked "Made in the Republic of China" she will know that that mark means quality.

Again, I would like to thank you very much for permitting me to participate in this inaugural session of the Workshop on Agricultural Foreign Trade Problems. I hope that no one will take offense at any comments I have made since I made them as one who has been here long enough to understand and appreciate the problems you are facing as you strive to further develop your economy, particularly the agricultural sector of that economy. I look forward to reading the results of this Workshop for I am confident that from these sessions will emerge a better understanding of the problems you face in increasing your agricultural exports and indications of what must be done to resolve those problems. Thank You.

Taiwan's Family Farm During Transitional Economic Growth*

Tsung-han Shen**

I. INTRODUCTION

In historical perspective, the quarter century after the Second World War (1950-1975) was a period of "transitional economic growth" in Taiwan. During this period, the agrarian economic structure of the pre-war years (1900-1940) was rapidly modified as Taiwan entered what Professor Kuznets calls the "epoch of modern growth" through industrialization. Central to the "transitional economic growth" process is modernization in two dimensions, namely, *technology transformation* and *production organization transformation.* The development of the agricultural sector in Taiwan in the last 25 years provides a good example of modernization in these two meanings.

While Taiwan had a labor surplus economy at the beginning of the transition period, the labor surplus was gradually lost due to rapid labor absorption by the industrial sector. At the later stage of development this labor shortage manifested itself in the agricultural sector in the two dimensions mentioned in the first paragraph. With respect to technology transformation, the traditonal labor-intensive farm technology was gradually replaced by labor-saving technology such as farm mechanization and cultivation methods. With respect to production organization transformation, the traditional small family was supplemented by joint farming operations and other devices to accommodate the new technology and to increase the efficiency of labor utilization. These developments brought about a rapid increase in agricultural productivity.

As a result, instead of maintaining an isolated self-sufficiency, the agricultural sector interacted with the industrial sector and became an integral part of the national economy. As is typical of industrially advanced countries, the long-run shifting of the economic center of gravity from the agricultural sector to the industrial sector is not smooth. The long-run labor migration out of the agricultural sector can be temporarily arrested in periods of recession. The experience of the recent recession in 1973-74 has produced a reverse flow of labor back to the farm.

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This testifies to the fact that after 25 years of modernization, the agricultural sector in Taiwan has already assumed the role typical of that in an industrial country.

Because of the peculiar nature of agricultural production (i.e. small scale, spatially dispersed, traditional outlook), government action is required to coordinate the effort of modernization. In the case of Taiwan, JCRR acts as a catalyst, promoting both technological transformation and organizational transformation and becomes an indispensable agent for modernization.

II. BACKGROUND OF TAIWAN'S FAMILY FARM

Taiwan's agriculture consists primarily of small family farms, each with about one hectare of land. In the 1950's farm products were largely for home consumption. Rice was the major crop and about 80 percent of it was for the farmers' own use including repayment of land tax in kind and barter for fertilizers. Only about 20 percent of rice output was for sale on the market. Usually they raised a few pigs and chickens also for home consumption. Feed was composed of kitchen waste and sweet potatoes. The farmers did not have much to do with marketing. The average farm family size was 6.5 persons, so there was more than enough labor for farming operations. In agricultural technical improvement, emphasis was put on the labor-intensive multiple cropping systems, under which two rice crops and one or two other crops were grown on the same piece of land in a year. The implementation of land reform in 1949-53 provided the farmers with an incentive to make more efficient use of agricultural resources, thereby increasing the return on their farm investment.

The situation changed in the 1960's with the rapid development of industry. Farm youths began to migrate in large numbers to cities. Real wages of farm labor kept rising. The farmers for the first time were confronted with a shortage of labor, especially at planting and harvesting times. Selective farm mechanization was promoted to ease the labor shortage, increase production and farmers' income, but most of the individual small family farms were unable to buy farm machines.

Furthermore, a greater variety of crops such as mushrooms, asparagus, mangoes, papaya and vegetables were grown, and more poultry and hogs were raised on the farm. Farmers used more fertilizers and pesticides for crops and concentrated feeds for animals. In the 1960's about 80 percent of all farm products were for sale on the market. Increasing purchases and sales were made by farmers. Marketing became important to them. However, the small farms with limited production and farm inputs were at a disadvantage in marketing in comparison with the big farms.

Consequently, they met with many problems in production and marketing in the late 1960's. To help solve the difficulties of the traditional small family farms, JCRR worked with the Taiwan Provincial Department of Agriculture and Forestry (PDAF) in developing measures to advance agricultural technology: farm mechanization, management, and organization.

III. FARM MECHANIZATION

Farm mechanization in Taiwan began in 1955 and can be divided into two stages. First, power tillers were used to substitute for water buffaloes, which were then in short supply. Second, in the mid-1960's the goal of the program was to replace scarce farm labor as well as to draft animals.

Taiwan's average one-hectare farm has long been considered too small for mechanization. Yet in the late 1950's farmers began to use power tillers because they were more economical and efficient than water buffaloes. A 1958 survey revealed an average of 52 work days per year for each water buffalo and 48 work days for each yellow ox. Usually these animals required a boy to tend them as they grazed along farm roads, for otherwise they might eat the crops. The average area that could be cultivated in a year by an animal was only about 1.5 hectares. A study made in 1953 also showed that half a million head of draft cattle would be needed for the 870,000 hectares of cultivated land in Taiwan, but actually only 400,000 animals were available.[1] The shortage of draft cattle was accentuated by two other developments. Multiple cropping and the expansion of crop area for food and industrial raw materials had encroached upon land available for pasturing or growing feed.

The first power tillers came from abroad. In 1961, through JCRR arrangements, local manufacturers and Japanese farm machinery companies cooperated in establishing two companies in Taiwan for making power tillers and other machines. The two companies progressed slowly in the early years because it took time for them to adapt their products to the local conditions such as climate, types of land soil, and kinds of crops. Now they are able to produce good quality power tillers. Recently, three big machinery manufactures have successfully produced combines and engines of high quality. Now farm machines are largely made in Taiwan and only a small percentage are imported. Table 1 shows that the numbers of all major types of agricultural machinery, with the exception of rice threshers which are gradually being replaced by power threshers, increased slowly in the early

1) Shen, T. H., ed., *Agriculture's Place in the Strategy of Development: The Taiwan Experience.* Joint Commission on Rural Reconstruction, July, 1974, pp. 397-399. Taipei.

period but rapidly in recent years. The increase was most pronounced in 1974 and 1975, due mainly to the promotion of joint farming, joint farm management, machine farming services, as well as to an increase in the government support price of rice.

Farmers are presently being encouraged to operate and/or manage their farms jointly. Joint farming operations and joint farm management have been introduced to enable small farms to realize economies of scale in production and marketing through cooperative use of farm inputs and sales of farm products without altering farmers' land ownership. Although the successful practice of joint farming operations and joint farm management relies heavily on the high cooperative spirit of the member-farmers, this type of farm organization is nevertheless distinct from the formal "cooperatives" in that the latter have legal status while the former does not. Both joint farming and cooperative farming are practiced by farmers in Taiwan. Marketing cooperatives are more predominant for such cash crops as bananas, citrus fruits, flowers, bamboo shoots, silk and eel.

Table 1. Numbers of Major Agricultural Machines in Taiwan

	1960	1965	1970	1971	1972	1973	1974	1975
Power tiller	3,708	12,213	28,292	32,030	35,222	38,393	42,123	48,598
Tractor	—	425	539	554	620	749	892	1,467
Rice transplanter	—	—	280	454	658	972	1,914	2,787
Power sprayer	317	4,489	17,820	27,038	25,309	43,176	45,399	—
Water pump	8,378	32,107	52,794	61,660	65,755	112,998	119,905	—
Rice thresher	177,338	205,784	186,398	195,784	196,637	177,714	135,158	—
Power thresher (with cleaning device)	—	—	—	—	146	316	379	2,816
Grain dryer (bin-and circulation-type)	—	150	198	214	361	708	1,008	1,683
Rice combine	—	—	20	75	154	329	1,127	2,053

Source: Provincial Department of Agriculture and Forestry.

IV. JOINT FARMING OPERATIONS

In order to offset the disadvantages of the small family farm, JCRR has worked since 1963 with the Provincial Department of Agriculture and Forestry to develop several alternative measures such as:

a) integrated use of improved techniques where a package of practices including superior rice varieties, healthy seedlings, good transplanting, proper application of fertilizers, intensified pest control, better irrigation and drainage was available from 1963-65 for joint rice farming in five-hectare units with the participation of five to ten farmers per unit;

b) joint rice farming operations in 15-hectare units with the participation of 30 to 40 farm families per unit in 1964-66;

c) joint farming operations with integrated use of improved techniques in 20-hectare units with the participation of 30 to 40 farm families per unit, for land consolidation areas and low productivity areas, in 1967 and 1968;

d) extension of joint farming operations with integrated use of improved techniques to non-rice crops and livestock in 1965-70; and

e) establishment of specialized agricultural production areas to facilitate marketing, input distribution and integration of joint farming operations for specific products since 1970.

These developments combine technology, farm mechanization and organization. They have evolved from a single improved technique to integrated improved techniques presented in a package. Through organization and mechanization, these measures have turned the traditional small family farms into larger, more efficient operating units for the production and marketing of crops and livestock. These developments are strategic and dynamic enough to cope with the change from an agricultural to an industrial economy.[2)]

There were two significant changes in the farm structure in the 1960's. As a result of industrization, the number of part-time farmers increased rapidly. The increase was largest among farmers operating less than 0.5 hectare of land, and least among farmers operating 1.5 hectares or more. At the same time, the active farm population in the age group of 20-29 decreased significantly. The growing proportions of younger and older farm people from 1965 to 1968 are shown in Table 2. These tendencies reduced the productivity of farm labor and capital investment, as shown in Table 3.

Table 2. Changes in Farm Employment by Age Group, 1965-1968

Unit: 1,000 persons

	Total	Age group				
		15–19	20–24	25–29	30–49	50 and over
1965–1966	+ 3	+11	− 6	−10	+15	− 7
1966–1967	+77	+36	− 5	−17	+49	+14
1967–1968	−79	− 3	−22	−13	−31	−10
1965–1968	+ 1	+44	−33	−40	+33	− 3

Source: C. L. Huang, "Supply Price of Farm Family Labor," *The Quarterly Journal of Taiwan Land Credit,* Vol. 6, No. 4, Taipei, Taiwan, 1969.

Note: The plus and minus signs indicate, respectively, the increase and decrease in agricultural employment over the previous period.

2) Shen, T. H., *ibid.,* pp. 380-397.

Table 3. Productivity of Full-time and Part-time Farms

	Full-time farms	Part-time farms	
		(A)	(B)
Income per hectare (NT$)	26,004	23,360	13,727
Income per man-equivalent (NT$)	17,248	12,990	5,935
Rate of returns on capital investment (%)	7.13	6.03	1.86
Returns per NT dollar input (NT$)	1.94	1.89	1.46

Source: Terry Y. H. Yu, "An Economic Analysis of Full-time and Part-time Farms on Taiwan," based on Farm Income Survey in 1967, *Journal of Agriculture and Forestry*, Vol. 19, Taiwan Provincial Chung Hsin University, Taiwan, October, 1970.

Note: Part-time farm "A" is defined as the farm household whose farm income is greater than its non-farm income. Part-time farm "B" refers to the farm household whose non-farm income is greater than its farm income. NT$ 40=US$ 1

To boost labor productivity and increase farm income, JCRR and PDAF have been endeavoring to establish new types of farms since the late 1960's. These include full-time specialized farms and part-time diversified farms.

In 1975 and 1976 the writer made visits to a number of joint-operation farms, joint-management farms, and specialized agricultural production areas.[3] The following is a brief description of two examples of joint management.

1. Joint Management of Rice Farms at Hsin-Wu Township, Taoyuan County

In 1970 JCRR assisted the Hsin-Wu Township Farmers' Association in organizing a group for joint management of rice farms. Thirty-one farmers, all primary school graduates, participated in this group with a total land area of 51.2 hectares. They were divided into five classes. Each class elected their own head and deputy head to manage the joint farming operation. The members of each class decided on their work schedules for their own farms, and also the rates of machine service they would charge themselves and other farms. Each member retained exclusive right to his own land, tools and implements, and to the produce from his own field; therefore, they had every incentive to increase production. Owing to labor wage increases in recent years, the group made a joint investment to purchase farm machines for use in operations ranging from plowing to harvesting on their own farms as well as for rendering machine farming service to their neighbors. The group has a special section with a manager, an accountant, a clerk, and a

3) Shen, T. H., "Transformation of Small Family Farms into Agribusinesses in Taiwan," *The Eastern Miscellany*, Vol. 7, No. 9, March 1974.

team leader to handle machine farming service in land preparation, in transplanting, in application of fertilizers and pesticides, and in harvesting. In 1974, with the use of machines in land preparation, in transplanting, in application of fertilizers and pesticides, and in harvesting, the group had net earnings of NT$17,000 per hectare on its own lands. In addition, it made a total profit of NT$33,000 from the machine farming service rendered to the neighboring farmers in land preparation. From its profits the group has accumulated a reserve fund. The group has now become a permanent cooperative type of farm organization.

Table 4. Purchase of Farm Machines and Members' Investment of the Joint Operation Group at Hsin-Wu, 1970

Class	Members	Area (Ha.)	Purchased Machines	Members' Investment (NT$)*
1	7	13.0	3 power tillers, 3 transplanters 2 sprayers, 2 threshers	$ 207,000
2	5	11.9	2 power tillers, 2 transplanters 2 sprayers, 2 threshers	140,400
3	9	10.4	2 power tillers, 2 transplanters 2 sprayers, 2 threshers	156,700
4	5	9.0	1 power tiller, 2 transplanters 2 sprayers, 2 threshers	108,000
5	5	6.9	2 power tillers, 2 transplanters 2 sprayers, 2 threshers	132,800
Total	31	51.2	10 power tillers, 11 transplanters 10 sprayers, 10 threshers	$ 744,900

Source: The Joint Operation Group at Hsin-Wu, Taoyuan County.
* The investment by each member of the class was in proportion to the area of his cultivated land.

2. Joint Management of A Hog Farm at Wai-pu, Taichung

To promote joint management of hog production and marketing, the township farmers' association at Wai-pu, Taichung County, assisted 10 hog farmers in organizing a joint-management group. With NT$10,000 from each member, the group had a total investment of NT$100,000 for its operation. JCRR also granted a subsidy of NT$100,000 to it for construction of pigpens. The land for the pigpens was rented from a member of the group. The operation was started in 1973.

The township farmers' association rendered assistance to the group in the form of (1) technical guidance, (2) subsidies of NT$3,000 in 1973 and 1974, (3) a loan of NT$350,000 for purchase of feed and other supplies, (4) sale of the association's feed at reduced prices, (5) interest-free loans in February and March, 1974 when

the feed price was rising, (6) help in the sale of hogs, (7) hog insurance, and (8) veterinary service.

The group employed two men (members) to take care of the hogs and do veterinary work, and a member voluntarily handled its accounts. The other eight members participated only in planning and not in raising the hogs; they continued their own farm work. In the period from December 1973 to August 1974, when the feed price continued to rise while the price of pork remained stable, the group suffered a loss of about NT$300 per hog. Beginning in September 1974, the situation became better as the price of pork was on an upturn and the rise in feed price slowed down. At the end of 1974, the group got a favorable balance. Although the favorable turn owed much to the various subsidies received, the group members were, nevertheless, confident in 1975 that, with accumulated experience in managing a modern hog enterprise and with the price structure of inputs and returns to normal following the turbulent times since 1973, they would be able to operate profitably without any subsidy. Their success was in large part due to the guidance and assistance of the township farmers' association.

V. THE SPECIALIZED PRODUCTION AREAS

In 1970 the joint farming program was broadened to include joint marketing and purchasing. Grading and packing improvements were also being introduced to help joint farming groups improve the marketability of their fruits and vegetables.

Interest in the broadened program had been keen, and 490 new joint farming groups involving 3,576 farmers were organized in 1970 and 1971. If each of these farmers represented one farm family, the 3,576 was 0.4 percent of total 879,000 farm families in Taiwan in 1971. The scope of their work included not only adoption of improved techniques but also the improvement of farm management, better utilization of farm resources, and promotion of a new marketing system.

As part of the effort to modernize Taiwan's agriculture, the Central Bank and JCRR jointly established a special farm credit fund of NT$200 million in June, 1972 for making capital loans at 6 percent per annum and production loans at 10 percent.

In 1973 the government launched the Accelerated Rural Development Program under which many "specialized agricultural production areas" were established encompassing many farming units, each under encouragement and guidance to enter into joint operation and to specialize in the product designated for the local area. Those areas may specialize in such main-line farm products as corn, oranges, grapes,

asparagus, hogs, milk and dairy products, and beef cattle which lend themselves to large-scale marketing and are suited to the local natural environment. The farmers have the option to reserve part of their farmland to engage in side-line production such as growing vegetables and fruits and raising hogs so as to make efficient use of farm resources. These specialized areas are provided with special long-term, low-interest loans as an incentive. Thus, the farmers in the areas can realize many benefits of large-scale farming and still enjoy their essential independence. Since 1973, 120 specialized production areas for some 20 agricultural products have been established in Taiwan.[4)]

Three types of areas which have been organized and successfully operated since June 1972 may be taken as examples.

1. Specialized Corn Production Area

Taiwan's annual feed corn production is about 140,000 metric tons, which can supply only about one-tenth of the requirement of the booming livestock industry.

An area of dryland, estimated at more than 100,000 hectares, is available for corn production under the current cropping patterns in Taiwan.

The leading cultivars are Tainan No. 5, a locally developed double-cross with an average yield of 4.5 metric tons per hectare, and Tainan No. 11, a new hybrid resistant to downy mildew with an even better yielding ability.

Lifting of corn import restrictions in 1967 has led to fluctuations in the price of corn which sometimes drops below production cost. A fuller exploitation of the potential for local corn production will probably require government price policy adjustments and the adoption of an integrated system for production, purchasing of inputs, storage, processing, marketing and utilization.

In 1973, with support from the government's Accelerated Rural Development Fund, JCRR cooperated with PDAF in establishing a specialized corn production area which covers six townships in the Chianan region.

Notable achievements in Taiwan's feed corn production have resulted from this project. Under the corn price support system (NT$5.5 per kg. for the year 1975/76), farmer's benefit is assured and their interest in corn cultivation stimulated. Corn production in Taiwan has almost doubled in the last four years, i. e., 48,265 hectares and 140,930 metric tons in 1975 vs. 25,746 hectares and 70,532 metric tons

4) Mao, Y. K., "Population and Land System in Taiwan," Conference on Population and Economic Development in Taiwan. The Institute of Economics, Academia Sinica, Taiwan, January 1976, pp. 23-24.

in 1972. Moreover, the linkage between production, marketing and utilization has also been improved.

Public facilities such as silos with a total capacity of 16,000 metric tons, four sets of dryers and ten dumping trucks have been installed at or bought by the township farmers' associations concerned. Fifty percent of the cost was financed by a government subsidy.

2. Specialized Mango Production Area

Taiwan's mangoes were originally introduced by the Dutch and later by the Japanese. In the past, it was considered as a forest, garden or roadside tree rather than a cash crop in horticulture.

Since JCRR initiated a project for the extension of the newly introduced American varieties, Irwin and Haden, in 1960, mango production of this island has greatly increased. According to the Taiwan Agricultural Yearbook, its harvested hectareage has increased to 5,000 hectares with an output of about 60,000 tons a year. Most of the mango fields are located on the arid slopeland in six adjacent townships of Tainan county. Inhabitants in these townships were rather poor in the past. Owing to the planting of mangoes, their livelihood has now been greatly improved.

Mango is a unique tropical fruit. In addition to its fresh consumption, it can be processed into juice or canned products for domestic and foreign markets. Of the mangoes in Taiwan, three-fifths are American varieties. They are produced primarily for fresh consumption and susceptible to anthracnose disease. Native varieties are good for juice-making. They are disease resistant and adapted to arid slopelands.

For the further development of Taiwan's mango industry, JCRR launched a breeding project in 1975 for the purpose of incorporating the good eating quality of the foreign varieties into the native ones. A total of 44 varieties were screened for resistance to fruit drop caused by anthracnose disease at the Fengshan Tropical Horticultural Experiment Station and National Taiwan University. The disease is a major menace to the mango crop.

So far, seven hybrid populations have been developed. This breeding attempt is designed to transfer the disease resistance to the leading mango varieties, Irwin and Haden. The success will be very helpful to the production of juice-making mangoes and to develop a proper use of slopelands.

Meanwhile, JCRR is using the Accelerated Rural Development Program (ARDP) fund to finance mango production in various regions. The project covers the establishment of specialized production areas which are expected to reach 2,000 hectares in the six adjacent townships of Tainan county. This intensive investment aims to improve the public facilities, such as feeder roads, packing houses and pesticide-spraying systems. In the past two and one-half years, the following major projects have been completed:

a) Construction of a concrete bridge across the Tseng-wen River for connecting the farm roads in the six adjacent townships of Tainan county.

b) Installation of an irrigation system required for the intensive chemical control of insect pests.

c) Reconstruction of farm and feeder roads for reducing the damage during transportation.

d) Encouraged the canning factories to collect mangoes from this area on a contract basis in order to use the excess production and off-grade fruits during the peak harvest season. The mangoes thus collected are sliced for canning.

e) Installation of two packing houses, one of them with hotwater treatment equipment.

3. Specialized Livestock-Crop Production Areas

Chinese farmers are known for their ingenuity in incorporating a variety of interdependent enterprises on a small piece of land. For a livestock enterprise, marketing costs and the expense of frequent visits by veterinarians and inseminators are considerably lower when a group of farms raising a particular kind of livestock (pigs, dairy cattle, beef cattle) are close to one another. Consequently, the idea of specialized animal-raising in integrated livestock-crop areas, conceived by the Animal Industry Division of JCRR, is now being extended in cooperation with the PDAF.

Under this system, animal barns are built right in the field instead of in the back yards of farm houses, a traditional practice which is not good for sanitation. Livestock manure is carefully collected in a pit built underneath the barn and returned to the fields to build up soil fertility. Some farmers have the hog manure passed first through a methane gas generating tank, then drained into the collection pits. The methane gas thus generated can be used as fuel.

To facilitate the application of liquid manure and the operation of large farm machines, farmers are urged to consolidate their lands in such a way as to form an integral plot, adjacent to a major path. This also facilitates the delivery of feeds and the shipping of products.

The local township farmers' association provides services such as veterinary medicine, artificial insemination, livestock insurance, and marketing. It also supplies farm credit for livestock barn construction and purchase of breeding stock and feeds.

To help set up new areas for livestock-crop production, government subsidies are provided to partially finance the cost of land consolidation, roads, power lines, water supply and telephones. The rest of the cost is met by farmers' own contributions or long-term, low-interest loans. More subsidies are available for remote mountain villages and other low-income areas.

Up to June 1975, 60 specialized hog-crop production areas have been established, involving 4,500 farms totaling 4,000 hectares of land. Each farm raises 6 sows and 50 fattening pigs; there will be 100 marketable pigs in a year.

There are also 16 dairy villages with 698 farms raising a total of 6,166 milk cows. All the cattle are of the Holstein-Friesian breed. Due to good care, the average milk yield per lactation at second calving exceeds 4,200 kg.

VI. CONCLUSION

Under the pressure of labor shortage and with the expansion of industry, the small family farms of Taiwan maintain their ownership of land, but are encouraged to organize themselves into joint farming and joint management groups to facilitate farm mechanization and increase labor productivity. From a historical perspective, technology transformation and organizational transformation of these types are typical of a transitional growth phase.

It is also evident, from the various examples that we have considered, that joint farming has proved to be highly successful in Taiwan. The practice of joint farming (including joint production, purchasing of inputs, and marketing), in my opinion, provides a unique solution to the twin problems of technology and organizational transformation in a period of "transitional economic growth." Joint farming creates the conditions which permit the effective and efficient adoption and utilization of new technology and cultivation methods without changing the individual incentive structure. It also allows the preservation of the family farm as the basic organizational unit of the society, a fact which contributes substantially to the social and political stability of Taiwan.

That the family farm system has proved advantageous to social and political stability was amply demonstrated in the economic recession of the last two years, 1974-75. In that period many industrial plants were closed down or reduced production and were forced to lay off a large number of workers. According to the Quarterly Report on the Labor Force Survey in Taiwan, employment in primary industry (agriculture) increased by 73,000 persons from 1973 to 1974. The result was increased crop and livestock production in 1974 as evidenced by the rise in multiple cropping index from 174.7 in 1973 to 179.4 in 1974. So the family farms supplied labor to industry during its accelerated expansion in 1968-73 and absorbed labor from industry during the recession in 1974 and 1975. In other words, the family farm serves as a regulator in the labor market. This reverse flow of labor during the recession of 1973-74 occurred for the first time in the phase of transitional growth. These reverse flows are merely short-run phenomena superimposed upon the long-run trend of migration to the industries.

It is generally accepted that the ideal size of a family farm in Taiwan should be about three hectares, which would justify the purchase of a power tiller and other farm machines. However, since the average size of a farm in Taiwan is only about one hectare and 40 percent of the farms operate less than 0.5 hectare, the joint farming operation has been introduced by the government as a policy measure to realize the benefit of larger scale operation. The joint farming operation seems to be the best alternative in the present stage of socio-economic conditions. Nevertheless, as a long-term development plan, the government is encouraging small family farms to enlarge the size up to about three hectares if current economic conditions continue to prevail.

As the trend goes, Taiwan is likely to become another Holland, a supplier of high value products such as tropical fruits, vegetables, flowers and fish with continued development of agricultural technology and farmers' organizations.

Policy and Performance in the Recent Taiwan's Agriculture*

Teng-hui Lee**

I. INTRODUCTION-TAIWAN'S AGRICULTURE AT THE CROSS-ROAD

During the period of 1946-1976, agriculture of Taiwan experienced rapid growth with an average annual rate of 6%. This was the then highest rate of growth in agriculture in the world. It is also one of the reasons why the western economists call Taiwan's case as the successful model. Under the well executed strategy, Taiwan's agriculture has already passed three important milestones. First, since 1965 there has been a decline in absolute numbers in the labor force of agriculture. This point is particularly important in historical perspective. Second, the island has reached a situation of maturity in biological innovation in agriculture. Third, it has emerged to a modern, flexible agriculture with an effective system for transferring net resources to other economic sectors.

The combined effects of these milestones reflect that Taiwan's agriculture has changed from dependent sector to independent sector. This transition of change has affected agriculture a substantial lower growth rate and relative lower per capita income compared with other sectors. In the earlier period of 1946-1965, considerable growth had occurred resulted from labor-using technique or biological innovation which reduced the unemployment of labor or slack resource. This suggests that reducement of unemployed labor as a source of growth is no longer possible in the later period. It also indicates that rapid growth in the past twenty years had drawn heavily on research of biological technique. In the same token recent declining of labor force in agriculture calls for a new type of research for the continuation of rapid growth of agricultural production. Thus obviously, Taiwan's agriculture is now at technically and economically the cross-road. A strong policy desire to improve the growth rate of agriculture and ratio of agricultural income to non-agricultural income was eagerly urged by the mass of the farmers.

Therefore, we would like to answer the following two questions in this paper:

1. What was the new agricultural policy which was adopted by the Chinese Government in 1972?

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2. What was the performance or the effects of the new agricultural policy on eliminating difficulties facing the recent Taiwan's agriculture?

II. THE NINE POINTS PROGRAM TO ACCELERATE AGRICULTURAL DEVELOPMENT

To accelerate rural and agricultural development and further improve the welfare of farm people, Premier Chiang announced on September 27, 1972 that the Central Government was prepared to earmark NT$2 billion in grants for the next two years to carry out a nine-point program. They are:

1. Abolition of the rice fertilizer barter system and reduction of fertilizer prices;
2. Price stabilization and adjustment for agriculture;
3. Tax adjustment for farmers;
4. Improvement of agricultural credit system;
5. Extension of specialized agricultural production areas;
6. Improvement of agricultural marketing;
7. Resource development and investment in rural infrastructure;
8. Strengthening of agricultural research and extension; and
9. Development of rural industries.

Objectives of the above nine points program can be summarized into the following three phases: (1) To reduce farmers' burden and increase their income; (2) To increase investment in rural infrastructure; and (3) To improve production structure and promote technical innovation. These policy measures aim at not only solving the difficulties facing farmers, but also to help Taiwan's agriculture shift smoothly to a new direction. To undertake and oversee the execution of this policy, a national planning committee was established. At the operation level, the Taiwan Provincial Government established an executive committee composed of the heads of concerned departments. The national planning committee and this provincial executive committee work closely to implement the plan.

The NT$2 billion government fund granted for 1973 and 1974 was allocated to the Ministry of Economic Affairs. In addition to this grant, approximately 1.8 billion of fund was provided to farmers through bank loans. As the agricultural development program is of long-run, funds will be granted continuously. The total grant including counter-part fund of Provincial Government reached to the amount of NT$6.5 billion up to 1977. The breakdown of these funds is given in Table 1.

Viewing from the budget allocation for implementing the nine points program in Table 1, it is clear that great emphasis was placed on the establishment of specialized production areas, integrated cultivation of rice and farm mechanization, infrastructure investment and strengthening of research and extensions.

Table 1. Budget Allocation for Implementing the Agricultural Acceleration Programs

Unit: NT$

Item	Grant of Central Government	Provincial Government	Total	%
Establishment of specialized production areas	728,791,014	440,803,648	1,169,594,662	17.9
Integrated cultivation of rice farming and mechanization	504,150,835	728,455,732	1,232,606,567	18.9
Improvement of agricultural marketing	120,647,503	92,726,738	213,374,241	3.3
Investment in rural infrastructure (irrigation, drainage village, road, windbreaks, etc.)	2,092,551,161	921,082,069	3,013,641,230	46.0
Establishment of industrial site in rural areas	14,259,167	—	14,259,167	0.2
Research and extension	438,250,375	91,915,499	530,672,177	8.1
Others	224,179,505	141,720,000	365,899,505	5.6
Total	4,123,343,863	2,416,703,686	6,540,047,547	100.0

1. Specialized Production Areas

Specialized crop and livestock production areas are being established on the basis of current distribution of crops, geographical conditions and market requirements. Joint operation, use of machineries, and cooperative marketing are most important technical features of resource allocation for small farmers. Thus, it is one of the new approaches to solve the desired long-run model of farm operation unit with land consolidation and the development of capital-intensive technique. For future development the economy of scale should be considered as the most important task in view of the scarcity of labor force in agriculture. The main types of specialized production areas lay in the following fields:

A. Special crop production areas: For major export crops such as mushrooms, asparagus, pineapples, bananas, citrus fruits, grapes, tea, silk and important vegetables, contract farming is promoted. Efforts are made on mechanization, joint operation to improve quality, strengthen inspection and promote joint export so as to increase the competitiveness of these crops on the international and domestic markets.

B. Livestock and feed production: The development of livestock industry is a new direction of agricultural production and government measures. In promoting integrated crop-livestock farming, emphasis was made on the complementary use of scarce resources and stability of farm income. The demonstration on such integrated farming system has been successfully conducted.

2. Farm Mechanization

The real wage in agriculture began to rise substantially in 1968. It was no

longer a question of repalacing animal power and human labor with machineries Emphasis was on how to save labor. Labor saving mechanization has also been extended to dairy, poultry and forestry. Problems in farm mechanization arise partly from the size of farms and partly from machinery manufacturing. Small farms limit the full use of power machines, and land fragmentation adds to the difficulty of mechanization. They also have limited purchasing power to purchase machineries. On the machine manufacturing side, price of machineries and spare parts are two times higher than in Japan. Besides, after-sale service and quality of machine should be improved. Therefore, the following measures were taken by the government:

A. Improving machine quality and reducing manufacturing cost;

B. Increasing the number of farm mechanization promotion centers;

C. Forming machine service teams;

D. Strengthening research and training, and

E. Promoting the joint use of machineries in integrated rice farming areas and specialized production areas.

3. Investment in Rural Infrastructure

In the earlier period of agricultural development, capital saving and labor using technique was strategically emphasized. To promote agricultural production with less labor input, investment in agricultural environment was extremely important. This includes the investment in resource development of slope land, public installations and facilities as drainage ditches, irrigation canals, dikes, windbreaks, rural roads and land consolidation. In addition, efforts were also made to improve environmental sanitation in the rural communities. As future increase in agricultural output in Taiwan depends primarily on increasing labor productivity by using a great mix of labor saving mechanization, the new arrangement and investment in rural infrastructure is one of the means to pave the way for efficient agriculture. Similarly, programs to influence the distribution of income between sectors are likely to involve a variety of measures including public support for health facilities, house repairing and construction.

4. Agricultural Research and Extension

The new agricultural policy calls for strengthening of agricultural research and extension work by hiring more staff, improving facilities of research agencies, and strengthening organization to provide for better and closer coordination of research works. The major emphasis was put primarily on the improvement of new variety

of crops and livestock, pest control, labor saving technique on cultivation method and new crop pattern and improvement of feeding efficiency, etc.

III. PRODUCTION EFFICIENCY AND FARMERS' WELFARE

According to the report prepared by the Provincial Government on the execution of the new agricultural policy, the benefit-cost ratio on the project was justifiable from the economic view-point. The new agricultural policy has the nature of multiple purpose and its benefit actually cannot be measured in terms of money value. The flows of benefit are also different for the periods. Therefore, we should evaluate the new agricultural policy in terms of production efficiency and farmers' welfare.

1. Production Efficiency

The average growth rate of agricultural output from 1960-1972 was 4.2%, slightly lower than in the preceeding preiod. (See Table 2).

Table 2. Growth Rates of Total Output, Total Input and Productivity in Agriculture

Unit: %

Period	Annual Compound Rate of Growth		Total Productivity	Relative Contributions by	
	Total output	Total input		Input	Productivity
1946—51	10.2	7.8	2.4	76	24
1951—60	4.7	2.7	2.0	57	43
1960—72	4.2	3.2	1.0	76	24
1972—76	3.7	1.7	2.0	46	54

Source: T. H. Lee & Y. E. Chen, "Growth Rates of Taiwan's Agriculture, 1911-1972", JCRR, Economic Digest Series: No. 21.

Output increased most rapidly in the first half of 1960's, owing to the expansion in production of newly developed products, such as mushrooms and asparagus, and strong demand for agricultural products in the international market. However, after 1968, the economic structure of Taiwan reached a turning point. Agricultural real wage went up sharply because of labor shortage in the rural sector as mentioned in the previous section. After implementation of the nine-point accelerated agricultural program, the annual growth rate of output was 3.7% in the period of 1972-76, which was slightly lower than that of the total period of 1960-72, but higher than that in the later part of the same period. When we quote the change in output of individual crop, such as rice in the recent period, it will be more clear about the production effect of the new agricultural policy.

Table 3. Rice Production

Year	Production (1,000 M/T)	Yield (Kg/Ha)	Year	Production (1,000 M/T)	Yield (Kg/Ha)
1960	1,912	2,495	1969	2,322	2,952
1961	2,016	2,577	1970	2,463	3,173
1962	2,113	2,660	1971	2,314	3,071
1963	2,109	2,815	1972	2,440	3,291
1964	2,247	2,937	1973	2,255	3,114
1965	2,348	3,038	1974	2,452	3,153
1966	2,380	3,017	1975	2,494	3,156
1967	2,414	3,067	1976	2,713	3,446
1968	2,518	3,188			

The increase in the agricultural output since 1972 indicates that Taiwan's agriculture has recovered from the recession and moved toward to a new direction.

In relation to the increase in output, the changes of factor input and productivity are analyzed in Table 2. The factor inputs discussed here include four categories; non-farm current input, land, labor and fixed capital. The annual rate of increase in factor inputs was only 1.7% in the period of 1972-76, lower than any other period. Decrease in land input and number of agricultural workers was the major cause for the slow rate of increase in factor input.

Dividing the aggregate output by the aggregate input gives the indicator of total factor productivity. While the average rate of increase in agricultural output was 3.7% per year in the period of 1972-76, that of input was 1.7%. Thus the average annual rate of increase in total factor productivity was 2.0%. About 46% of the growth in output is therefore attributable to increase in input, the remaining 54% to the increase in productivity. However, the contribution of increase in productivity to the growth in output was only 24% in the period of 1960-72 and 43% in the period of 1951-60. This fact indicates that the production of agriculture became more efficient in the period of 1972-76 than that of the previous periods. The nine-point accelerated agricultural program has brought some light in the growth direction of output.

2. Efficiency in Specialized Area

The establishment of specialized agricultural area is one of the important approaches to the land holding and operating unit. The 22 crop and livestock specialized agricultural areas have been distributed in more than 200 townships. They include soybean, sorghum, corn, mango, pineapple, citrus fruits, banana, pear, grape, flower, vegetables, green asparagus, garlic, bamboo shoot, seedless watermelon,

tea, sericulture, hog, dairy cow and beef cattle. As mentioned before, the specialized agricultural area is one of the break through in farm planning and management under the mechanized group farming system. The primary purpose of this device is to improve the structure of agricultural production in the selected area by: (1) Enlarging the scale of farm operation through group approach; (2) Improving the basic production facilities; and (3) Providing opportunity for joint marketing. Individual family farms will continue to be the basic operating units, but the farmers will be organized into groups to engage in various farming activities on a cooperative basis.

The economic benefit of specialized agricultural areas is shown in Table 4, which varied according to types of products. The highest benefit is from vegetable specialized area and next is hog, sericulture and citrus fruits specialized area. The lowest benefit is seen in beef cattle specialized area. Although the benefit has been changed from type to type, a new measure of farming scale with institutional device will have a potential of development in the future.

Table 4. Economic Benefits of Specialized Agricultural Areas after Project

Item	Additional Benefit (NT$/Ha.)	Item	Additional Benefit (NT$/Ha.)
Soybean	2,154	Bamboo shoot	4,426
Sorghum	6,088	Tea	23,360
Corn	3,372	Sericulture	26,500
Mango	16,484	Hog	29,296 (per family)
Pineapple	2,427	Dairy cow	10,475 (per family)
Citrus fruits	26,000	Beef cattle	1,167 (per family)
Vegetables	55,192		

Source: Evaluation of ARDP, JCRR.

3. Farmers' Welfare

The ultimate goal of the new agricultural policy is to increase farmers' welfare to the level comparable to the non-farmers'. To indicate the change of welfare situation, the income parity approach has been considered in Table 5. Per capita farmers income was 70% of per capita nonfarmers income in 1966, but it decreased to only 50% in 1970 and 60% in 1971. This was the most unfavorable income status for farmers in history. This was the reason why the mass of farmers requested the change in agricultural policy in the later period of 1960's. After implementation of the new agricultural policy, the income ratio has been improved to some extent. But this is still far lower than the optimum ratio (about 75%). How to narrow the income gap between farmers and non-farmers is heavily dependent on policy

device and technological break through. The income effect of new agricultural policy is still on the half-way. A special effort has to be emphasized.

Table 5. Per Capita Farmers' Income and Non-farmers' Income

Year	Farm Family (A)	Non-farm Family (B)	(A)/(B) %
1966	4,509	6,464	70
1968	4,757	8,219	58
1970	5,350	8,894	60
1971	6,191	9,650	64
1972	7,540	11,341	66
1973	8,533	14,170	60
1974	13,180	19,263	68
1975	14,274	21,285	67

Source: RED, JCRR

IV. CONCLUDING REMARKS

All the achievements of nine-point agricultural development program mentioned above were mostly direct and short-run. The long-run effects on technical and institutional change which will be induced by the program should be the most important strategy in the case of Taiwan. This includes broad areas on which further efforts should be done. The first of these points is to establish efficient production structure with the desired farm scale. One of the important strategical questions is which farm scale model would be best serve the country in future. The two extreme cases are generally conceived by people: those are the U.S. approach of large scale farm with the development of capital intensive technique and the Japanese approach of part-time farmers in which 80% of farm family income earned from non-farm sources. However, some intermediate between the above two models would be an approach preferred by people. Under the principle of land-to-the-tiller, the approach should require some institutional change with respect to the farm management and increase in the operating units. Viewing from the nine-point rural development programs, it is clear that Taiwan preferred the alternative approach. But this still remains a challenge.

The most serious and urgent problem is how to decrease income inequalities between agriculture and non-agricultural sectors. Special attention was drawn to the possibilities of altering the terms of trade favorable to farmers. There are a number of problems involved in each approach, i.e. government financial burden, low consumers' preference, and farmers' much reliance on subsidy. Up to the present time, the government has been very careful on executing this approach. Another

attention was also given to the regional income disparities that are occurring in the present stage of development.

The last discussion area is centered on the problem of Taiwan's research capacity. We have noted previously that Taiwan has reached the maturing stage of labor-intensive technique. These achievements have been admired by many countries. However, a number of reservations are held on the present capacity in the areas of designing machineries and agricultural engineering. Although labor saving technique is now centered by the research workers, additional efforts should be put on field mechanical technology and adequate research on new crops.

Approaches to Agricultural Modernization in Taiwan

You-tsao Wang*

I. INTRODUCTION

Agricultural modernization usually evokes in the minds of most people a picture of a farm of hundreds of acres and big farm machines. Admittedly agriculture in European and North American countries is advanced, but large-scale farming is not necessarily modern. Modernization is dynamic instead of static; it carries no set standards but changes in response to times and objective conditions. Modernization at present may soon turn outdated because of fast progress and change in science and technology and socio-economic settings. Even in the same period of time, modernization varies from country to country owing to the different degree of economic development. The modernization of one economy may not be the modernization of another. The American type of agricultural management cannot necessarily apply in the midst of our country's objective conditions. Furthermore, modernization should not apply to production only; it also involves the upgrading of social and living conditions. In a word, modernization is dynamic, multifacet, innovative, progressive, forwardlooking, and modernization in agriculture should mean continuous innovation and development anticipating the needs of the future.

Modernization is a socio-economic process essential to progress and development. Agricultural modernization in Taiwan has been significant, as evidenced by improvements in the structure of the agricultural sector, productivity, and rural living conditions. At a time when the other sectors of the economy are steaming ahead at a fast pace, modernization in the agricultural sector appears all the more imperative, in order to keep abreast with that in the others.

Based upon the status of our economic development and the availability of our natural resources, agricultural development in the future should center upon:

1) boosting production by virtue of up-to-date scientific developments;
2) adjusting the production structure to coordinate with economic development as a whole;
3) augmenting farm income to a level comparable with that in other economic sectors; and
4) helping develop an egalitarian society.

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II. PREREQUISITES TO AGRICULTURAL MODERNIZATION

While modernization varies with time and place, some prerequisites are indispensable to any modernization. In terms of resource allocation, modernization means the effective utilization of all resources to derive maximum benefit out of each resource. More important, resource allocation, being geared to the needs of economic development, requires constant adjustment to make it respond closely to new developments and remain efficient at all times.

As to farm management, modernization denotes commercialized management aimed at producing for the market to make a profit rather than satisfying the basic needs of the farm family. Farm management in this case does not differ in essence from that of other businesses.

To derive maximum profit, the farmer must turn out products needed by the consumer; prices constitute the best means of guiding farm production. The market of farm products as composed of small and numerous buyers and sellers is almost one of perfect competition, a condition best suitable for the functioning of prices. However, farm products with a low supply/demand elasticity cannot entirely depend upon the functioning of the market, which will often result in drastic price fluctuations. To protect the interests of both producer and consumer, some degree of planned production and marketing may be imposed when necessary. The Food Equalization Fund launched in 1974 is dedicated to this purpose.

Continued increase in farm production makes up a prerequisite of modernization, but it has to rely upon progress in science and technology. Under the price system, competition among the producers will contribute to improved production efficiency and encourage innovative developments. Unfortunately agricultural research programs being time-consuming and not likely to produce immediate profit are often shunned by private enterprises. The government has been keenly aware of this situation and the extreme importance in scientific technology and has recently organized an *ad hoc* group to be responsible for coordinating overall planning in agricultural research and development.

Agricultural modernization extends beyond production and management to embrace the improvement of rural society and farmers' living conditions. An effort must be made to assure reasonable income distribution, the healthy development of farmers' organizations, and the recruitment and training of agricultural workers. Meanwhile, the quality of life must be continuously improved by providing necessary amenities and services.

III. MODERNIZATION EFFORTS IN THE PAST

Agriculture has been growing at a very admirable pace since the retrocession of Taiwan to the Republic of China, particularly after the initiation in 1953 of the first four-year economic plan. Statistics show that agricultural growth averaged an annual 4.5% between 1952 and 1976, a rate greater than that of population growth.

Besides meeting domestic demand, agricultural production has surpluses for export, which in the early stages of Taiwan's economic development constituted a major force in promoting industrial growth.

Modernization in the agricultural sector has proceeded in various aspects. In field of resource use, emphasis was first placed on labor-intensive production aimed at fostering land productivity. In this stage the multiple cropping index rose continuously and the yield per hectare also showed corresponding increase. But production visibly turned from labor-intensive into capital-intensive in around 1967 when agricultural production began to undergo a metamorphosis of structure and a budding industry started to absorb farm labor.

In farm management, subsistence farming gradually gave way to commercialized agriculture. Farm production is mainly for the market, requiring advanced techniques and increasing investment. This point is evidenced by the commercialization degree of farm products. Of the total farm receipts in 1952 about 30% was in cash, but this percentage climbed to 78% in 1975. Within the same period, cash also soared from 39% to 87% of the total production expenditure on the farm.

As for modernization in rural life, it can be illustrated by changes in the receipts and expenses of farm households. The Survey of Family Income and Expenditure in Taiwan Province reveals that the per capita farm household income rose from NT$4,509 in 1966 to NT$17,076 in 1976, while the farm household expenditure per capita soared from NT$3,593 to NT$13,009 during the same period. Meanwhile, food costs decreased from 58% to 43% of the expense account, and the other expenses climbed relatively. Material amenities in these ten years also showed great improvement. In 1966 every 100 farm households averaged only one TV set, 14 refrigerators, 12 record players, six bicycles, and five newspaper subscriptions; ten years later the corresponding figures were 70 TV sets, 46 refrigerators, 47 bicycles, 18 record players, and 14 newspaper subscriptions.

IV. MEASURES FOR PROMOTING MODERNIZATION IN THE FUTURE

To assure agriculture of continued modernization, the following measures have to be enforced:

1) Plan and conserve natural resources — As agricultural production depends to a great extent upon natural resources, their planning and conservation will always remain a basic factor in future agricultural development. Restricted on the one hand by limited arable land and burdened on the other with increasing population pressure, agricultural production will have to rely upon integrated planning of natural resources in order to meet rising domestic demand.

Under guidance of the Comprehensive National Land Development Program, a project has been underway in taking an inventory of agricultural resources and launching regional planning for all agricultural lands. The islandwide program is scheduled to be completed by the end of 1978.

Conservation of agricultural resources deserves as much attention as their planning and utilization. Timely and effective measures must be taken to forestall damage that may be caused to agricultural resources by expanding human and industrial activities.

2) Adjust the combination of production factors to improve efficiency — The combination of various production factors needs to be adjusted from time to time in the process of economic growth in order to boost the aggregate output. In recent years, agricultural growth logged a slower pace and agricultural, especially labor, productivity was lower than in the industrial sector. It is therefore necessary to transfer the abundant farm labors to other economic sectors from the viewpoint of the economy as a whole. A comparison of the costs of various production factors also shows that there is a necessity of the continued replacement of labor by capital in agricultural production. Therefore, mechanized farming will receive continuous promotion in the modernization process for the purpose of boosting the productivity of farm labor.

The drastically rising labor wage rate in recent years makes the substitution of machines for human labor even more imperative. Under the "Guidelines for Accelerating Mechanized Farming" promulgated in 1970, loans were made available to farmers for purchasing farm machines and promotion centers were established and teams organized to provide custom farming and repair services. By the end of 1976, machines in use had totaled over 60,000 sets and 60% of farmland had been machine prepared. In the past seven years, the horse power per hectare has risen from 0.2 to 0.6.

3) Enlarge the farming scale in response to labor and capital changes — The farming scale varies from stage to stage in economic development, but it has to be expanded because of changes in labor and capital.

Farms in Taiwan are small and numerous; their expansion in acreage will involve a lot. What can be done under the present circumstances is to encourage family farms to adopt joint farming operations and to promote custom or cooperative farming so that the farming scale may be enlarged without affecting existing farm ownership.

Another solution is the specialized production area in which public facilities are improved and joint production and marketing operations adopted with government support to hold low production costs and raise farm income.

4) Improve production techniques to raise yields — Under limited resources, technical innovation constitutes the primary force in agricultural growth. Technological progress has contributed greatly and will continue to contribute significantly to Taiwan's agricultural development. Emphasis will focus on varietal improvement, pest and disease control, and cultural techniques. But advances in this respect will have to depend upon competent personnel and generous financing.

5) Increase infrastructural investment — Experience has led us to believe that there is a close relationship between investment in public facilities and agricultural development. Availability of chemical fertilizer and high-yielding varieties does not necessarily mean increased production if there is no sufficient infrastructural support.

Despite heavy investment and significant progress in irrigation facilities in the past, continuous funding for them in the future is indispensable to assuring growth in farm production. Rural roads, electrification and communications also have to receive due attention in the allocation of funds.

6) Streamline marketing mechanism — As commercialization of farm products rises, marketing advances in importance. The orderly marketing of farm produce from producer to consumer deserves serious attention because of its extreme importance and its relative backwardness.

To protect the interests of both producer and consumer, the marketing system for farm produce must be immediately and thoroughly improved through such measures as setting up more markets to facilitate transactions, promoting cooperative marketing to beef up the bargaining power of the farmers, and strengthening the collection, grading, packing, processing, and

storage of farm products to enable the price system to function satisfactorily and hold low marketing costs.

7) Foster the welfare of the farmers — Agricultural modernization aims in the long term to improve the life and welfare of the farmers through increased production. In the modernization process, close attention should also be paid to continuously improving such services as education, health, water and electricity supply, and transportation in rural areas.

V. CONCLUSIONS

In a dynamic economic society as we live in, various systems and procedures must innovate constantly in response to changes in time and space. Innovation is not necessarily motivated by unsatisfactory existing systems, but by reaction to the progress of the times and the change of the environment. Agricultural modernization aims to promote constant innovation, which assumes progress.

Agricultural development in Taiwan with its remarkable achievements has laid a solid foundation for further success. But overall planning and *esprit de corps* must be always stressed and close watch kept on changes in economic conditions in a bid to further agricultural modernization.

Economic Research and Agricultural Sector Analysis to Support Agricultural Policy*

Yu-kang Mao**

I. INTRODUCTION

During the past 25 years, we have had some success with agricultural development, and our rural areas have undergone considerable change. Our economy in 1950 was predominantly agricultural. Rural people made up 53 percent of the civilian population, and farm workers accounted for 59 percent of the total labor force. Agricultural production provided more than 35 percent of the net domestic product.

Since 1950, crop production has more than doubled, livestock production has more than quintupled, and fishery output has increased by more than eight times. In aggregation, the total agricultural output in 1975 was 2.8 times that of 1950. The average annual growth rate of agricultural production during this 25-year period was 4.3 percent.

Higher production has required a substantial increase in off-farm inputs. The amount of chemical fertilizer used has more than tripled since 1950. There has been a comparable increase in the use of insecticides, and other modern supplies.

Power tillers have largely replaced water buffaloes on our farms today. First imported on an experimental scale in the early 1950s, the number of power tillers as late as 1965 was only about 8,700. By 1975, the number had increased to 41,200, one for every 20 farms.

Development has not changed Taiwan's traditional small-farm agriculture. In fact, the average farm size decreased from 1.37 hectares in 1950 to about one hectare in 1975. But compared with 1950, farm land is now more intensively cultivated.

Farmers' welfare, however, cannot be measured solely by production levels nor by the total income of farm families. Family budgets only partially reflect the availability of social services and amenities like medical care and education, transportation and communications, housing and electric power, and so on. More than

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95 percent of farm families now have electric power. Nearly half of all the farm houses in rural areas are built either of brick or reinforced concrete. Many new forest and rural roads have been constructed, while low-standard country roads have been paved with asphalt.

Also important is the opportunity for rural people, either as individuals or through democratic participation in group activities, to improve their living conditions. In this respect, our farm people have enjoyed notable improvements in the past 25 years.

Rural progress in Taiwan has been achieved largely by means of technological innovations and social justice measures, which have been introduced as a matter of development policy.

In contrast with many developing countries, the Republic of China did not take the "industry first" approach when it started to develop its economy in the early 1950s, even though at that time most development theories favored such a course. Instead, we have relied on agricultural development as a foundation for industrial growth. This is why rural development has received so much emphasis in our development planning.

II. PHASES OF AGRICULTURAL DEVELOPMENT

It is useful to examine agricultural development in Taiwan by classifying it into different phases according to their characteristics over the postwar period.[1] The 1946-1951 period was characterized by recovery and rehabilitation of agricultural development after World War II. From 1951 to 1960 was the period of further development after rehabilitation. In early 1960, the government adopted monetary and fiscal measures to accelerate economic growth, and which resulted in a turning point in Taiwan's economy. Taiwan's economy was shifted from an predominantly agricultural to one in which the industrial sector played a dynamic role. Generally speaking, from the early 1960's until 1968, there was a period of further growth in agriculture. After 1968, a drastic change of economic structure took place and for the first time rural areas were faced with a labor shortage problem. Moreover, the growth rate of agricultural output decreased, and agricultural development entered a new phase of adjustment.

1. Recovery and Rehabilitation Period, 1946-50

In the immediate postwar years, acute pressure on food prices threatened the livelihood of the people. Because of a large influx of migrants from Mainland

1) T. H. Lee and Y. E. Chen, Growth Rates of Taiwan's Agriculture, 1911-1972, JCRR, 1975.

China during 1945-50, population increased at an annual rate of 4.9 percent. Therefore, food price relative to general price level was very high. With favorable farm prices and continuous supply of inputs, agricultural production increased rapidly. By 1951, the agricultural output had surpassed the prewar peak.

Agricultural output between 1946 and 1951 grew at a rate of 10.2 percent a year. Four factors contributed to this rapid agricultural recovery and rehabilitation. They were: (1) rapid increase of labor input, expansion of crop area, and active promotion of multiple-crop diversification; (2) recovery of the production techniques, rehabilitation of irrigation facilities and reorganization of farmers' associations; (3) implementation of land rent reduction program in 1949 which stimulated tenant farmers to increase production; and (4) U. S. financial and technical assistance.

2. Continuing Development of Agriculture after Recovery, 1951-60

Agriculture continued to progress after its recovery. Despite limited land resources and small-size farming, agricultural output grew at a rate of 4.6 percent per year during 1951-60. Successful land reform, namely, the Land-to-the-Tiller Program, was the most important factor contributing to agricultural progress in this period. This program was launched at the beginning of 1953 and had produced desirable results. It strengthened the basis for more intensive use of both farm land and labor resource through the application of modern farming techniques, which included high-yielding varieties, chemical fertilizers, pesticides, and new cropping systems and patterns.

3. Further Growth of Agriculture during the Period 1960-68

Agricultural production had been growing rapidly since the early 1960's, although the growth rate was slightly lower than that in the previous period. As the economy became more and more sophisticated, many new and high-valued products were developed. These include mushroom and asparagus. With strong foreign demand, export of these commodities increased rapidly and helped to boost the level of farm income. However, by the latter half of the 1960's, a considerable outflow of farm labor had resulted in farm labor shortage. The situation was especially serious during planting and harvesting seasons. Consequently, farm wage rates rose substantially. In the meantime, significant changes in cropping systems and patterns also took place. Livestock and fishery production expanded notably along with the increase in per capita real income.

4. Sustained Development under Drastic Change of Economic Structure Since 1968

Since 1968, in spite of rapid expansion of livestock and fishery production, the growth rate of agricultural production continued to slow down owing not only to unfavorable weather but also economic factors, such as limited arable land, shortage of farm labor, relatively low profit of agricultural production. The multiple-cropping index began to decrease in 1969, indicating a tendency of less intensive use of farm land. The total planted area in winter crops (sweet potatoes, rapeseed, flax, and wheat) also showed significant decrease. The income of our farmers has lagged behind that of industrial and other workers. However, agricultural sector still provides sufficient rice for domestic consumption, raw materials for industry and earns foreign exchange by export of agricultural products.

In order to cope with hindering factors and to boost agricultural productivity, the Government of the Republic of China announced, in September 1972, accelerated agricultural development measures with US$50 million subsidy for a two-year period beginning in January 1973. The nine accelerating rural and agricultural development measures aim to lighten the farmers' burden and to increase in productivity. These include abolition of the rice-fertilizer barter system, abolition of the land surtax levied for education, relaxation of the terms of agricultural loans, improvement of agricultural marketing, strengthening of rural infrastructure, etc. The other two items would contribute to technical improvement and the rise of farm family income: the former measure is strengthening of agricultural research and extension, and the latter is encouragement of the establishment of factories in rural areas.

The agricultural problems which Taiwan is facing today are the problems of a higher development stage. These are new problems derived from structural changes of economy which occur inevitably as a result of rapid industrialization. These problems arising today are not unique in Taiwan, for instance, Japan had similar problems nearly a decade ago. Consequently, the Japanese experiences have been of great benefit to our policy making. It seems possible that some developing countries in Asia and the Far East will encounter similar problems in the future.

III. THE EMPHASES OF ECONOMIC RESEARCH IN DIFFERENT DEVELOPMENTAL PHASES

In Taiwan, agricultural economic research is independently carried out by government agencies and various academic and research institutes. Viewed from

the standpoint of economic development, these researches can be roughly divided into three stages. They are the period before 1960, the period during the 1960's and the period since 1970.

Before 1960 the emphases of government economic policies were placed on the efficient use of the factors of production, especially land and labor. Its purpose was to increase farm production and farmers' incomes. But this was also the period during which war damages from the Second World War was recovered and a new economic framework, after 50 years' colonial occupation, had to be established. Thus, in addition to economic analyses, efforts were also made to collect and compile basic economic data. Among the data compiled the following are the important ones:

(1) Production statistics:
Crop production.
Livestock production.
Fisheries production.
Forestry production.

(2) Cost: Cost survey for major crops is published annually.

(3) Price:
Farm inputs.
Farm products.

(4) Income: Farm income survey every five years since 1952, and farm record-keeping since 1953.

As far as economic research was concerned, its emphases during this period were:

(1) To study input-output relationships so as to ascertain an optimum crop system or the most profitable farm operation which can be used as a model for extension.

(2) To analyze and measure farm price fluctuations. This includes the study of price trend, seasonal patterns and cyclical price variations.

(3) Mainly based on farm record-keeping data, to examine individual farm household and regional farm economy. This approach attempted to discover from various farm business the strong and/or weak points which can be used as reference for farm improvements and policy decision.

During the 1960's, the effort to collect basic data was continued, but research emphasis was shifted somewhat due to changed economic situation. Largely as a result of expanded production and increased commercialization, marketing of farm products, especially in the domestic market, had become a problem. Agricultural

economic research during this period was therefore concentrated on the study of price and distribution of agricultural commodities. More specifically, the emphases were on:

(1) Domestic marketing channels for the major farm products, marketing margine and facilities

(2) Foreign market potential and exploration

(3) In-depth study on supply and demand of farm products, including consumption patterns, price and income elasticities, elasticity of substitution and long-term projection for food demand and supply

(4) Livestock production and the demand for imported feeds.

By 1970, largely because of rapid economic development, Taiwan's farm economy had undergone considerable changes. Labor surplus had disappeared and farm production had become increasingly market-oriented. On the other hand, however, the high growth rate in the industrial sector has made agricultural development lagged behind. Farm income has been low when compared with that of non-farm sectors. These situations have not only forced the government to reevaluate its policies but also led the economists to shift their attention. The research projects in the 1970's emphasized on the study of structural changes in the agricultural sector and how to adjust the sector to the growing economy.

Sponsored by JCRR, a series of studies on agricultural structural changes has been carried out. This includes studies on farm size, farm mechanization, farm labor migration, production infrastructures, marketing modernization, factor substitution between labor and capital, rural taxation, functions of farmers' organizations, food and fertilizer policy, farm credit system, etc. The results of these studies have been extensively used by the government in formulating what is now called the New Agricultural Policy which I have mentioned at the end of Section II.

It may be of your interest to note that JCRR has played a very important role in sponsoring agricultural research in Taiwan. It is not only a prime fund source but also an initiator of many research projects. Partly due to its close relationship with the Chinese Government that JCRR is able to sponsor projects which are practical and policy oriented. Agricultural economists in JCRR actually serve as a bridge between the government and academic economists.

IV. SECTOR ANALYSIS

1. The Objectives

A number of problems have emerged on the agricultural scene of Taiwan as a

consequence of the change in its economic structure in recent years. To meet the demand for grains by an expanding population and to mitigate the effects of worldwide food shortages, regional agricultural planning is considered to be necessary, for it is one of the ways to make the best use of the limited resources. In working towards this goal, the JCRR, besides carrying on island-wide surveys on basic resources and collection of required information in cooperation with the agencies concerned, has already engaged itself in a pilot project of regional agricultural planning in Pingtung county in southern Taiwan where the surveys have been completed.

Generally speaking, regional planning in agriculture aims mainly at achieving the following:

(1) Making an inventory of available agricultural resources—their uses and potentialities—in the interest of formulating medium-and long-range agricultural development plans.

(2) Optimum utilization of all available resources to turn out the largest possible production.

(3) Integrated agricultural production.

(4) Coordination on distribution of land between agricultural and non-agricultural uses.

2. Collection and Analysis of Basic Data

(1) Aerial survey of paddy fields

The primary purpose of aerial survey of paddy fields is to gather information on actual rice acreage and other land uses required for integrated agricultural planning. Since July 1974, JCRR together with the Department of Agriculture and Forestry of Taiwan Province has sponsored a paddy field aerial survey program under which aerial photos have been taken. These photos, together with soil and irrigation data have been used to produce maps on the scale of 1 : 25,000 and to calculate acreage by categories of land uses. The results so gained will make up a sort of data bank for paddy fields. The survey for the Pingtung area had already been completed and the whole islandwide program was accomplished at the end of June 1976.

(2) Survey and planning for slopeland development

To get a complete grasp of the agricultural potentialities, a survey program on all slopeland in Taiwan was initiated in July 1974 by JCRR and the Provincial Mountain Agricultural Resources Development Bureau. A pilot project was started in the Pingtung area to produce maps on the scale of

1 : 25,000 and 1 : 50,000. The maps were made up with the information from the photos and land use classifications and capabilities. Meanwhile work has also been to collect information on soil, water and other conditions in slopeland areas where it is generally considered to be most possible for development. The whole program will be completed by the end of 1977.

(3) Aerial survey of forest resources

To obtain all basic forest data required for formulating a consolidated forest management program, a program which was scheduled to be wound up at the end of 1976, was jointly set up by JCRR and the Provincial Forestry Bureau in 1972 to conduct a survey of all forest lands by means of aerial photos.

(4) Non-urban land use zoning and codification

To assure reasonable distribution of land between agricultural and non-agricultural purposes, a pilot program for zoning and codification of non-urban land use for the Pingtung area was launched in December 1974 by JCRR and Taiwan Land Bureau. With basic data and conclusions reached among the agencies concerned, the non-urban land in Pingtung was divided into eight zones for special agriculture, general agriculture, industry, rural community, forestry, slopeland conservation, recreation and others, respectively. The non-urban land was at the same time classified into 18 uses such as arable and pastoral, construction, forestry, fish culture, etc. Such zoning and codification will serve as an important basis for regional agricultural development planning.

(5) Large-scale base maps

Being not on a large scale, the presently available maps are not adequate for use in agricultural resources survey. To facilitate such survey and to supply basic data for other planning purposes, a program was jointly established by JCRR, Ministry of Interior and the Taiwan Forestry Bureau in July 1974 to produce, by means of aerial photos, orthophoto maps on the scale of 1 : 5,000 (of plains) and 1 : 10,000 (of slopeland). The mapping program is scheduled to be completed in five years.

(6) Remote sensing

Remote sensing is an joint effort of employing modern sensors, data processing equipment, information theory and processing methodology, communications devices, space and air-borne vehicles for the purpose of carrying out aerial or space surveys of the earth's surface. The data so gained

will provide accurate and timely information which is useful for agricultural and other important economic decisions. A remote-sensing program has been put into practice by JCRR and other agencies concerned to help establish a basic-data bank for agricultural development.

3. Planning Methods and Procedures

(1) Area-by-area mapping of current land use based upon aerial surveys:
With each county as a unit, township-by-township mapping on the scale of 1 : 25,000 is made on the basis of aerial surveys of paddy fields and slopeland. A county-wide land-use map is also produced on the scale of 1 : 100,000.

(2) System analysis for regional agricultural planning

For the specific purpose of promoting regional agricultural planning, JCRR in 1974 secured the cooperation of the University of Hawaii in applying system design and linear programming technique to working out, by the use of the computer, the best possible farming types for different regions, which will serve as a basis for planning specialized production areas. Data resulting from survey on the slopeland and paddy fields in the Pingtung area were thus put through the process of system analysis to remedy defects in past land use and labor distribution by working out cropping acreage and systems adaptable to various regions. Computer models will hereafter be used to work out suitable adjustments based on alterations in basic data (water, land and manpower resources), policy, production value, etc.

The general structure of the model is presented in Table 1. There are 10-day period accountings for two major resources: labor and cropland. These accounting rows and columns are not explicit in Table 1 for the simplicity of presentation. In addition, there are minimum requirements for rice production expressed in terms of farmland for rice and upper or lower bounds defined for major crops included in the program. An activity is defined as a specific method or process of producing one or more of commodities. For example, each activity unit (hectare) of rice grown on farmland in a period reduces the 'a' units supplies of labor during the appropriate period and also withdraws one hectare of total farmland for the period the rice crop occupies the farmland. Each unit of the activity also adds one hectare of farmland for rice to fulfill the requirement of rice acreage on the constraints.

Table 1. Generalized Matrix of the Model Used in Taiwan

Resource supplies or constraints	Types of constraints	Crop production activities
Labor	$\geq$	[a]
Total farmland	$\geq$	[1]
Farmland for rice	$\leq$	[1]
Bounds for major crops	$\leqq$	[1]
Obj. function		nr

In the model, capital required for the production is assumed available in unlimited supply. The cropland is classified into five land types. Except rice, the demand for each crop is approximated by bounds. All crops appear as competitors. However, given the minimum constraints of farmland for rice, the crops exeluding rice must compete for the rest of labor and land resources required for the rice production. Therefore, most emphasis appeared in this model is devoted to modeling time of planting or production scheduling. The objective function of the program is to specify the annual pattern of multiple-cropping consistent with the 10-day-period supplies of labor and cropland. The objective function is to maximize total farm profits under the assumption of constant farm level prices. The optimal solution of a program determines (A) acreages of all the specified crop activities in a region, and (B) a by-product of programmed shadow prices of labor and farmland as a result of scarcity.

(3) Township-by-township mapping depicting future development

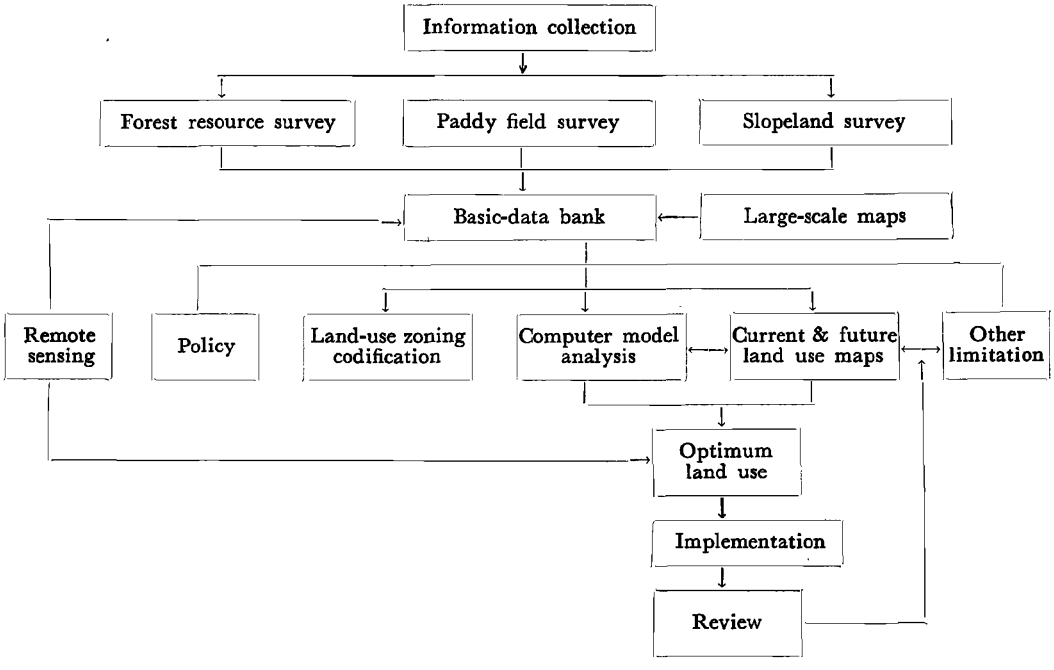
On the basis of current land use conditions, cropping systems and principles of regional development, specialists from various agencies concerned worked out a township-by-township planning for future agricultural development and have 1 : 25,000 maps produced in line with the planning. Meanwhile, reference should be made to data about soil, irrigation and land use limits used in paddy field and slopeland surveys for computing acreage for various crops and cropping systems. The results so gained will at last be used for overall planning and economic-benefit estimation.

(4) Islandwide planning and zoning adjustment

In principle, agricultural planning should be integrated and carried out islandwide at once to obtain a well-balanced understanding and assessment before regional planning is implemented. However, as the required surveys were first completed in the Pingtung area, actual planning for this area ensued on a pilot basis. Consequently planning is set on a county-by county course. Any adjustment and correction therefore will have to be

made only after islandwide surveys have been completed. Such future adjustment and correction, if any, will be only to a small extent because planning has to take into consideration such prerequisites as government policy, proper land use areas and regional planning principles. As a matter of fact, any future change in land resources, labor force, and demand will necessitate adjustment in integrated agricultural planning from time to time.

The procedure of regional agricultural planning in Taiwan may be summarized in the following chart:



4. Remarks

The system analysis model used in the regional agricultural planning in Taiwan is rather a simple one. It indicates the optimum crop pattern of the region under the given conditions without taking into consideration of the competition of other regions. Many subjective upper or lower bounds are placed to the production of major crops. Therefore, the result can only be considered as a tentative one. In order to improve the model, a better regional programming model should be developed in Taiwan. Regional programming, as its name implies, is concerned with determining feasible regional programs (resource allocations, production plans) that are optimal with respect to a stated objective. The basis for a regional program model surrounds the definition of a set of regions in an economy consistent with climate, soil, farm types, marketing structure, and other economic characteristics

required to describe the resources available, production techniques, and interactions of economic variables within the region and with other regions to be examined. This concept leads to requirement of the carefully delineated region which assumes a unit of an integrated economy and, hence, the model constructed is interregional (or even intraregional) in character. If the economic development is associated with the structural changes, the interregional structural changes often occur when a development policy affects the regional comparative advantage, either penalizing or supporting the production possibilities in the region. Therefore, a marketing system between each pair of regions must be constructed to provide the channels for distributing commodities through regions, form and time activities of transportation, processing, and storage, etc. An agroeconomic zone model or a crop model for a county is merely a building block of the interregional model. Possible regional and firm adjustments according to historical farm production patterns must be reflected in the model structure to allow the possible inter-actions consistent with the concept of interregional character described above.

The process of modeling involves then the operation of the interregional system. The solution results of a region, a sub-regional or sector model can be checked against the existing conditions, which should provide information indicating how the models work. The proper delineation of regions, production, processing, and marketing activities can increase the reliability of the system. Failure to include the relevant variables could restrict the possibilities open to the system as it adjusts. The validation of the model is therefore a prerequisite before the policy analysis can be made.

The policy analysis is estimating the economic consequences of undertaking stated policy alternatives. In each alternative, the output of the analysis consists of predictions of several performance variables which might include local, regional and national estimates of production of crops and livestock, farm and retail prices, farm income, resource use, exports and imports, interregional movements of farm commodities, food consumption level, etc.

The policy analysis involves two important tasks: (1) design the implementation plans for policies and (2) transform the analysis between policy alternatives.

The first task is a very important one pointed out the outset for policy analysis leading to action programs. Such action programs often require many kinds of skills and technical knowledge, and it should not be presumed that economists are also expertise in this area. A price support policy or a credit expansion scheme would probably require skills of economists. But economists are unlikely to be the best qualified people to specify all details of, for example, a program to

increase yield by promoting fertilizer application, a seed multiplication program, or a program to introduce crops with shorter growing seasons so as to foster multiple cropping (as needed in the crop model of Taiwan). Economists may be expected to work jointly with other subject matter specialists in formulating alternative policies to ensure that the implementation plans can be evaluated and compared within some specific framework of economic analysis in the model structure.

The second task is also related to the implementation plans with respect to the time path of planning. The programming models are usually normative in nature. The normative system is a useful and versatile tool to analyze impacts of alternative policies but the system provides little or no information on how the transformation can be accomplished from one to the other alternatives during the transformation period. In other words, solutions of the model do provide a large amount of information about the direction and possible magnitudes of the impacts of a particular policy but provide no direct time path of transformation between policy alternatives. A model could be formulated to follow the transformation through time (multiple year solutions) for the planning purpose but is more complicated for transformation analysis.

In addition to improve our regional planning model, an econometric model of agricultural sector for the purpose of planning is also to be developed in Taiwan. In recent years, highly sophisticated econometric models have been devised for agricultural planning within the context of overall economic development in many countries. But Taiwan's agricultural planning had to be worked out without the benefit of these tools, for they have not yet become available. Agricultural planning in Taiwan was worked out by conventional method, it was chiefly through close cooperation among the agencies and organizations concerned and coordination of their programs, projects and budgets. The conventional method was useful in the early stage of development for its simplicity and understanding by decision makers. As agriculture developes, the inter-sectoral relationship and the agricultural problems have become more and more complicated, the conventional procedure and method of planning have been found inproper and inefficient. Because there is no way to analyze systematically the consistence of the plan, the impact of alternative policies and the required measures to achieve the planned targets.

Agricultural Planning and Development Strategy of Taiwan*

Yu-hsin Kao**

I. INTRODUCTION

Taiwan has been successful in agricultural development. During the past 25 years, agricultural production has been increasing at an average annual rate of 4.5 percent. At the same time, Taiwan has also had some success with population control. Its average annual population growth rate has been reduced from 3.3 percent in the 1950s to under 2 percent for the past 5 years. As a result, per capita production of agricultural commodity has increased.

The progress in Taiwan is of particular significance when the following two factors are taken into consideration. First, Taiwan is a small island with high population density. Out of the total area of 35,981 square kilometers (about 13,890 square miles), two-thirds is mountainous terrain. Only about 24 percent of it is actually under cultivation. Secondly, in comparison with other developing countries Taiwan has done better than most of them. For developing countries as a whole, the U. N. Food and Agriculture Organization reported in 1973 that agricultural production had increased at a rate of only 2.8 percent a year from 1961 to 1971. And almost half of the 92 developing countries for which FAO computes production index numbers experienced a drop in per capita production.

The advance in Taiwan's agriculture has also helped to provide capital for its industrial development. As a result, Taiwan has changed from a predominately agricultural economy to a semi-industrial one. Agriculture's share of domestic production declined to 13 percent in 1976 compared to 36 percent in 1952, while industry's share of domestic production increased from 18 percent to 39 percent over the same time.

Probably the most important result of Taiwan's agricultural development is the improvement in farmers' living condition. Comparing the average standard of living in 1976 with that of the 1950s, there is a marked improvement. Death rate dropped sharply, indicating improved nutrition, sanitation, and health services. Brick

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houses with tile roofs replaced plaster and bamboo houses. In the 1950s there were no television sets and only a few radios in rural Taiwan; by 1976 most rural households had televisions and electric appliance.

Agricultural development is a continuing process. The contents of an agricultural development program are determined by many factors—the country where it occurs, the stage of development within that country, the skill and wisdom of its planners and administrators and the extent to which its citizens are informed, consulted and encouraged to participate. Therefore, the development model of Taiwan can hardly be considered as a universal pattern and can be transferred to other countries. However, the process Taiwan has undergone through and the strategy Taiwan has adopted may be of some use for the countries that face similar problems as Taiwan.

II. PLANNING FOR DEVELOPMENT[1)]

Highly sophisticated econometric model has been devised in recent years for agricultural planning within the context of overall economic development. But Taiwan's argicultural development had to be undertaken without the benefit of these tools, for they had not yet become available. Agricultural planning in Taiwan has been carried out chiefly through close cooperation among the agencies and organizations concerned and coordination of their programs, projects and budgets. The principal instrument has been a succession of Four-year Agricultural Development Plans formulated within the framework of Taiwan's overall economic planning.[2)]

The guide line for Taiwan's economic planning is a balanced growth between the industrial and agricultural sectors, so that one would not be developed to the detriment of the other. If all the resources had been given to the agricultural sector, industrial development would not have occurred. In the same way, if agriculture had received too small a share of the resources, limited production would have caused price to increase, and industrial development would have been inhibited. To put the goals of Taiwan's development in a nutshell, it is to improve the well being of the rural population and to facilitate the use of surplus agricultural capital to promote industrial development.

1) A good reference for Taiwan's agricultural planning is Dr. T. H. Shen's book *Agriculture's Place in the Strategy of Development: The Taiwan Experience* (Taipei, Joint Commission on Rural Reconstruction, 1974).

2) Taiwan has developed an input-output model. Information from that model has been used in formulating recent economic development plans.

The first four-year economic plan was started in 1953 and concluded in 1956. To administer the first four-year plan, the government established in 1953 the Economic Stabilization Board (ESB), a policy-making body of ministerial-level officials chaired by the Premier of the Executive Yuan. Under ESB, a separate Committee known as "Committee D" dealt with agricultural matters.

ESB was inactivated in 1958 and the Ministry of Economic Affairs was made responsible for the Second Four-year Plan. Committee D was renamed the Agricultural Planning and Coordination Committee but continued to perform the same functions.

In 1963, a Council for International Economic Cooperation and Development (CIECD) was established and put in charge of overall planning. The Joint Commission on Rural Reconstruction, a Sino-American bilateral organization, assisted in drawing up the agricultural plans.

The CIECD was reorganized into an Economic Planning Council in 1973 carrying out the same kind of activities as before. JCRR continued to be responsible for agricultural planning.

The objectives of the first four-year agricultural development plan were (1) to increase food production, (2) to reduce agricultural imports, (3) to improve the livelihood of the farmers, and (4) to maximize the farmers' contribution to the national economy. These objectives have continued to guide Taiwan's agricultural development policy throughout the ensuing years, with shifts in emphasis sometimes to reflect changing economic and social conditions.

In addition to increase in food production, technical improvements were also accomplished in land use and irrigation during the first planning period. Succeeding plans continued to stress increase in agricultural production with special emphasis on exports. The second and third plans (1957-60 and 1961-64) spelled out the need for resource development as a means to increase production.

The same general objectives were again stressed in the fourth plan (1965-68) with the additional aim of creating employment for rural labor and reducing the pressure of farm labor on the limited land resources.

It is worth pointing out that the production target for each plan was not a computer output, nor was arbitrarily determined by the high-level planners. It was a result of repeated discussions among government agencies of various levels, and local people were also consulted. This process was repeated each year, and adjustments were made to reflect changing production and market situations at home and abroad. These adjustments were especially important for such export commodities as sugar, bananas, pineapples, mushrooms, and asparagus.

The impact of rapid industrialization on Taiwan's agricultural sector was definitely being felt by the time of the fifth four-year plan (1969-72). The plan called for continuing to increase agricultural production with special emphasis on agricultural research and farm mechanization. It also called for increasing agridultural investment, expanding markets, stabilizing prices, and increasing farm income by reducing production and marketing costs.

During the fifth planning period "a new agricultural policy" was put into effect to accelerate Taiwan's agricultural development and redress the deteriorating economic positon of the rural population. The new policy sets forth 14 measures and nine points to raise farm output and income by lowering farm costs, improving rural infrastructure, increasing production efficiency and strengthening agricultural financing and marketing. The sixth four-year plan (1973-1976) continued to carry out the new policy set forth in the fifth period.

III. DEVELOPMENT STRATEGY[3)]

To increase agricultural production and to fulfill the targets of the development plans, the government first designed a strategy to motivate farmers' incentives. The essential conditions for a positive attitude toward expanding production are political and monetary stability and institutional improvement. Factors which can serve as incentives include prices, land tenure, marketing facilities, credit and tax. Some of these factors, such as transportation, storage, and communication are a basic part of a marketing system and can be improved only through economic development. Other factors, however, are primarily controlled by the government and can be adopted to meet various goals.

Agricultural development involves many aspects, and the aspects involved are very much interrelated. Consequently, the strategy for development must be comprehensive and the inter-relationships among the various factors must be taken into consideration.

In the text which follows the writer will describe briefly Taiwan's experience in agricultural development over the past years—the measures Taiwan has taken and the results they have produced.

Land Reform Program

For an incentive method to be as effective as possible, the economic benefit from increased production must go to the cultivator of the land. In some cases, this means that the land ownership structure must be changed to some extent.

3) Dr. Y. K. Mao, "Rural Development Strategies in Taiwan." *Proceedings of the Third Asian Pacific Social Development Seminar,* Cultural and Social Center for the Asian and Pacific Region, Seoul, Korea, 1976.

In the immediate postwar years, farm population in Taiwan constituted more than 50 percent of the total population. The pressure on land was high, and the average farm size was very small. Moreover, many farmers on this island did not even own the small pieces of land which they cultivated. They were merely tenants under the age-old tenure system.

The unequal distribution of land ownership was a deeprooted social anomaly that had entrenched itself as an institution. With monopolistic power in their hands, the landlords could demand exorbitant payments for the right of tilling their land. Thus, rents were at least 50 percent of the crop harvest. In addition, tenants in most cases had to bear variable costs. To lease a piece of land they had to pay a rent deposit, and to keep it they had to renew it every year. In a situation like this it was naturally difficult to motivate farmers to improve farming techniques to increase their production, and the results were discontent and unrest in the rural areas.

To redress this situation, land reform was the first measure the Chinese government took to promote agricultural development.

The land reform program was introduced as a means of fulfilling a policy of allowing farmers to own the land they tilled and enjoy the fruits of their labor. The program had three stages: rent reduction (1949), sale of public land (1951) and land to the tiller (1953).

In the rent reduction stage, emphasis was placed on two aspects: reduction of rent and security of tenancy. Under this measure, farm rental rate was set at 37.5 percent of the annual main crop yield, and the tenure of lease was prolonged to a minimum of six years.

The sale of public land was used by the government as a demonstration of its interest in the land reform program. The price of public land offered for sale was fixed at 2.5 times the value of the annual main crop yield. The purchase price was to be paid in 20 semi-annual installments. During the ten years of land price payment, the tenant purchaser's annual financial burden including the installment payments and farm land tax was less than the "37.5 percent" farm rent paid by tenant farmers on private lands.

Following the sale of public land, the government started the final phase of land roform, known as the land-to-the-tiller program.

Under this program each landlord was allowed to keep three chia (about 2.907 ha.) of medium-grade paddy field or twice that much dry land. Holdings exceeding

that limit were purchased by the government. Land so purchased was resold by the government to tenant farmers who had been tilling them.

As in the case of the sale of public land, for each grade of land the price was set at 2.5 times the value of its annual main crop yield. The landlord was paid 70 percent of the land price with land bonds and 30 percent with stocks of government owned industries. This kind of payment arrangement forced the landlords to shift their investment from land to industry.

The benefits of the rural land reform program are many. Needless to say, a direct impact has been a radical change in the tenure system. After the program, farm families owning all or part of the land they tilled increased from 61 percent to 88 percent of the total. Tenant families in the whole province decreased from 39 percent to 12 percent of the total number of families.

Other benefits of social and economic nature can also be observed. On the economic side, land reform has given a great incentive to farmers, which has facilitated the successful implementation of various agricultural programs. As a result of this, great improvements have been made in Taiwan's agriculture. Probably because of the "theory" that ownership can turn sand into gold, Taiwan farmers worked much harder after land reform. The index of multiple cropping shot up from 172 in 1953 to 190 in 1966.

On the social and political side, after land reform, farmers were fed and clothed better and many of them started to build and repair their houses. Since land is the major source of farm income, land reform has also played an important role in the redistribution of income, which in turn has brought social justice to the rural areas.

Land reform has also brought farmers into community activities. They now show pride of ownership and pride in their community. Many have run for and won local public offices. With this improved social and political status of farmers there has come a feeling of responsibility and better citizenship.

Modern Inputs and Adaptive Research

To support the aspiration for increasng agricultural production, new technology and modern farm inputs are required. The most important modern input is chemical fertilizer that has played a very important role in the increase of crop yield. In the meantime, new technology has been introduced to field cultivation and experimental research.

There are many agricultural research institutes in Taiwan. Most are govern-

mental agencies carrying on both fundamental and applied research in crop production, forestry, fisheries, livestock and food processing. Professors at the agricultural colleges also conduct research in cooperation with the research institutes.

Technological innovation has been a prime mover in Taiwan's agricultural development. According to a study made in 1968 by Dr. Y. T. Wang, now Secretary-General of JCRR, two-thirds of the increase in Taiwan's agricultural production could be attributed to technological improvement, and one-third to the increased use of farm inputs.[4)]

Farmers' Organization

Technological progress alone is not sufficient to solve the problem of agricultural development. It also calls for organizational support. The most important farmers' organization is the farmers' association. It is a multipurpose cooperative organization. Its main function is to help its members to solve their farming, financial and marketing problems. It also serves as a bridge between the farmers and the government.

The farmers' association in Taiwan is organized on three levels: provincial, county and township. At present, there are a total of 294 farmers' associations, of which one is the provincial association, 20 are city associations, and 273 are township associations.

The township association is the key link in the whole system of farmers' association. It is in direct contact with the farmers and serves them in various ways.

As the name indicates, Taiwan farmers' association is an organization of the farmers. Its major services are extension, credit and marketing.

Other farmers' organizations include irrigation associations and marketing cooperatives. The irrigation associations were organized to operate irrigation facilities and to maintain orderly water distribution. It also assists the government in planning and implementing new irrigation projects. Most marketing cooperatives in Taiwan are engaged in the marketing of fruits. Their major business concerns bananas and oranges.

Farm Extension

To develop new knowledge, ideas and practices in agriculture is not eoough. They must be diffused and put to use in actual farming situations. This is usually

4) Y. T. Wang, *Technological Change and Agricultural Development in Taiwan,* 1946–1965, JCRR Economic Digest Series No. 19, 1968.

done by means of agricultural extension, which serves as a bridge between agricultural research and field application of new farming techniques.

In Taiwan, agricultural extension services are provided by the farmers' associations. Since 1952, an agricultural extension section has been operating in each township farmers' association with an average of six extension agents.

Farm extension service is performed by the farmers' associations in close cooperation with the district agriculrural improvement stations. To render effective assistance to the farmers, most of the activities conducted by the extension agents are channelled through the farming study groups organized at the farm level. The subjects studied by these groups include cultivation, farm machinery, application of fertilizers and agricultural chemicals.

Farm Credit

Modern input means to some extent higher production cost for the farmers, which in turn means a heavier financial burden. To relieve or at least to lessen their financial constraint, farm credit is definitely needed. Or it is a necessary condition for farm modernization.

Farm credit service in Taiwan is performed by the credit department of the township farmers' associations. The department accepts savings deposits from and extends loan to its members. Most of the loans extented are for production purposes which include the purchase of farm inputs and the improvement of land and facilities. The principle of supervised credit has been applied to some loans. The main sources of lending funds of farmers' associations are the deposits of their members. Borrowings from the government and banks make up the seasonal shortages.

Besides the credit provided by the farmers' associations, there are other financial institutions which do business with the rural people. The Taiwan Cooperative Bank, the Land Bank of Taiwan, and the Farmers' Bank of China are the major ones. They all have branch offices in the rural areas and provide both short-term and long-term farm loans. But farmers usually feel more at ease in discussing their financial problems with a staff member of the farmers' association than with a professional banker. Therefore, some of the loans provided by the banks are channelled through the farmers' associations.

Pricing of Farm Products

Although this is the last measure to be discused in this paper, it does not mean that this is the least important one. In fact, many economists argue that

a profitable price is the most effective incentive for farmers to increase agricultural production. Without profit, the farmer will be unwilling to purchase modern inputs and take the risk necessary to increase his production.

Government intervention in market pricing has long been a debating problem, but the Chinese government in Taiwan strongly feels that the reduction of price uncertainty is equally as important as the level of prices. In Taiwan, prices for 60 percent of the farm production are determined by the market without government control; the prices rise and fall in accordance with supply and demand. For certain commodities, however, the government intervenes to keep the prices stable. Methods used by the government in influencing the prices of various commodities include:

—Free market pricing with government intervention. This method has been applied to major farm products such as rice. For commodities under this program, their prices are allowed to fluctuate only within the limits considered reasonable by the government. For example, if the price of rice exceeds the upper limit, the government will release its stocks on the open market until the price returns to a reasonable level.[5] Contrarily, if the price falls below the lower limit, the government will enter the market to purchase rice.

—Guaranteed pricing. To encourage sugarcane production, a guaranteed price is announced before the planting season. Farmers are therefore assured of a certain minimum price that he will receive for his crop.

—Contract pricing. To ensure supply of raw materials for the processors and to stabilize farmers income, the government encourages canneries of mushrooms and asparagus to enter into contract production. Collective bargaining between the canners and the farmers, with government arbitration, determines the prices to be paid for the commodity, and contracts between the canners and farmers are signed before the crop is planted. Modified contract pricing is also used for bananas and pineapples.

IV. CONCLUSION

Agricultural planning in Taiwan has relied on practical experience and close coordination among the agencies concerned. So far it has been quite successful. In recent years, however, we have striven to incorporate modern planning techniques with our planning mechanism. In addition to the input-output model I

5) In 1973 a guaranteed price for rice was established. But since the government does not have enough money to buy up all the excess supply, the market prices have been lower than the price guaranteed.

mentioned earlier, a regional planning model has been developed. Its primary purpose is to make best use of resources for agricultural production.

The measures discussed in this paper by no means cover all the measures Taiwan has taken to develop its agriculture. But they are the measures which the author thinks have contributed most to Taiwan's agricultural development. In implementing these measures the Chinese government has paid very much attention to the interrelationships among them, since they are all an integral part of Taiwan's overall development program. Without good coordination in action and timing, the effect of the development strategy would have been much less effective.

The Accelerated Rural Developmemt Program in Taiwan*

Terry Y. H. Yu**

I. INTRODUCTION

Agricultural production in Taiwan in the past was marked by a high degree of diversification, taking advantage of the abundant farm labor supply to raise land productivity. In recent years, due to the rapid growth of the industrial and commercial sectors, the basic structure and development pattern of agriculture have shifted significantly from labor intensiveness to more capital use. To solve the problems posed by the continuing exodus of the rural labor force, rising farm production costs and the relative decline of farmers' income, measures are being taken, among others, to enlarge the farming scale, extend integrated operations and promote farm mechanization so as to increase labor productivity.

In November 1969, the Government announced a new agricultural policy designed primarily to reduce the cost of production and to increase farmers' income. The policy set forth 14 measures for gradual implementation. A number of action programs for carrying out that policy have since been developed and put into operation. These action programs include: (1) Reduction of fertilizer prices in March 1970, and again in February 1971; (2) establishment of the Agricultural Financing Coordination Committee in June 1970; (3) the improvement of agricultural marketing program approved in November 1970; (4) reduction of tax burden on farmers in August 1971; and (5) the Promotion of Farm Mechanization Program launched in 1972.[1)]

But it was soon felt that although these programs would produce the desired results in the long run, they should be accompanied by measures of a more intensive nature in order that the immediate problems of the farmers could be solved. Consequently, Premier Chiang Ching-kuo in a statement made on September 27, 1972 announced that the Government had decided to concentrate its efforts on nine

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1) For details of these programs, see T. H. Shen, *Turning Point in Taiwan's Agricultural Development Policy,* reprinted from *Agricultural Development on Taiwan Since Warld War II.* Mei Ya Publications, Inc., Taipei, Taiwan, 1972.

measures, in addition to carrying on the programs already in progress, in a drive to accelerate rural and agricultural development. Thus, a program which is comparable in significance to the land reform program of the 1950's was set in motion. The measures included in what has been known as the Accelerated Rural Development Program (ARDP) are as follows:

(1) Abolition of the rice-fertilizer barter system
(2) Abolition of the educational surtax on farm land tax
(3) Easing of the terms of agricultural credit
(4) Improvement of agricultural marketing
(5) Strengthening of rural infrastructure
(6) Acceleration of the extension of integrated use of improved cultural techniques
(7) Establishment of specialized agricultural areas
(8) Strengthening of agricultural research and extension
(9) Encouragement of the establishment of new industries in rural areas.

Financed initially with a special government grant of NT$2 billion (equivalent to US$52.6 million at current exchange rate of 38 to 1), the program has improved farming conditions in many regions of the island and provided additional employment opportunities for rural people mainly through expanded public investment in the construction of the rural infrastructure. The program was started in January 1973 and was originally scheduled to be concluded at the end of 1974. However, in view of the need for more concentrated efforts to lay a good foundation for modernization of the agricultural sector, the Government decided to extend the program indefinitely with financial support for it to be made available on an annual basis. For the first half of 1975, NT$500 million in grant funds was appropriated from the National Treasury. For FY1976 (covering the period from July 1975 to June 1976) another NT$2 billion was made available from the special budget of the Ministry of Economic Affairs (MOEA). As was the case with previous agricultural development programs, the Joint Commission on Rural Reconstruction (JCRR) has been entrusted to plan and administer the use of the funds in cooperation with other agencies concerned. Emphasis is placed on projects of proven value as well as activities which are capable of generating quick results to benefit farmers in impoverished areas.[2)]

II. ORGANIZATION AND PRINCIPLES OF OPERATION

The ARDP is an integrated project-based action program. It is oriented to

2) For allocation of ARDP grant funds see *JCRR Generd Report*, No. 30, 1975.

improving the rural and agricultural environments as well as farmers' living conditions. Various agencies are involved in the execution of the program. In order to facilitate program implementation, following the premier's announcement, a series of meetings were held by agencies concerned, including MOEA, JCRR and the Taiwan Provincial Government, to discuss the procedures of implementation. The major decisions reached and the guidelines laid down at the planning sessions are as follows:

1. Organization

(1) A national planning committee was organized which had as its members the Minister of Economic Affairs, the Minister of Finance, the Governor of the Central Bank of China, the Secretary-General of the Executive Yuan, the Director-General of the Directorate General of Budget, Accounting and Statistics, the Chairman of JCRR, Chairman of the Economic Planning Council, the Governor of Taiwan Province, and the Mayor of Taipei Special Municipality. The Minister of Economic Affairs serves as convener, and the Secretary-General of JCRR as executive secretary.

(2) At the operating level, a working committee each was established by the Taiwan Provincial Government and the Taipei Municipal Government, with the heads of their departments concerned as members and their secretaries-general as conveners.

(3) The funds of the government grant were allocated through JCRR and used under the guidance of the national planning committee.

2. Principles of Operation

(1) All the projects under the program should be developed in accordance with the nine measures as announced by the Premier.

(2) As far as possible, the projects should be implemented on a regional basis in selected localities, with top priority given to low-income areas. Attention should be paid not only to carrying out each project to its completion, but also to coordinating the various projects in such a way as to bring them into a complementary relationship with one another so that the effects of integrated development can be achieved.

(3) Emphasis of work should be on the regional improvement of the basic structural conditions of production, raising of production efficiency, and inducement of more private investments from the farmers. Direct subsidies to individual farmers should be avoided as much as possible as this program is not a relief operation.

(4) In the case of those activities which have the potential for further development, it is important that the farmers should be able to carry on the work on their own initiative after completion of the projects.

(5) Provisions should be made for the proper maintenance and operation of the infrastructural facilities so as to assure long-term benefits from such projects.

(6) The local governments, farmers' organizations and individual farmers should be encouraged to participate actively in the implementation of the various projects. When necessary, a local government may be asked to contribute matching funds for a project according to its financial ability.

III. FRUITION OF THE PROGRAM

A total of 801 projects involing NT$4,496 million in subsidies were approved during the three and a half years from January 1973 to June 1976. In addition, local government appropriated a total of NT$1,227 million to match the subsidies from the Central Government. Business and farmers' organizations also contributed NT$191 million for the projects, and the amount contributed by participating farmers was estimated at NT$1,033 million. All these matching contributions may be looked upon as "induced investments". The total cost of ARDP for the period under review thus exceeded NT$6,947 million, of which the participating farmers shared about 15%, compared to 64% grant-in-aid by the Central Government and 18% contributed by local governments. It is clear from its fund allocation that ARDP is a joint venture in which both government and the farmers must actively participate.

1. Major Achievements

(1) Abolition of the rice-fertilizer barter system: With the measure brought into effect in January 1973, the farmers have been able to get all the fertilizers they need for their rice crop in the form of a loan and repay it after harvest.

(2) Abolition of the educational surtax on farmland: The farmers' annual tax burden has been lessened by about NT$88 million since this surtax was abolished in the second crop of 1972.

(3) Easing of lending terms of agricultural credit: To support the ARDP, bank loans totaling NT$2.7 billion were extended to the farmers during the three and a half years according to their actual production needs. No upper limits were set on the amount of lending, and the borrowers were not required to put up extra securities beyond the movables or immovables which were purchased with the loans.

(4) Improvement of agricultural marketing: Efforts in this regard centered on cooperative marketing of hogs and vegetables, modernization of marketing facilities, and establishment of a market information reporting system. During 1973-1974, more than 440,000 hogs were supplied through the FA cooperative marketing system to the Taipei and Keelung areas, an increase of 67.6% as compared with pre-ARDP years. The quantities of fruits and vegetables supplied daily to the Taipei area also increased after the operation of the Taiwan Fruit and Vegetable Marketing Corporation.

(5) Strengthening of rural infrastructure: The items of work completed during the three and a half year period included construction and repair of 47 kilometers of sea dikes on the west coast and more than 10,000 meters of levees along the Choshui and Peikang rivers, planting of 680 hectares of seacoast windbreaks and 5,500 kilometers of farm windbreaks, construction and repair of irrigation and drainage facilities for more than 644,000 hectares of farmland, reclamation of 679 hectares of tidal lands, construction of 505 kilometers of mountain feeder roads and simple water supply system for 207 villages, improvement of environmental sanitation in 54 townships, construction of 13 fishing harbors, and development of more than 12,000 hectares of slopelands for farming purposes.

(6) Promotion of integrated use of improved cultural techniques and farm mechanization: During the period, an additional 145,000 metric tons of brown rice was harvested as a result of the extension of the integrated approach to 484,000 hectares. The approach was also applied to dryland food crop production, resulting in increased yields. In farm mechanization an expanded loan program was carried on to help farmers buy machines. Efforts were also made to organize small farmers for joint farming operations and encourage custom farming and machine rental services. Emphasis in machine extension was on rice combines and other modern machines.

(7) Establishment of specialized agricultural areas: This measure was designed to improve the structure of agricultural production by encouraging the farmers, through the construction of public facilities and other forms of assistance, to engage in selected farming activities on a cooperative and concentrated basis. As of June 1976, a total of 200 specialized agricultural areas of 22 different kinds were established, mostly in coastal and slope land regions, with over 80,000 families participating.

(8) Strengthening of agricultural research and extension: Stress was laid on breeding and technical improvement in crop, livestock and fish farming; pest

and disease control; food processing development; beefing up of research facilities; training of low-level agricultural workers and strengthening of extension education activities. The items completed during the period included multiplication and extension of virus-free citrus seedlings and seed potatoes, establishing of a breeding sow propagation center, extension of superior species of tilapia and mirror carp, and trial manufacture and export of canned black salsify and mangoes.

(9) Encouragement of establishment of industrial plants in rural areas: To provide rural people with employment opportunities, four industrial parks have been developed at Chushan, Yuanchang, Yichu and Peitou, where private investors will be encouraged to set up factories for food processing and production of handicraft article and other labor-intensive products.

(10) Agricultural improvement on outlying islands: Completed with ARDP funds were 11 dams, two water supply systems and one reservoir on Kinmen and one dam and one reservoir on Matsu. Other projects included improvement of crop and livestock production, establishment of a vegetable seed multiplication of fishing vessels.

2. Estimated Benefits

Economic evaluation of agricultural projects is a difficult task. In addition to the intricacy of the concept of project benefits and costs, there are problems of scope and nature in empirical analysis, especially when the projects are extremely diversified in category and large in number. For the purposes of reviewing the efficiency of project implementation and from the viewpoint of project objective, evaluation of ARDP may be centered around the question: "What do farmers get from the program"? In other words, we are interested in estimating the potential increase of farmers' income made possible by the projects. More specifically, "project benefits," as used in this report, refers to annual increases of net farm income created by completion of the projects. The with-and-without project approach is appropriate for this purpose.

At the end of June 1976, the net benefits that had accrued to the farmers amounted to an estimated NT$5,680 million, of which about NT$247 million came as a result of institutional reforms, including abolition of the rice-fertilizer barter system and the educational surtax on farmland, and easing of terms of agricultural credit.

From the cost-benefit relationship of the individual projects, it is found that the average rate of returns to technological improvement for many of the production

and marketing items was remarkably high. Highest rate of increase in net revenue per unit with project reached 730%, while the greatest saving in operational cost per unit with project reached 83%. Based on these "income effects," it can reasonably be expected that at least some of the farming operations in Taiwan are still at the stage of increasing returns to scale. Income generating potential is a good guideline to be used in designing an agricultural development plan.

According to the Report of Farm Record-Keeping Families in Taiwan, net income per farm from farming was estimated at NT$63,604 in 1974, compared with NT$42,183 in 1973, up 50.8% at current prices. In real terms, farm income in 1974 registered an increase of 7.3% from its 1973 level. Average net farm income was estimated at a record high of NT$65,917 in 1975, up 3.6% from 1974 at current prices. In real terms, farm income in 1975 was 9.2% higher than the previous year's level. The higher real farm income was a result of relatively higher farm prices and lower general price level in 1975 as measured by the Index of Wholesale Prices in Taiwan.

While the worldwide stagflation that struck the industrial sector in Taiwan had unavoidably substantial impact on the rural economy, the implementation of ARDP has certainly served to stabilize farm income through keeping the negative impact of the economic crisis on farming to a minimum. The inflation resistance strength of the agricultural sector under ARDP is evidenced by the fact that, when farm income recorded a positive growth in real terms, nonfarm income for farm families declined 10.5% in 1974, due mainly to the sharp decrease in industrial production which was the result of falling demand for Taiwan products abroad.

IV. STRATEGIES OF PROGRAM IMPLEMENTATION

The idealogical basis of economic development programs in the Republic of China is the Principle of the Peoples' Livelihood, the economic idea envisaged in the Three Principles of the People. The programs are designed to promote "growth with equity" by which the government tries to distribute the economic benefits of the development process to all parts of society. Underlying Taiwan's development program is what may be called "a people-oriented development strategy."[3)]

Projects of ARDP have been formulated within the framework of overall economic planning. In the process of planning, government agencies are required to establish goals for each county after consulting local people and considering local conditions. This process is repeated each year, and adjustments are made to

3) See James P. Grant, *Growth from below: A People-Oriented Development Strategy*, Overseas Development Council, development paper 16, December 1973.

reflect changing production and market situations at home and abroad. Project priorities for the ARDP have been determined more or less according to the following order:

(1) food production program
(2) strengthening of rural infrastructure
(3) establishment of specialized agricultural areas and farm mechanization
(4) stabilization of farm prices and income
(5) availability of capital and modern inputs
(6) agricultural extension services to the farmers
(7) improvement of farmers living conditions

In the following, strategic factors that characterize ARDP will be identified.[4] Emphasis is placed on how development policies are carried out and reach village and farm level.

1. Increased Food Production

Under ARDP, the government introduced high, guaranteed prices for rice and abolished earlier policies considered detrimental to the interest of rice farmers, most notably the system of bartering fertilizer for rice.[5] These new policies coupled with the extension of township-wide integrated rice cultivation technique have undoubtedly provided substantial incentives to rice producers; preliminary estimates of rice crop in 1976 exceed the planned target of 2.7 million tons, setting new record for rice production in Taiwan. Major strategies adopted to implement the increased rice production policy include the following:

(*1*) *Food stabilization fund:*

Established in April 1974 with a special government appropriation of NT$3 billion, this fund is used for stabilizing the market of rice through unlimited purchase when its price falls below the level guaranteed to the farmers by the government. About 110,000 tons of rice was so purchased in 1974. The amount purchased in 1975 increased to 246,774 tons. As a result, the fund has accumulated NT$7.6 billion.

(*2*) *Raising of guaranteed purchase price of rice:*

The guaranteed prices for japonica and indica rice of the first crop of 1974 were set at NT$10 and NT$8.5 per kilogram, which were 66%

4) General strategies of development in Taiwan have been reviewed in *Agriculture's Place in the Strategy of Development: The Taiwan Experience*, edited by T. H. Shen, JCRR, July, 1974.
5) See H. Y. Chen, W. F. Hsu and Y. K. Mao, "Rice Policies of Taiwan," *Food Research Institute Studies*, Vol. XIV, No. 4, 1975, Stanford University, pp. 403-417.

and 49% respectively, more than those in 1973. The same prices were maintained for the second crop of 1974. Since 1975 the guaranteed prices for the two varieties of rice have been set at NT$11.50 and NT$10.50, respectively. Higher purchase prices provide a strong incentive for the farmers to increase production.

(3) *Extension of interest-free rice production loans:*

Non-interest-bearing loans for rice production were provided to farmers with a maximum amount of NT$15,000 per hectare for the first crop and NT$20,000 per hectare for the second crop. The farmers were required to repay the loans in kind after harvest. In 1974 such loans totaled NT$760 million, and more than 74,000 tons of paddy was collected under this measure. The loans and paddy collected under this measure in 1975 increased to NT$1,015 million and 89,000 tons, respectively.

2. Regional Resources Development

The competition for the limited land, labor and water resorces between agricultural and industrial uses in Taiwan is becoming acute. JCRR has been exploring the possibility of using high speed electronic computer and systems analysis in the planning of agricultural resources allocation on a regional basis. Remote sensing, a relatively new technology developed in the U.S. originally for military purposes, has extensive application in the detection, identification and characterization of natural resources and environmental factors. Using the data collected by this technique and on the basis of criteria established according to slope, soil depth, soil texture and other limiting factors, lands will be graded and classified into different categories of use. Those suitable for farming will be further studied with regard to soil, water source, cropping pattern, labor availability, soil conservation requirement, etc., so that realistic regional development plans can be worked out for implementation by stages.

3. Specialized Agricultural Area and Group Farming Approach

The establishment of Specialized Agricultural Areas (SAA) is one of the important items implemented under the ARDP. As of June 1976, SAA have been established for 22 crop and livestock items scattered throughout more than 200 townships on the basis of the development potentiality of the selected product items. The items selected for the establishment of specialized areas are as follows: Soybean, sorghum, corn, mango, pineapple, citrus fruits, banana, pear, grape, flower, vegetables, green asparagus, garlic, bamboo shoot, seedless watermelon, tea, sericulture, hog, dairy cow, and beef cattle.

The SAA is looked upon as a breakthrough in farm planning and management and is expected to result in a mechanized group farming system. Conceptually, an SAA is an area designated for specialized production of a given farm product for which an integrated production, processing, storage and marketing system is to be established. The primary purpose of this measure is to change the structure of agricultural production in selected areas by (1) promoting the production, in each such area, of a single demand-oriented crop or animal as its main product; (2) enlarging the scale of farm operation through the group approach; (3) improving basic production facilities; and (4) providing for commercial-scale handling and marketing of products. Individual family farms will continue to be the basic operating units, but the farmers will be organized into groups to engage in various farming activities on a cooperative basis. The areas to be selected for specialized production activities must have the right farming environment and development potential. The construction of public facilities, the joint marketing of products, and the improvement of environmental sanitation form an important part of the work to be carried out in each area.[6]

4. Vertical Integration

Currently there are more than a dozen farm products that are produced and marketed under some type of contractual arrangements in a form of vertical integration. Vertical integration occurs when a firm combines activities unlike those it usually performs but related to them in the sequence of production and marketing activities.

The processes of integration are not new; they have been going on in Taiwan for many years both within and outside of the agricultural sector. During the last few years, however, the integration process has crossed over the farm gate to incorporate selected parts of the farming operation. Sugarcane, tobacco, mushroom, asparagus, pineapple, soybean, corn, sorghum, onion, watermelon, rice, tomato, milk, etc., are cases in point. For these products, the actual farm production process has been brought under the coordinating control of some other agency, governmental or private, in the processing-marketing organization. In most instances, this has been accomplished through a contractual arragement between the producers and the integrating agency. The nature of the contracts covers the entire range from only a minor transference to a transference of practically all the farmers' decision-making power in return for a fixed and guaranteed payment or price.

Numerous factors are involved in the contractual arrangements of farm and

6) For an economic evaluation of this program, see Terry Y. H. Yu, "Specialized Agricultural Area Program in Taiwan," *Industry of Free China*, Vol. 45, No. 6, June 1976.

non-farm activities. In some cases, a considerable amount of managerial freedom is lelt in the farmer's hands, but he also still bears the risk from fluctuating and unfavorable market conditions. In other cases, very little managerial freedom is left for the farmer, but he no longer assumes the risk of uncertain prices and income.

In many instances, contractual arrangement in production and marketing is facilitated by the establishment of commodity development and stabilization fund. Under an economic system which is highly dependent on foreign trade for its development, Taiwan's agriculture in the past has experienced significant seasonal as well as cyclical fluctuations in the production and prices of many commodity items. Unstable production and prices are apt to result in a greater uncertainty of income for farmers.

In order to reduce the rate of fluctuations in production and prices so as to improve farmers' income, many measures have been designed and implemented by use of special funds. The establishment of a special fund is aimed at the development and stabilization of the commodities concerned. From an operational point of view, stability is viewed as a matter of adjusting production, disappearance, and/or prices to achieve more consistent internal relationships among these factors in the industry. More specifically, smaller seasonal variations in production are expected to initiate a more even flow of commodities throughout the year and a tendency toward reducing seasonal fluctuations in prices.

5. Credit Infusion

In the process of economic development, the degree of commercialization of semisubsistence types of farms has increased. Capital shortage has often been given as one of the crucial factors for slow growth in agriculture. Even where capital is available, devising a method of channelling it to the farmer in the amount, time and conditions that will benefit him most can be problematical.[7]

Under ARDP during the period of 1973 to 1975, special lending funds totaling NT$2.5 billion were made available to serve farmers' needs, in addition to a total grant of NT$4.5 billion appropriated by the government for project implementation. At the end of 1975, the ARDP loans outstanding amounted to approximately NT$1.5 billion, of which 77% were delivered to the farmers by the farmers' associations (FAs).

The credit department of an FA is the most important local agency for delivering agricultural credit to small farmers. The FA in Taiwan is a federated system of

7) Reference is made to M.O. Ijero, "Credit Infusion as Small Farmer Development Strategy: The NTC-NSUKKA Project," *the Developing Economies,* Vol. XIV, No. 1, March 1976.

multiple-function cooperative organizations formed by the farmers to serve their felt-needs. Currently there are 283 township and district FAs in Taiwan, of which 270 associations have credit departments.[8]

Inasmuch as the FAs are close to the farmers and are capable of tying their borrowings to purchase of farm supplies, marketing of farm products and extension services, the FAs are in the most suitable position to render low cost credit services directly to farmers. Most of the loans made by the FAs are without collateral and only guaranteed by two other members.

6. Sales through Service

Farmers buy an increasing amount of supplies and equipment each year for their farming operations. They want more consistent services, greater management assistance and increased technical advice. The farmers will especially want those services that will save them time and labor and provide a full range of assistance covering the supplies and services required in production and marketing operations.

In order to meet farmers' demand and to grow and survive, FAs and government-entrusted supplies firms are placing increasing emphasis on the principle of "sales through service." For example, they distribute fertilizers to the farm home and offer free farm planning service as part of their sales program; they sell feed and offer increasingly sophisticated advice on livestock feeding; country gas stations and machinery repair service centers are being established to facilitate farm mechanization; credit institutions are offering record-keeping and farm management analysis; and during harvest seasons, bank employees are sent out to collect loan repayments at the farmers' homes.

To reduce the cost of shipping paddy rice from the farmers' homes to the local FAs, at-cost transportation teams were organized through the FAs with ARDP support. In the first crop season of 1974, 28 township FAs were selected for carrying out this program on a trial basis and in coordination with the repayment in kind of the interest-free rice production loans. The number of participating townships increased to 85 in the first crop season of 1976. It benefits the farmers through providing facilities to test the moisture content of paddy. If the paddy meets quality specifications, it will be shipped to the government-entrusted storage by the transportation teams organized by the FA.

Most of these changes are continuous. With the information and services provided by the FAs and other agricultural supply firms, farmers will be able to

8) See Y. K. Yang, "The Role of Farmers' Associations in Taiwan in Credit Delivery System," Mimeo, JCRR, November 1976.

more accurately anticipate market conditions for their products. To the extent farmers' production plannings are consistent with market conditions, resources will be allocated according to their most efficient alternative uses.

7. Medical Care for Remote Rural Areas and Environmental Sanitation

To solve the problem of medical personnel shortage at health units in remote rural areas, the Provincial Health Department in 1973 started a pilot program for improving health services in the coastal areas with assistance from the National Health Administration and JCRR. Under this program, the physicians of the Provincial Hospital at the county level are assigned to serve at the township health stations in remote areas on a rotation basis to provide the much needed medical care for the local people.

Under the ARDP, a significant amount of the budget was also earmarked for the improvement of environmental sanitation and water supply in rural areas. During the period from 1973 to 1974, physical improvements, including remodeling of houses, construction of drainage ditches, paving of roads, etc., were made for 27 villages, and simple water supply systems built for 78 villages. Completed at the end of 1974, the two projects had benefited a total of 350,000 people living in specialized agricultural production areas, fishing and salt field areas, black foot disease areas in southwest Taiwan, and other impoverished areas. In actual implementation of the village projects, the township public office is required to work hand in hand with the township FA and other local agencies concerned.

In sum, Taiwan's development strategy attempted to balance the emphasis given to the industrial and agricultural sectors so that one would not be developed to the detriment of the other.[9] In other words, Taiwan's development policy had two goals: to improve the standard of living for the rural population and facilitate the use of surplus agricultural capital to promote industrial development. While there were massive transfers of capital from agriculture to industry, it was planned so that it would not hinder agricultural development. Only in the last few years has the rate of agricultural growth declined, and the government has implemented ARDP to halt this trend. To reduce the earnings gap between rural and urban areas, the government has started a new six-year rural and agricultural development plan to increase farmers' earnings.

9) This assessment can also be found in the Report to the Congress, by the Comptroller General of the United States, *Providing Economic Incentives to Farmers Increases Food Production in Developing Countries*, ID-76-34, May 13, 1976.

V. CONCLUDING REMARKS

All the achievements of ARDP would not have been possible without the clarity in objectives of development policy and active participation at all levels of program implementation. Most of the strategies and policy guidelines are stipulated in the Statute for Agricultural Development promulgated on September 3, 1973.

Taiwan's experience provides an illustration of the induced technical and institutional changes hypothesis as proposed by Ruttan.[10] During the past several years, rural and agricultural development programs have focussed on efficiency in terms of productivity and income with a view to creating growing and prosperous agriculture to provide foods enough for economic growth. On the other hand, Taiwan's agriculture during the recent past was characterized by its flexibility in response to export demand. Since the government adopted an open strategy, international trade has been used as an adjustment instrument. More importantly, the government has been stable and progressive enough to be trusted by farmers.

Understandably, the ARDP is not without shortcomings. To make the best use of the project funds, administrative expenses for project execution must be reduced to a minimum. From this point of view, some of the projects which are closely related in their objectives and procedures can be consolidated for better coordination. It was found also that many of the projects were in the nature of continuation projects, thus the area and number of farmers who benefited from the projects have not been significantly expanded. Whether this phenomenon has resulted in any unfavorable impact on social justice is a subject worthy of investigation.

Furthermore, small farmers in most cases are too dependent on government subsidy. For those who cultivate less than one half hectare of land, the number of whom account for more than 40% of total farm population in Taiwan, absolute benefits derived from ARDP may not be large enough to enable them to become viable entities. Ways and means will have to be found to enlarge the size of the family farm. In this respect, many non-economic factors enter into the picture.

In order to cope with the need for future development and to facilitate the transition of the economy into a higher stage, the government has drawn up a new six-year economic plan for the period beginning 1976 and ending 1981. The real annual gross national product is expected to increase 7.5%, on the average, over the base year of 1975. The main features consist of fostering a gradual change in the economic structure while trying to attain a balanced development between industry

10) Vernon W. Ruttan, "Induced Technical and Institutional Change and the Future of Agriculture," A/D/C reprint, the Agricultural Development Council, Inc., December 1973.

and agriculture. It is expected that in the next six years agriculture will grow at 2.5% per year, and that the percentage of agricultural employees in the total employed labor force will drop from 29.9% to 24.2%.

The foremost objective of the six-year agricultural development plan is to narrow the disparity between farm and nonfarm incomes. Under the plan, the percentage of per capita farm income to that of nonfarm sectors is expected to increase from 67% in 1975 to 70% by 1981. To reach this policy goal, the per capita farm family income in real terms will have to grow at an annual rate of 6.5%. Crucial determinants of this growth are higher labour productivity, reasonable levels of farm prices and more off-farm employment opportunities for the farm population.

With effective application of first, labor absorption, and then labor "squeezing" strategies,[11] Taiwan has been able to enjoy full employment. Fuller employment of both farm and nonfarm families in rural areas has resulted in a decrease in Gini ratio from 0.321 in 1970 to 0.297 in 1975[12], indicating that income distribution has been improved in the province. In the years to come, more attention will be paid to uplifting the status of farmers and others engaged in the agricultural sector. It is now unmistakably recognized by policy makers that, through strengthening of farmers' incentive to actively participate, rural development policies and programs can reach the farm and village level at an accelerated rate.

11) For concept of "labor squeezing" strategy, see Harry T. Oshima and Nguyen Dac Quy, "Labor Squeezing in Labor Shortage Economies of Asia: The Interplay of Appropriate Technology and Institution," Council for Asian Manpower Studies, Discussion Paper Series No. 74-07, August 1974.

12) Source of data: *Report on the Survey of Family Income and Expenditure, Taiwan Province, Republic of China*, Department of Budget, Accounting and Statistics, Taiwan Provincial Government, Republic of China.

Specialized Agricultural Area Program in Taiwan

Terry Y. H. Yu

I. INTRODUCTION

Specialized Agricultural Area Program (SAAP) is designed to enlarge the scale of family farming through the practice of joint farm work operation or joint farming. Individual farm management is expected to be incorporated into the specialized agricultural area program to increase the efficiency of farm business.

According to Article 15 of the Statute for Agricultural Development, promulgated on September 3, 1973, "The competent authority for agriculture at the national level shall mark off areas for specialized agricultural production of selected farm products, where the production, processing, and marketing of these products shall be carried out on a planned basis." Article 24 further states: "When family farms exchange lands within the same specialized agricultural area for the purpose of enlarging their farming scale and facilitating joint farming operations, as certified by the competent authority for agriculture at the municipal or prefectural (city) level, they shall be exempt from deed tax in accordance with the Statute on Deed Tax."

In order to facilitate the establishment of specialized agricultural areas, the Taiwan Provincial Government promulgated on April 21, 1975, the "Requirements and Standards of Specialized Agricultural Areas and Procedures for Submitting Project Proposals." Under the regulation, both the establishment and termination of a specialized agricultural area must be approved and announced by competent authorities of agriculture.

The establishment of Specialized Agricultural Areas (SAA) is one of the important projects implemented under the Accelerated Rural Development Programs (ARDP) which were put into effect on January 1, 1973. By June 1976, Specialized Agricultural Areas had been established for 22 crop and livestock items and in more than 200 townships on the basis of the development potentiality of the selected items. The items selected for production in specialized areas are: soybeans, sorghum, corn, mangos, pineapples, citrus fruits, bananas, pears, grapes, flowers, vegetables, green asparagus, garlic, bamboo, bamboo shoots, seedless watermelons, tea, sericulture, hogs, dairy cows, beef cattle and fish.

II. BACKGROUND

The arable land in Taiwan has always been limited for the past 25 years at about 0.9 million hectares. The acreage per farm family was 1.29 hectares in 1952, but shrank to 1.02 hectares in 1975. Farm surveys indicate that the percentage of farm families owning less than 0.5 hectare increased from 34.4% in 1955 to 37.4% in 1960, and to 43.9% in 1970. Currently, over 70% of the farm families own less than one hectare of farm land.

The relatively low farm income, central to the agricultural problem, is due mainly to the smallness of farm size and inadequate investment. In a bid to modernize Taiwan agriculture, the government has launched since January 1973 a series of accelerated rural development measures which included, among others, increased investment in agricultural public constructions, improvement of rural living conditions, building of factories in rural areas, implementation of joint production and marketing system, and establishment of SAA.

It is well recognized that farming as a business is characterized by greater risk and uncertainty resulting from natural and socio-economic factors. Although various technologies have been introduced to increase the efficiency of farm business operations through the reduction of such risks and uncertainties, shortrun fluctuations in production remains to be the dominant factor affecting farm prices and farm income.

In order to stabilize output and income, farmers in Taiwan have long since adopted a diversified farming system under which several kinds of crop and/or livestock are grown and/or raised during the same time period. However, experience indicates that diversified farming suits better larger farms with abundant labor supply due to the economies of scale and complementaries associated with it.

Despite its relatively slow pace, the cropping system in Taiwan has changed gradually from labor-intensive to capital-intensive. The old problem of labor surplus is being replaced by one of labor shortage, and instead of "labor absorption", "labor squeezing" has become the recommended strategy for development. As a result, agricultural production has now become more specialized at the individual farm level and more diversified for the nation as a whole.

In order to solve the labor shortage problem, many technical and organizational programs have been designed and demonstrated to improve labor productivity under a capital-intensive pattern of land use.

Since 1966, the Taiwan Provincial Department of Agriculture and Forestry (PDAF) has conducted various experiments and demonstration projects having to

do with labor exchange, custom labor, integrated techniques, joint farming, and the like. Different programs were introduced according to regional characteristics in land use, farm size, capital availability, market situation, and technical conditions. Results of these experiments have in general been satisfactory, and significant demonstration effects have been observed.

However, due to continuous changes in the structure of agricultural industry during the recent past, farm management programs have to be modified to suit new production and marketing conditions as well as long-run agricultural development policies. Current experiments and demonstration programs include the following operational patterns: (1) joint farming, (2) contract farming, (3) partnership farming, and (4) vertically integrated farming. Since these programs are designed mainly to benefit small farms through expansion of farm business without altering land-ownership, they are more practical and feasible than other approaches that involve revision of existing laws and regulations governing land-ownership in Taiwan.

The impact of farm business expansion through joint farming operations on the intensity of land use is quite clear. As farming becomes more capital-intensive and more specialized, emphasis will be placed on higher labor productivity in addition to rising land productivity. This implies a lesser degree of diversification in the future for individual farms.

III. OBJECTIVES

The establishment of SAA is looked upon as a breakthrough in farm planning and management and is expected to result in a mechanized group farming system. Conceptually, an SAA is an area designated for specialized production of a given farm product for which there is an integrated system of production, processing, storage, and marketing. The primary purpose of this measure is to change the structure of agricultural production in each of these areas by (1) promoting the production of a single crop or animal that is demand-oriented as its main product, (2) enlarging the scale of farming through group approach, (3) improving its basic production facilities, and (4) providing for commercial-scale handling and marketing of products. Individual family farms will continue to be the basic operating units, but the farmers will be organized into groups to engage in various farming activities on a cooperative basis. The areas selected must have the right farming condition and development potential. The construction of public facilities, the joint marketing of products, and the improvement of environmental sanitation form an important part of the work in each area.

More specifically, the objectives of the SAAP may be stated as follows:

1) To mark off agricultural areas on the basis of comparative advantages or "growing the right crop on the right land" so as to increase the efficiency of agricultural resource utilization.
2) To modernize techniques of production and marketing through joint use of farm machinery and expansion of farm business.
3) To facilitate implementation of agricultural policy designed to adjust the structure of agriculture to the changing economic situation.
4) To strengthen infrastructure for the improvement of agricultural production and farmers' living.

IV. PRINCIPLES OF PROGRAMMING

Operationally, the SAAP is implemented on a project basis. Major principles of operation are as follows:

1) As far as possible, the projects are implemented on a regional basis in selected localities, with top priority given to low income areas.
2) Attention is paid not only to carrying out each project from beginning to end, but also to coordinating the various aspects of work in such a way as to bring them into a complementary relationship with one another so that the benefits of integrated development can be realized.
3) Emphasis of work is placed on regional improvement of the basic structural conditions of production, raising of production efficiency, and inducement of more investment by the farmers. This program not being a relief operation, direct subsidies to individual farmers should be avoided as much as possible.
4) In the case of those activities which have the potential for further development, the farmers should be encouraged to carry on the work on their own initiative after completion of the projects.
5) Provisions should be made for the proper maintenance and operation of the infrastructural facilities to ensure the long-term benefits provided by these projects.
6) Local governments, farmers' associations and individual farmers are encouraged to participate actively in the implementation of the SAAP. When necessary, all three parties may be called upon to contribute matching funds according to their respective financial ability.
7) The products designated for production in an SAA should be determined

on the basis of potential development in demand and supply conditions. More than one specialized areas may be marked off for a specific product.

8) The size of a specialized area should be determined in accordance with the kind of facilities needed and in such a way that economies of scale may be fully realized.

9) In the programming of specialized areas, both production and living conditions should be considered so as to faciliate the implementation of package programs.

10) The procedure of programming SAA may be divided into the following three steps:

   a) Selection of products: It is the responsibility of the national competent authority for agriculture to coordinate with local agricultural agencies concerned in selecting the products to be developed in specialized areas.

   b) Selection of location: The location of a specialized area should be selected on the basis of the principle of comparative advantages with both technical and socio-economic conditions given due consideration.

   c) Submission of project: Proposals to establish an SAA should be submitted by the local government to the national competent authority for approval in accordanc with the "Requirements and Standards of Specialized Agricultural Areas and Procedures for Submitting Project Proposals."

V. GENERAL REQUIREMENTS

1) Size of a specialized area:

The size of a specialized area must be 50 hectares or larger for all product items except vegetables for which 20 hectares is the smallest size. The minimum size for joint farm work operation should be five hectares for food crops and one hectare for other cash crops.

2) Farm management:

   a) Based on the principle of "Min Shen Chu Yi" (one of the Three Principles of the People), family farm should be maintained as the basic unit of farm organization. However, in order to increase the efficiency of farm management as well as the welfare of farmers, government agencies concerned should assist family farms to improve their operations and to enlarge the scale of family farming through joint farm work operations, joint farming, contract farm work operations, contract farming and other group management practices.

b) In executing joint farm work operations or joint farming, it is not necessary to unify the type of farmers' organizations, as it should be determined on the basis of locall socio-economic conditions, type of enterprises, and farmers' will. Joint farm work operations and joint farming may also be performed on a contractual or custom work basis.

c) Cooperative farming is one of the approaches to enlarge the size of farm business. Agencies in charge of cooperative affairs should coordinate with agricultural agencies in helping farmers organize cooperative farms to practise joint farm work operation or joint farming.

d) In addition to joint farm work operation, joint farming, and cooperative farming, farmers can also organize themselves into partnerships or corporations in the interest of economies of scale.

3) Marketing:

a) Commodities produced in the SAA should be sold through joint marketing channels for the sake of better control of product quality and marketing costs.

b) Vertically integrated contractual arrangements may be practised for SAA products. The contracts may cover only a minor transference of the production process or a transference of practically all the farmers' decision-making power for a fixed amount of payment.

VI. ECONOMIC EVALUATION

The economic evaluation of agricultural projects is a difficult task. In addition to the conceptual difficulties involved in estimating benefits and costs, there are the problems of scope and nature in empirical analysis, especially when the projects are extremely diversified in category and large in number. For the purpose of reviewing the efficiency of project implementation and from the viewpoint of project objective, evaluation of an SAAP may be centered around the question: "What do farmers get from the Program? In other words, we are interested in estimating the potential increase in farmers' income made possible by the program. More specifically, "project benefit" as used in our analysis refers to the annual increase in net farm income thus created. The with- and without-project approach is appropriate for this purpose.

In order to facilitate the collection of necessary information for economic analysis, several discussion meetings were held during and after the project period. Personnel responsible for executing the projects in the fields were oriented and

first-hand data were reviewed. College professors were occasionally invited to conduct economic survey of some of the projects. Results of economic studies on technological progress in agriculture were also used as secondary data whenever applicable in arriving at the benefit-cost relationships of the projects.

Preliminary estimates of benefits and costs of SAAP for 1974-75 are summarized in Tables 1, 2 and 3.

Table 1. Estimates of Project Benefits and Costs of Specialized Agricultural Areas, 1974-75

Category	Value	Category	Value
Benefits (NT$1,000)	211,760	Distribution of cost (%)	100.00
Costs (NT$1,000)	282,357	ARDP grant	20.41
ARDP grant	57,643	Local governments' contributions	6.52
Local governments' contributions	18,404	Private organizations' contributions	3.06
Private organizations' contributions	8,626	Participating farmers' investment	70.01
Participating farmers' investment	197,684		

Remarks: 1) Benefits refer to the annual increase in net farm income made possible by completion of the projects.
2) Estimates based on reports submitted by project executing agencies in August 1975.

Table 2. Net Benefits of Specialized Agricultural Area Program by Product Items, 1974-75

Item	Unit	Net Benefits	Item	Unit	Net Benefits
Soybeans	Hectare	NT$2,154	Vegetables	Hectare	55,192
Sorghum	〃	6,089	Bamboo shoots	〃	4,426
Corn	〃	3,371	Tea	〃	23,368
Mangos	〃	16,484	Sericulture	〃	26,500
Pineapples	〃	2,427	Hogs	Household	29,296
Citrus fruits	〃	26,000	Dairy cows	〃	10,475

From the tables presented above, it can be seen that the economic benefit of the SAAP was satisfactorily high. Based on these findings, it can reasonably be expected that at least some of the farming operations in Taiwan are still at the stage of increasing returns to scale. Policy implication of this assessment for agricultural development planning is clear: high pay-off projects should be given high priority for public investment. Income generating potential is a good criterion for designing agricultural development plans.

The significant income effect of the SAAP suggests the expansion of project scope and coverage. But how should they be expanded? Some farmers do not seem to be motivated, and their autonomous investment is lacking. In other words, they are heavily dependent on government subsidy. The crux of this problem lies

mainly in the small size of individual farmers' land holding. For those who own less than one half hectare of land—and they account for more than 40% of the total farm population—the potential amount of economic benefit they derive from the SAAP may not be great enough to offset their opportunity cost. Thus, ways and means must be found to enlarge the size of individual farms. In this particular respect, however, many non-economic factors come into the picture.

Table 3. Percentage Share of Specialized Crop Production Areas, 1974-75

Crop Item	Area under SAAP (Ha.) (A)	Total Planted Area in Taiwan (Ha.) (B)	Share (%) $\frac{(A)}{(B)} \times 100$
Soybeans (Spring)	1,500	8,414	17.8
Sorghum (Spring)	2,600	8,087	32.2
Corn (Autumn)	4,800	13,831	34.7
Mangos	400	10,180	3.9
Pineapples	3,306	16,778	19.7
Citrus fruits	750	40,941	1.8
Bananas	5,184	18,407	28.2
Pears	450	10,520	4.3
Vegetables	740	41,934	1.8
Green asparagus	970	17,355	5.6
Garlic	800	3,266	24.5
Bamboo shoots	2,800	20,857	13.4
Tea	1,342	33,051	4.1
Sericulture	1,350	1,629	82.9

Notes: (1) Total area is based on Taiwan Agricultural Yearbook, 1974.
(2) Total vegetable area is obtained by dividing the total planted area by 3. It is assumed that, on the average, 3 crops of vegetables can be harvested on the same piece of land in a year.

VII. CONCLUDING REMARKS

Modern agricultural production is essentially market-oriented and basically subject to the restrictions imposed by the availability of resources. Although it is generally agreed that the average farm size should be somewhat expanded, farm management in Taiwan in the near future will still continue to be on a small scale with family farms as the backbone. However, increasingly visible and common will be the specialized production of fruits, vegetables, industrial crops, livestock, and fish as well as integrated farming like combined crop-fish-livestock production. This transformation in structure necessitates the updating of agricultural technical know-how. The demand for agricultural extension personnel equipped with specialized knowledge will become greater along with the establishment of SAA and the strengthening of specialized management and joint marketing net-

works. An increase in off-farm job opportunities is bound to augment the number of farms managed on a part-time basis. The result is that these farmers may account for as much as 90 percent and non-agricultural income will be increasingly important. It is conceivable that, as a consequence of farm labor shortage, custom farming and management will become more popular.

It is clear that future agricultural development will have to center around coordination with changes in the economy's consumption structure, readjustment of utilization of agricultural resources, abundant supply of high quality foodstuffs, and intensified production of export-oriented farm products. Production will be directed toward diversification in line with specialization. Farming will become more capital-intensive to raise labor productivity and per-unit production. Supply and demand will be closely coordinated by means of increased investment in public facilities, construction of modern market installations, and contractual arrangements. In addition, the establishment of stabilization funds for main crops, implementation of farm product purchase at guaranteed prices, and promotion of agricultural insurance will all help increase farm income and bring stability to rural society.

It is believed that future agricultural development entails up-to-date techniques, adequate systems, and sound organization, the coordination of which depends upon successful agricultural research. All these measures are expected to be incorporated into the specialized agricultural area program for further development.

The Farm Labor Force of Taiwan: Problems and Prospects

Hsi-huang Chen*

I. INTRODUCTION

1. The Problems

Recently, there have been serious discussions on human resources utility and agricultural mobility in Taiwan, aiming at the adjustment and mobility of farm workers and family members in a situation of increasing manpower needs in non-farm sectors. This discussion is particularly timely as Taiwan's economists have been aware of problems associated with waste of human resources resulting from changing economic structure and uneven economic growth.

The issues raised by the process of high economic growth and agricultural development are:

(1) A continuous outflow of farm resources resulted in the demand for frequent adjustment of agricultural structure in order to meet the dynamic economic situation; and

(2) The drastic agricultural labor mobility in short-run influenced the long-run equilibrium of employment which made it difficult to accomplish the long-run agricultural production goal.

2. The Purpose of this Report:

The purpose of this report is to examine Taiwan's farm labor problems under the process of high economic growth and prospect to future situation.

II. GENERAL TRENDS OF FARM LABOR DEMAND DURING THE PROCESS OF HIGH ECONOMIC GROWTH

1. Aspects:

Taking the different stages of economic development from 1952 to 1966 and 1966 to 1975 for comparison:

(1) With 1971 constant price, in the first period (1952-1966), the real value of agricultural production increased from NT$16,979 million in 1952 to

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NT$29,730 million in 1966 while industrial production increased from NT$8,324 million to NT$33,752 million. The average annual growth rate in the first period showed that 4.1 percent for agriculture and 10.5 percent for industry. In the second period (1966-1975), the constant agricultural production value increased from NT$29,730 million in 1966 to NT$36,448 million in 1975 while industrial production increased from NT$33,752 million to NT$93,497 million. The average annual growth rate in the second period showed respectively of 2.3 percent and 12.0 percent for agriculture and industry.

(2) During the first period, labor input for agriculture increased from 1.5 million persons to 1.7 million persons showing an annual increase of 0.8 percent while labor input for industry increased from 0.4 million persons to 0.9 million persons represent an annual increase of 6.8 percent. In the second period, agricultural labor input decreased from 1.71 million persons to 1.65 million persons or an annual increase of −0.48 percent, while industrial labor input increased from 0.94 million persons to 1.96 million persons which showed an annual increase of 8.51 percent. It is the first time in the history of agricultural development in Taiwan that showed a decline of agricultural employment not only in relative terms but also in absolute numbers.

2. Issues:

(1) During the high industrial growth period 1966-1975, since farm labor was absorbed by industry, the decline of farm labor in absolute number made it impossible to maintain the labor-intensive farming system. Thus the efficiency of labor-intensive farming is no longer in existence in Taiwan. It leads us to a question that whether we should apply more capital in substitution of labor for maintaining high land productivity in order to push agricultural production further or should we change the farming system from intensive-farming to extensive farming with lower land productivity?

(2) Since industry used to absorb good quality farm labor and the mobility potential of young people is much greater than that of old ones, thus agriculture tends to be the residual claimant of the labor force. The remaining farm labor today is characterized by limited education, few transferable skills, and old age. How can we use this kind of farm labor for agricultural modernization? For further agricultural development, we need a certain number of educated young people to stay on farms and

engage in full-time farming. The question is: How many educated young people should stay on farms for agricultural modernization? and what can we do to attain this purpose?

III. CHANGE IN THE EMPLOYMENT STRUCTURE DURING THE PROCESS OF HIGH ECONOMIC GROWTH

1. Aspects:

Here, the stages of 1956-1966 and 1966-1974 are taken for comparison.

(1) During the first period of 1956-1966, according to the census data, the national total of employment increased by 55.1 percent while agricultural employment increased only 6.8 percent. The non-agricultural sector showed a great gain with a 145.7 percent increase in employment during the same period. In the second period of 1966-1974, the net increase of national employment was 36.1 percent while agricultural employment decreased 12.6 percent. With respect to the percentage of agricultural employment to total employment, agriculture's share in the total economy accounted for 65.2 percent in 1956, and then decreased to 44.9 percent in 1966 and 28.8 percent in 1974. The share of agricultural employment was decreasing steadily.

(2) On the other hand, the change of proportion of agricultural employment showed a −20.3 percentage point for 1956 to 1966 and −16.1 percentage point for 1966 to 1974. That is to say, for every 1,000 additional employees in the national economy, there were 203 workers who shifted from agricultural sector to non-agricultural sector during the period of 1956-66, and 161 workers who shifted from agriculture to non-agriculture during 1966-74. These data mean that the increase of non-agricultural employment usually resulted in a decrease of agricultural employment.

(3) The total change in occupational structure in 1956-1966 was the outcome of gain chiefly in the three groups of service, professional and clerk workers at the loss of farm workers. In the 1966-1974 period, the total change in occupational structure was mainly from the growth of operative workers and the loss of agricultural employment, and in turn these gaining occupations were governed by the change in manufacturing and construction industries.

2. Issues:

(1) During the periods of 1956-66 and 1966-74, the decline of agricultural

employment both in relative and absolute number implies that current occupational structure in Taiwan is favorable for extending farm size and accelerating farm machinzation. Therefore, it is urgently needed to investigate the application of agricultural labor force in order to organize effective occupational training programs.

(2) The decline in agricultural employment is resulted mainly from the total economic activities and little from variations in job pattern within agriculture. This clearly implies that people living on farms believed that farming did not offer as great an economic opportunity as did in other activities. The most important issue is whether programs should be devised to make it easier for farm people to choose between continuing in agriculture or accepting employment in other sectors of the economy.

IV. RURAL LABOR MOBILITY IN RELATION TO ECONOMIC DEVELOPMENT

1. Aspect:

Two rural labor mobility surveys were conducted by the Rural Economics Division in 1963 and 1968. The followings are the comparison of these two survey findings:

(1) Rural labor mobilities were divided into three categories: commuters, seasonal workers and long-term employees. Making a comparison between 1963 and 1968, the male commuters almost doubled from 23.5 percent to 45.7 percent while the female commuters increased by about 55 percent, from 35.0 percent to 54.3 percent. On the contrary, the male seasonal workers decreased from 61.07 percent, to 27.6 percent while the female decreased from 41.1 percent to 21.8 percent. This radical change of employment structure in farm family members is due to rapid industralization in that period and the rapid increase in creating permanent job opportunities to replace unstable seasonal farm work.

(2) The increase of commuters in the farm families indicates the stable job opportunities for rural people. It also means that new factories are established in the nearby distance of surveyed townships, so that the rural people are able to commute from their farm homes. On the contrary, the swift decrease of seasonal workers reflected the shortage of farm laborers, especially during the harvest and transplanting seasons.

(3) The relative weight of outmove male long-term employees was increased by 11.2 percent, from 15.5 percent to 26.7 percent, while that of female workers remained unchanged 23.9 percent. However, both male and

female long-term workers were increased in absolute number to some extent during the period reviewed.

2. Issues:

(1) A problem of farm labor shortage has occurred and may become more serious in future provided that the outflow of young labor continues if other things are given constant.

(2) The persistence of the rural area as a low-income region makes it clear that moving peoele out will rarely solve rural economic problems unless, at the some time, sufficient farm capital moves in.

V. FUTURE PROSPECT AND IMPLICATIONS

According to the above analysis, we reach the conclusion that the decline of agricultural employment is due to the expansion of industries. In the face of further economic development of Taiwan in future there appears to be a general agrement that farm and non-farm labor markets are becoming increasingly interdependent. With respect to the future industrial development, farm labor problems can be examined from two different angles:

1. It is assumed that labor-intensive type of industries will continue to expand and farm labor force will continually outmove to non-farm sector. Finally, the farm workers could be fully absorbed if proper precautions are not adopted. Thus we might loss our second generation farmers in the near future. Under this situation, we should take farm labor shortage problems into consideration as our long-term farm policy.

2. On the other hand, we assume that capital-intensive and technological-intensive type of industries will be adopted for substitution of labor-intensive industries in the future, so that the growth of industry need not depend on the transfer of farm labor. Because when the industries have labor shortage, they might apply more advanced machinery and require less labor from the farm sector. With this situation, industrial sector will make more progress by using more advanced machinery and new technology, and farm sector can only stay in the lower level of technical operation, because there is still too many laborers in farm sector which made it difficult for farm mechanization and modernization. Therefore, the disparity of socio-economic technological levels between farm and non-farm sectors might get wider and wider as economic development going on in the future. It may lead to the accentuation of dualism in this country. I don't know whether the dualistic system of economic development is good or not. We should make more research on this problem.

Table 1. Labor Input and Production Value of Agriculture and Industry

Unit: Production: NT$ million at 1971 price level
Labor: 1,000 persons

Year	Production value		Labor input	
	agriculture	industry	agriculture	industry
1952	16,979	8,324	1,528	375
1953	17,905	7,960	1,569	401
1954	17,084	11,447	1,594	426
1955	18,983	11,793	1,609	453
1956	19,183	13,030	1,618	501
1957	20,089	15,002	1,622	550
1958	21,895	16,634	1,616	595
1959	22,328	18,725	1,640	641
1960	21,036	16,397	1,641	675
1961	22,015	18,007	1,653	702
1962	23,145	19,923	1,659	738
1963	22,668	24,270	1,675	775
1964	26,840	28,441	1,684	823
1965	28,608	30,702	1,688	878
1966	29,730	33,752	1,709	940
1967	30,232	39,953	1,733	1,010
1968	30,782	46,152	1,738	1,093
1969	30,464	53,603	1,732	1,188
1970	32,451	61,701	1,692	1,333
1971	31,575	75,703	1,668	1,443
1972	34,004	88,828	1,632	1,590
1973	36,316	97,358	1,624	1,810
1974	37,192	88,371	1,697	1,891
1975	36,448	93,497	1,652	1,961
Average annual growth rate(%)				
1952—1966	4.08	10.52	0.81	6.78
1966—1975	2.29	11.99	− 0.48	8.51

Sources: 1. Befofore 1971, the figures of labor inputs were estimated by Economic Planning Council.
2. After 1972, the figures were based on the data provided by Taiwan Provincial Labor Force Survey and Research Institute.

Table 2. Changes in Proportion of Age Distribution of Agricultural Workers

Unit: %

Year \ Age	Total	15—29	30—49	50 and above
1955	100	53.0	36.1	10.9
1965	100	40.7	45.2	14.1
1973	100	25.4	55.2	19.4

Source: Agricultural Census.

Table 3. Growth and Change in Employment of Taiwan, 1956-66 and 1966-74

Sectors	Number of Employment			Net Increase or Decrease				Percent of Total Empolyment			Shift in Industrial Structure During	
	1956	1966	1974	1956–66		1966–74		1956	1966	1974	1956–66	1966–74
	1,000 prs.	1,000 prs.	1,000 prs.	Number 1,000 prs.	%	Number 1,000 prs.	%	%	%	%	% point	% point
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Non-agriculture	854	2,098	3,688	1,244	145.7	1,590	75.8	34.8	55.1	71.2	20.31	16.07
Agriculture	1,600	1,709	1,493	109	6.8	— 216	— 12.6	65.2	44.9	28.8	—20.31	—16.07
Total	2,454	3,807	5,181	1,353	55.1	1,373	36.1	100.0	100.0	100.0	0.00	0.00

Source: Computed by data from "Population Census", 1956 and 1966, Taiwan Provincial Government, and "Report on Labor Survey in Taiwan", 1975, Taiwan Labor Research Institute.

Table 4. Growth and Change in Proportion of Industrial Origin of Net Domestic Product, 1956-66 and 1966-74

Sectors	Net Product			Net Increase or Decrease				Percent of Total Product			Shift in Industrial Structure During	
	1956 million NT$	1966 million NT$	1974 million NT$	1956–66		1966–74		1955	1966	1974	1956–66	1966–74
				million NT$	%	million NT$	%	%	%	%	%	%
Non-agriculture	19,486	76,380	351,755	56,894	292.0	275,375	360.5	69.0	74.4	83.3	5.38	8.93
Agriculture	8,759	26,326	70,530	17,567	200.6	44,204	167.9	31.0	25.6	16.7	— 5.38	— 8.93
Total	28,245	102,706	422,285	74,461	263.6	319,579	311.2	100.0	100.0	100.0	0.00	0.00

Source: Taiwan Statistical Data Book, 1975, Economic Planning Council.

Table 5. Occupation Change Caused by Factors Influence

Sectors	No. of Employee			No. of employee weighted by growth rate		No. of employee weighted by structure chang		Change caused by factors influence							
								All factors		growth effect		industry effect		occupation mix effect	
	1956	1966	1974	1966	1974	1966	1974	1956–66	1966–74	1956–66	1966–74	1956–66	1966–74	1956–66	1966–74
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(2)—(1)	(3)—(2)	(4)—(1)	(5)—(2)	(6)—(4)	(7)—(5)	(2)—(6)	(3)—(7)
Non-Agriculture	854	2,098	3,688	1,325	2,855	2,094	3,679	1,244	1,590	471	757	769	824	4	9
Agriculture	1,600	1,709	1,493	2,482	2,326	1,713	1,502	109	— 216	882	617	— 769	— 824	— 4	— 9
Total	2,454	3,807	5,181	3,807	5,181	3,807	5,181	1,353	1,374	1,353	1,374	0	0	0	0

Sources: Same of Table 3.

Table 6. Industry and Occupation Mix Effects on Agricultural Employment, 1956-66 and 1966-74

Periods	Absolute Values of Components			Relative Proportions of Components	
	Total of Structural Components 1,000 prs.	Industry Effect 1,000 prs.	Occupation Mix Effect 1,000 prs.	Share of Industry Effect %	Share of Occupation Mix Effect %
1956—66	— 773	— 769	— 4	99.48	0.52
1966—74	— 833	— 824	— 9	98.92	1.08

Source: Derived from Table 5.

Analysis of Agricultural Labor Force in Taiwan*

Yu-kang Mao

I. INTRODUCTION

In recent years, the following problems have always been mentioned in discussing the problem of agricultural labor force in Taiwan:

1. Large outflow of farm labor
2. Labor shortage in the agricultural sector
3. Aging of farm workers.

Many people see these problems as a crisis of future agricultural development. In fact, each of the three problems involves many aspects and calls for a great deal of discussion before any concrete conclusions can be drawn.

The main objective of this paper is to examine the above-mentioned problems, to explain the change in agricultural labor force in recent years and to make some suggestions for future manpower policy.

II. ANALYSIS OF AGRICULTURAL LABOR FORCE

1. Is There A Shortage of Agricultural Labor?

To begin with, the shortage of agricultural labor is not a year-round situation nor it is a phenomenon of the entire agricultural sector. In reality, the agricultural labor shortage has two special characteristics. First, it is a seasonal phenomenon and second, it only happens on individual farm. Seasonal shortage of farm labor occurs only in the period of sowing, planting, harvesting, etc. whose operation must be completed within a period of few days. During the rest period of the crop season, agricultural labors are not in short supply. Sometimes there even existed a large surplus. According to the 1976 report of farm record-keeping, monthly labor demand during the 1975 slack seasons accounted for 6.3% of the total demand of that year[1]. In other words every gainfully employed farm labor worked on average about 12.26 days per month.

* The author wishes to thank Messrs Lin Chai-yuan and Kao Yu-hsin for their assistance in this study and preparation of the paper.

1) The busy season and slack season are different from region to region in Taiwan. The average of the highest labor requirement in each region is taken as the labor requirement for the peak season. The average of lowest labor requriement in each region is taken as the labor requirement for the slack season.

Even that figure is sometimes misleading, for part of the total working days is supplied by seasonal helpers and regular helpers who are not counted in the total number of the actively employed farm labor. Subtracting this part of labor supply, the actual working days per month of every gainfully employed labor during the slack season will be less than 12.26 days. Therefore, as far as the slack season is concerned, agricultural labor supply still exceeds demand, and the shortage of agricultural labor force is largely a seasonal phenomenon.

The shortage of agricultural labors is also a micro-phenomenon. It is not a serious problem when the agricultural sector is taken as a whole. Again, based on the farm record-keeping data of 1975, the monthly labor demand in the busy season, which is the average of eight agricultural areas in Taiwan, was about 12.3% of the annual total need, and the total working days of each agricultural labor was 23.9 days for the busy months. If the labor supplied by seasonal helpers and regular helpers is substracted, then the monthly working days of each agricultural labor during the peak season must be less than the average. Thus if individual farm can exchange labor and help each other, the labor force of agricultural sector should be sufficient to meet the demand even during the busy seasons. This indicates that the seasonal shortage of farm labor only takes place on individual farm and it is not so when considered from a macro-point of view. Hence, the argument that the agricultural labor force is in short supply is not correct and needs further analysis.

Table 1. Monthly Working Days of Each Actively Employed Farm Labor in Peak and Slack Seasons, 1975

Item	Number
Number of total employed persons in agriculture	1,463,907
Total working days	284,817,551
Yearly working days of each employed person	194.56
Monthly working days of each employed person	16.21
Monthly working days in slack season	12.26
Monthly working days in busy season	23.93

Note: 1. The total number of actively employed farm labors does not include the labors engaged in fisheries.
2. The monthly working days of slack season account for 6.3% of yearly working days.
3. The monthly working days of busy season account for 12.3% of yearly working days.
4. The total working days of 1975 comes from the 1975 agricultural census data.

Source: 1. The Report of 1975 Agricultural Census of Taiwan-Fukien District of the Republic of China.
2. Quarterly Report on the Labor Force Survey in Taiwan, Republic of China.

Since agricultural labor shortage has been a situation of individual farm and peak seasons, it is not a phenomenon of recent years and it has been with us for

a long time even at the time when the non-agricultural sector was still undeveloped and there were a large number of unemployed labor in the agricultural sector. Therefore, if we use the labor requirement of the peak seasons as a standard to measure whether or not the agricultural labor are sufficient, we shall find that labor shortage in the agricultural sector has had a long history. Therefore, the labor shortage of individual farm family during the busy seasons is not an abnormal condition. If the farm labor force is large enough to meet the peak season demand, there would be a large surplus in the slack period. Moreover, it would also result in disguised unemployment, low labor productivity and low farm family income.

Some people suggested that the surplus labor of slack seasons could be absorbed by means of establishing factories in rural area. But this has not proved to be very effective. According to the surveys on labor movements, factory labor in the rural areas have a tendency to give up agriculture entirely.[2] As a result, to establish factory in rural areas would increase job opportunities, but can not solve the problem of labor shortage on individual farm during the peak season. Probably, the best answer to this question rests on change of production structure and agricultural mechanization.

The optimal number of agricultural labor force should not be the highest demand during the peak season, for this problem is very much like the inventory and queuing problems in operations research. If the quantity of inventory or service equipment has to satisfy the highest demand, there will be a large surplus in normal time. This will result in a waste and lower the production efficiency. For the purpose to maximize profit, the optimal quantity of inventory or service equipment need not to satisfy the highest demand.

At present, there is a steady labor emigration from the rural areas. Why do the farm families permit their sons and daughters to move to the cities and endure the difficulty of labor shortage and high wages? The main reason is that the farm families can maximize their profit by moving out part of their labor. In recent years, the industrial and commercial sectors have developed very rapidly and, as a result, the opportunity cost of farm labor has been very high. Therefore, the emigration of agricultural labor would not only increase the income of the emigrants, but will also raise the labor productivity of farm. If the decrease of agricultural labor can be accomplished without affecting land productivity and the total agricultural production, it will be an opportunity rather than crisis for agricultural development.

2) Huang Chi-lien: *Rural Factories and Farm Labor Employment* (in Chinese), Department of Agricultural Economics, National Taiwan University, p. 31.

Many people are troubled by the seasonal shortage of agricultural labor, worrying that it would cause decline in land productivity and agricultural production in the future. But experience does not support this argument. Agricultural production and land productivity of recent years have not declined despite the decrease of agricultural labor.

There is another argument which is worth discussing. Many people believe that agricultural labor is indivisible, which means that the total surplus of agricultural labor force is the sum of individual surplus of every gainfully employed agricultural labor. Therefore, the move-out of agricultural labor will have a great impact on agricultural production. However, this view is only true under the condition that agricultural production technique is always static. But in fact the technique of agricultural production in Taiwan has progressed rapidly. This can be supported by the upward trend of agricultural production, agricultural labor productivity and land productivity. As shown in Table 2, the index of net domestic agricultural production rose from 85.67 in 1969 to 118.44 in 1977. During

Table 2. Production Value, Land Productivity and Labor Productivity of Agriculture, 1966-1977

Year	Net Domestic Agricultural Production (NT$ Million)	Agricultural Employment (1,000 persons)	Cultivated Area (1,000 ha.)	Index of Net Domestic Agricultural Production (1971=100)	Labor Productivity (NT$/person)	Land Productivity (NT$/ha.)
1966	34,044	1,617	896	94.87	21,054	37,996
1967	33,903	1,722	902	94.48	19,688	37,586
1968	33,608	1,676	890	93.66	20,053	37,762
1969	30,742	1,726	915	85.67	17,811	33,598
1970	32,619	1,681	905	90.90	19,405	36,043
1971	35,884	1,665	903	100.00	21,552	39,739
1972	34,198	1,632	899	95.30	20,955	38,040
1973	38,903	1,624	896	108.41	23,955	43,419
1974	40,786	1,698	917	113.66	24,020	44,478
1975	41,979	1,652	917	116.99	25,411	45,779
1976	41,892	1,649	920	116.74	25,404	45,535
1977	42,502	1,615	920	118.44	26,317	46,198

Source: 1. Net domestic agricultural production: National Income of the Republic of China.
2. Agricultural employment: Quarterly Report on the Labor Force Survey in Taiwan, Republic of China.
3. Cultivated land area: Taiwan Agricultural Yearbook, 1977 edition.

the same period, labor productivity rose from NT$17,811/person to NT$26,317/person; and land productivity from NT$33,598/ha. to NT$46,198/ha. Although labor productivity in the agricultural sector has increased gradually, but it is still lower than the productivity of his counterpart in the manufacture. As shown in Table

3, from 1966 to 1977, the labor productivity ratio between agriculture and manufacture is below 50% except for 1966 and 1975.

During the process of economic development, full employment and high labor productivity are two major objectives. When there are labor surplus in the agricultural sector and strong demand for labor in the non-farm sectors, migration of rural labor is a right way to promote economic development. It is good for both labor productivity and full employment.

Table 3. Comparison of Labor Productivity Between Agriculture and Manufacture

Year	Labor productivity in agriculture (NT$/person)	Labor productivity in manufacture (NT$/person)	Agricultural labor productivity / Manufacture labor productivity (%)
1966	21,054	41,386	50.87
1967	19,688	42,551	46.27
1968	20,053	49,477	40.53
1969	17,811	50,818	35.05
1970	19,405	51,378	37.77
1971	21,552	57,682	37.36
1972	20,955	59,733	35.08
1973	23,955	59,259	40.42
1974	24,020	53,089	45.24
1975	25,411	48,378	52.53
1976	25,404	53,108	47.83
1977	26,317	54,660	48.15

Note: Productivity is measured by 1971 NT dollars.
Source: 1. National Income of Republic of China.
2. Quarterly Report on the Labor Force Survey in Taiwan, Republic of China.

Of course, agricultural labor productivity can also be increased by increasing agricultural production. But this is difficult to achieve because of limited area of cultivated land and diminishing returns of capitals. Therefore, with more capital investments in agriculture to increase the production and labor productivity are also a difficult task. Hence to have a smaller number of labor force in agriculture would be a more feasible way of increasing farm labor productivity.

According to the above analysis, we can conclude that during ordinary times, the total number of agricultural labor is still in excess of the actual demand and that the agricultural labor shortage is mainly a seasonal and micro phenomenon. The best method to tackle this problem is to adjust agricultural production structure and to promote agricultural mechanization. To stop the labor migration from farm is like putting the horse behind the car and it would hamper the growth of the economy rather than advancing it.

At present, the decrease of agricultural labor is not a crisis. On the contrary, it would help raise the productivity of agricultural labor and also marks a turning point in the course of agricultural development.

2. Analysis of The Change In Agricultural Labor In Recent Years

According to labor statistics, the number of actively employed farm labor reached the highest record in 1963, totaling 1,770,000 persons. During the period from 1964 to 1969, the total persons employed fluctuated between 1,600,000 and 1,700,000 persons.[3] Thereafter, there has been a declining trend except for 1974. In that year, the number of agricultural labor increased as a result of the worldwide economic crisis which forced many factories to lay off workers. Many of them had to go back to their farms. Detailed information is shown in table 2.

There are three factors which influence the total number of actively employed agricultural labor. The first is the number of labor entrants, the second is the number of net emigration and the third is the number of person who withdraw from or give up farming on account of death, accident and old age. If the number of the first category is larger than the sum of the second and third, then the total number of agricultural labors will increase. Otherwise, it will decrease. Having studied the changing process of agricultural labor force in recent years, we observed that the major reason for labor decrease was not caused by emigration, but rather by the decrease of new entrants. As shown in Table 4, during the period 1962-1967, 1967-1972 and 1972-1977, the number of new entrants are

Table 4. Estimated Number of Labor Entrants and Emigrants of Agriculture, 1962-1967, 1967-1972, 1972-1977

Unit: person

Item \ Period	1962—1967	1967—1972	1972—1977
Number of labor entrants	301,250	230,500	155,500
Number of emigration and retirement	359,000	318,000	175,500

Source: Calculated from Appendix Table 1.

301,250, 230,500 and 155,500 persons respectively, which shows a downward tendency. During the period from 1967 to 1972, the total outflow of agricultural labors was 318,000 persons, while the new entrants were merely 230,500 persons. Hence, the total number of agricultural labor force in 1972 was smaller than that of 1967. Had the number of new entrants between 1967 and 1972 maintained at

3) Shirley Kuo: The Economic Structure of Taiwan (in Chinese), Department of Economics, National Taiwan University, p. 198.

the same level of the 1962-67 period, the number of agricultural labors in 1972 would have been as large as in 1967. Similarly, if the number of new entrants of the 1972-1977 period had maintained at the same level of 1962-67 or of 1967-72, the total number of agricultural labors in 1977 would have been larger than that of 1967 and 1972. Therefore, it is fair to say that the decrease of agricultural labor force in recent years was largely due to the decrease of new entrants. Or to put it the other way, the number of young men who wish to work on farm has declined.

As far as emigration of rural labor is concerned, the major factor is the labor retirement due to old age. It is not because of the labor who give up agriculture and move to city jobs. As shown in Table 5, the net outflow of agricultural labor

Table 5. Change of Agricultural Labors by Age Groups, 1967-1972, 1972-1977

Unit: person

Age group	1967—1972	1972—1977
15—19 years	− 155,000	− 98,000
20—44 years	− 47,750	+ 28,250
Over 45 years	− 115,250	− 105,750
Total	− 318,000	− 175,500

Note: "−" denotes net emigration, "+" denotes net immigration.
Source: Calculated from Appendix Table 1.

during the period from 1967 to 1972 was 318,000 persons, but the labor who shifted job from agriculture to other industries totaled only 47,750 persons. Their age was between 20 years and 44 years. Because a 45 year-old labor in 1967 will be over 50 in 1972, his giving up agriculture is probably due to age. This kind of labor withdrawal is a natural phenomenon, it is not because of the attraction of non-farm job. Support can be found from other studies. One of them has concluded that "there is little possibility for an old agricultural labor to change job."[4] On the other hand, the emigration of young farm labors aged between 15 and 19 is another matter. They are teenagers and probably have not decided their careers for good. So their case is different from those whose age is over 25 years. Similarly we could not count the teenagers as permanent farm labors during the period when there were few non-farm job opportunities and they were forced to stay at home. Hence, the decrease of this age group should not be considered as a permanent loss resulting from job change. This situation can further be explained by Table 5. During the period from 1967 to 1972 the net emigration of the 15-19 age group was 155,000

4) Liao Cheng-hung: A Study on Rural Labor Migration in Taiwan (in Chinese), Department of Agricultural Extension, National Taiwan University.

persons, and during the next five years it was 98,000 persons. The decline in net outflow was due to the rapid development of the non-agricultural sector in recent years. The availability of nonfarm jobs facilitated their movement and cut short the waiting period at home. As a result, the total number of actively employed young farmers has decreased year after year. However, those who prefer to stay very likely plan to make farming their life-long career.

The above analysis also indicates that the larger labor force in the early years was partly due to an over-estimate of the younger age group.

The total emigration of agricultural labor during 1967 to 1972 was 318,000 persons, of which only 47,750 persons or 15.2% were likely due to change of jobs. The net emigration for the next five years was 175,500 persons. But during the same period 105,750 persons retired from farming because of age and 98,000 teen-agers moved out of farm. The sum of the two figures is larger than the total emigration. Therefore, during this period there was not only no outflow resulting from job change, but actually there was a small inflow. Again, this was due to the economic depression which made many factory workers loss their jobs and move back to the farm.

Based on the above analysis, we can conclude that the decrease in total agricultural labor force in recent years is largely due to a smaller number of the young generation who wish to take up farming, or put it the other way, due to a decrease in new entrants. The often mentioned cause—emigration—does not seem to have played an important role. As to the reasons for emigration, retirement because of age seems more important than the move-out for non-farm jobs.

III. ANALYSIS OF THE AGE COMPOSITION AND CHANGING PATTERN

It is true that agricultural labor have become older over the years. As shown in Table 6, the average age of agricultural workers in 1967 was 34.7 years, it increased to 38.8 years in 1972 and 39.2 years in 1977. This situation has caused concern of many people. Our observation is that the increase of agricultural labor age appears to be a temporary phenomenon, and it will not continue forever, since the increase of agricultural labor age results from the declining ratio of young persons and increasing ratio of old age group.

Prior to the rapid economic development, the non-agricultural sector was not able to absorb all the young labor force which the farm sector could release, forcing

many young labors to stay in agriculture and resulting in a pyramid age distribution in the farm labor force.

The bottom-heavy labor force is characterized by low average age and disguised unemployment. It can be considered as an abnormal or transitory period in the course of economic development. As industrial and commercial sectors began to develop and the demand for labor helped raise the average age of agricultural labor force and the lower ratio of young farm labors. On the other hand, the average age of farm workers was young in the early years when there was a large number of surplus labor. The young labors at that time were forced to stay on farm because there were no other places to go. When there were job opportunities available they were somewhat too old to find a non-farm job. This is why there is a large proportion of farm workers of middle age at present.

Table 6. Percentage of Agricultural Employment by Age, 1967, 1972, 1977

Unit: %

Age \ Year	1967	1972	1977
Total	100	100	100
15—19 years	17.49	14.13	9.63
20—24	9.14	8.96	8.21
25—29	13.25	9.09	9.35
30—34	13.95	11.97	9.24
35—39	13.28	13.93	13.39
40—44	10.16	14.28	15.45
45—49	8.74	10.92	13.15
50—54	6.71	8.67	9.18
55—59	4.15	5.81	7.08
60—64	2.13	1.85	4.26
Over 66 years	0.97	0.57	1.05
Average (years)	34.70	36.80	39.20

Source: Calculated from Appendix Table 1.

Table 6 shows that the proportion of young farm workers has declined in recent years. From 1967 to 1977, the share of the first four age groups comprising persons between the ages of 15 to 34 had declined, and the proportion of the age group of over 35 years had increased. This is shown by Figure 1. After 1967, the peak of age distribution of farm workers has moved to the right. It was 34 years of age in 1967 and 44 years in 1977. This result is the outgrowth of the surplus labors in the early years and it is not because of, as some people argued, the emigration from the farm sector. This further illustrates that the rise of average

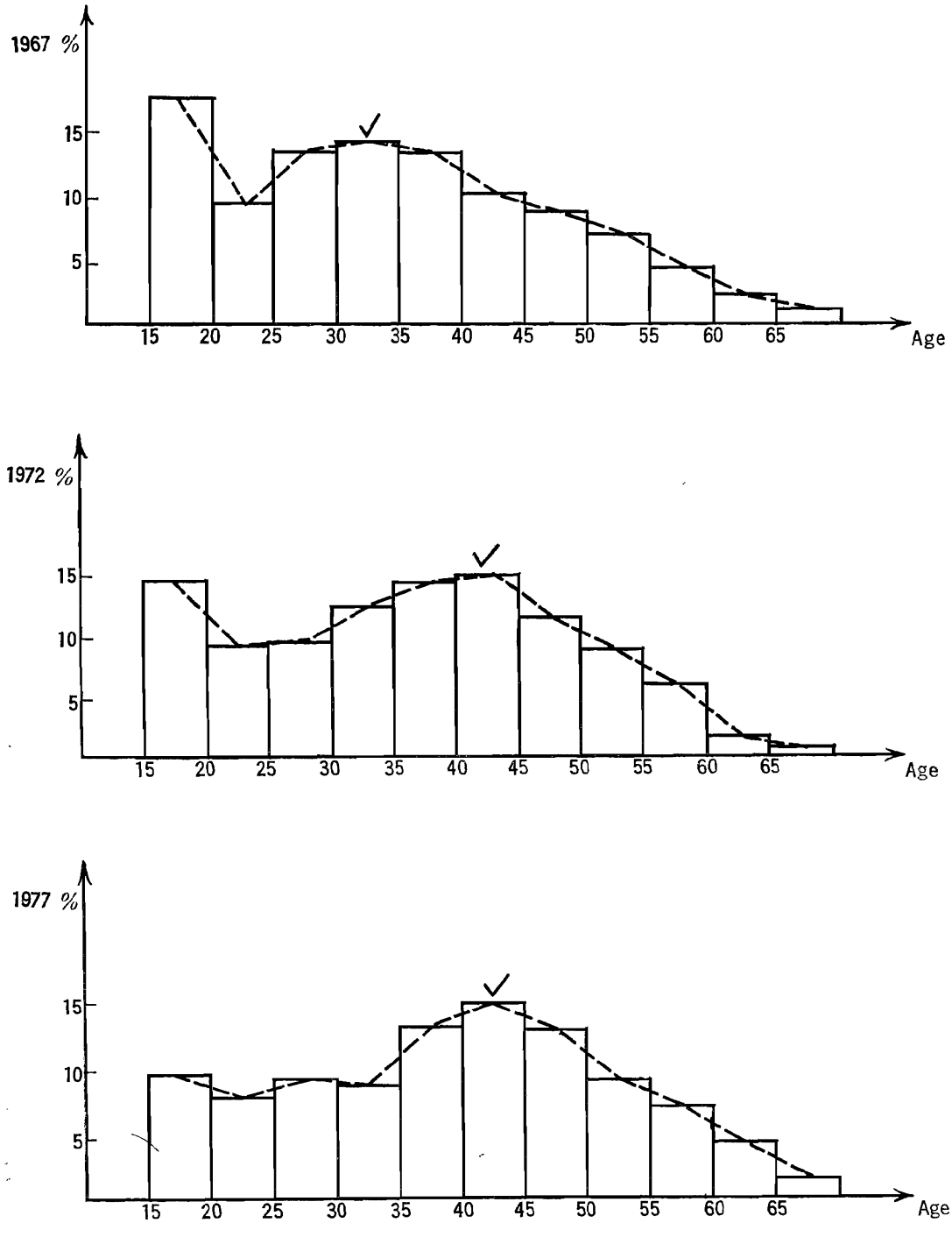

Figure 1. Percentage Distribution of Agricultural Employment by Age, 1967, 1972, 1977

age of agricultural labor is due to the decrease of new entrants, which in turn makes the proportion of the middle-age group relatively large. We regard this situation a transitional phenomenon. If we compare the present age distribution of farm workers with that in the past and pay no attention to its characteristic, we would get a wrong conclusion.

It is true that the average age of farm workers will increase in the coming years. But when the middle-age workers at present retire from the active labor force, the proportion of each age group will return to normal. By that time, the average age would also decline.

IV. POSSIBLE CHANGE OF AGRICULTURAL LABOR FORCE IN THE FUTURE

1. Change In The Number of Farm Workers

Along with the development of Taiwan economy, the young rural labor will continue to migrate to non-farm sector in the future, and the number of new labor entrants in agriculture will decrease. On the other hand, as the ratio of agricultural labor force is high at present, a growing number of farm workers will retire from agriculture in the future because of old age. As a result, the total number of agricultural employment would become smaller gradually in the coming ten years or so.

If we assume that the annual emigration rate of agricultural labor during the period from 1977 to 1987 is 1.5%,[5] and that the annual emigration rate of each age group during the same period is equal to the average of 1967-1972, and 1972-1977 then the number of each age group and total agricultural labor force can be estimated. These figures are shown in Table 7. According to this estimate, the total number of agricultural labor force in 1982 and 1987 would be 1,497,000 and 1,388,000 persons respectively, which are 117,500 persons and 226,500 persons

Table 7. Change in the Number of Total Agricultural Employment, 1977-1982, 1982-1987

Unit: person

Year \ Item	Number in the beginning	Entrants	Net emigration	Number at the end year
1977—1982	1,614,500	101,260	−218,760	1,497,000
1982—1987	1,497,000	103,450	−212,450	1,388,000

Source: Calculated from Appendix Table 2.

5) It is assumed that total agricultural labor force will decrease 1.5% per year in the next 10 years.

less than that of 1977. The reason for decrease is that the number of new entrants is smaller than the number of net emigration. During the period from 1977 to 1982, the number of new entrants will be 101,260 persons, but the emigration is estimated to be 218,760 persons. Similarly, during the period from 1982 to 1987, the number of new entrants will be 103,450 persons, but the emigration will be 212,450 persons. The characteristics of the emigration can be observed from Table 8. During 1977 to 1982, total emigration will be 218,760 persons, among which 155,220 persons or 71% of the total are 45 years of age or over. The number of emigration between age 15 to 19 is 71,800 persons which equals to 33% of the total. As to the age group between 20 and 44, there will be a small net immigration of 8,260 persons. Similarly, from 1982 to 1987 there will be 170,020 persons emigrating from agriculture because of old age, which is 80% of the total emigration for that period. The new emigration of 15 to 19 age group is 46,910 persons or 22% of the total emigration. On the contrary, there will be 4,480 persons moving to agriculture in the 20 to 44 age group.

Table 8. Estimated Net Change of Agricultural Labor by Age Group, 1977-1982, 1982-1987

Unit: person

Age group	1977—1982	1982—1987
15—19 years	− 71,800	− 46,910
20—44 years	8,260	4,480
Over 45 years	− 155,220	− 170,020
Total	− 218,760	− 212,450

Note: "−" denotes net emigration, "+" denotes net immigration.
Source: Calculated from Appendix Table 2.

2. Change In Average Age of Agricultural Labor

As decribed in the last paragraph, the number of new labor entrants in agricultural sector will continue to decrease in the future. This will cause decline in the share of young farm workers. Furthermore the middle-aged agricultural labors at present would become old and move to the aged group, which means that the proportion of old agricultural labor will rise gradually, and the average age of labors will increase accordingly. As shown in Table 9, in the three years of 1977, 1982 and 1987, the share of each age group over 45 years increased year after year, while the shares of each age group under 29 years declined. In the meantime, the average age of agricultural labor force would increase also. Furthermore, Figure 2 shows that from 1977 to 1987 the peak of age distribution curve of agricultural labor moves to the old age direction. Therefore, we can

Table 9. Percentage Distribution of Agricultural Labor Force by Age, 1977, 1982, 1987

Unit: %

Age \ Year	1977	1982	1987
Total	100.00	100.00	100.00
15—19 years	9.63	6.76	7.45
20—24	8.21	5.59	3.92
25—29	9.35	9.33	6.60
30—34	9.24	9.37	9.23
35—39	13.39	10.40	10.47
40—44	15.45	15.38	12.04
45—49	13.15	16.09	16.00
50—54	9.18	12.52	15.26
55—59	7.08	7.99	10.91
60—64	4.26	4.29	4.69
Over 65 years	1.05	2.28	3.43
Average age (years)	39.20	41.60	43.30

Source: Calculated from Appendix Table 2.

conclude that the average age of agricultural labor will continue rising in the coming years. Based on our calculations, the average age of agricultural labors in 1982 and 1987 will reach 41.6 and 43.3 years of age respectively, while in 1977 it was only 39.2 years of age. This situation will remain until 1987 and it is mainly the result of a high percentage of old labors. When these persons retire from agriculture, then the average age of agricultural labors will decline immediately. Judging from figure 2, the average age of agricultural labors will decline drastically 30 years from now. After that, the average age will maintain at a stable level.

V. CONCLUSIONS AND SUGGESTIONS

Based on the above analysis, we can conclude that the decrease of agricultural employment in recent years is largely due to decline in new labor entrants each year, not because of large number migration from the farm. Furthermore, the emigration of agricultural labors comes from two sources. The first is the retirement of aged persons which, needless to say, is a normal phenomenon. The second is the large number emigration of the 15-19 age group. These young labors had not made up their mind about their occupations when they were on the farms, their emigration should not be considered as a loss of farm workers.

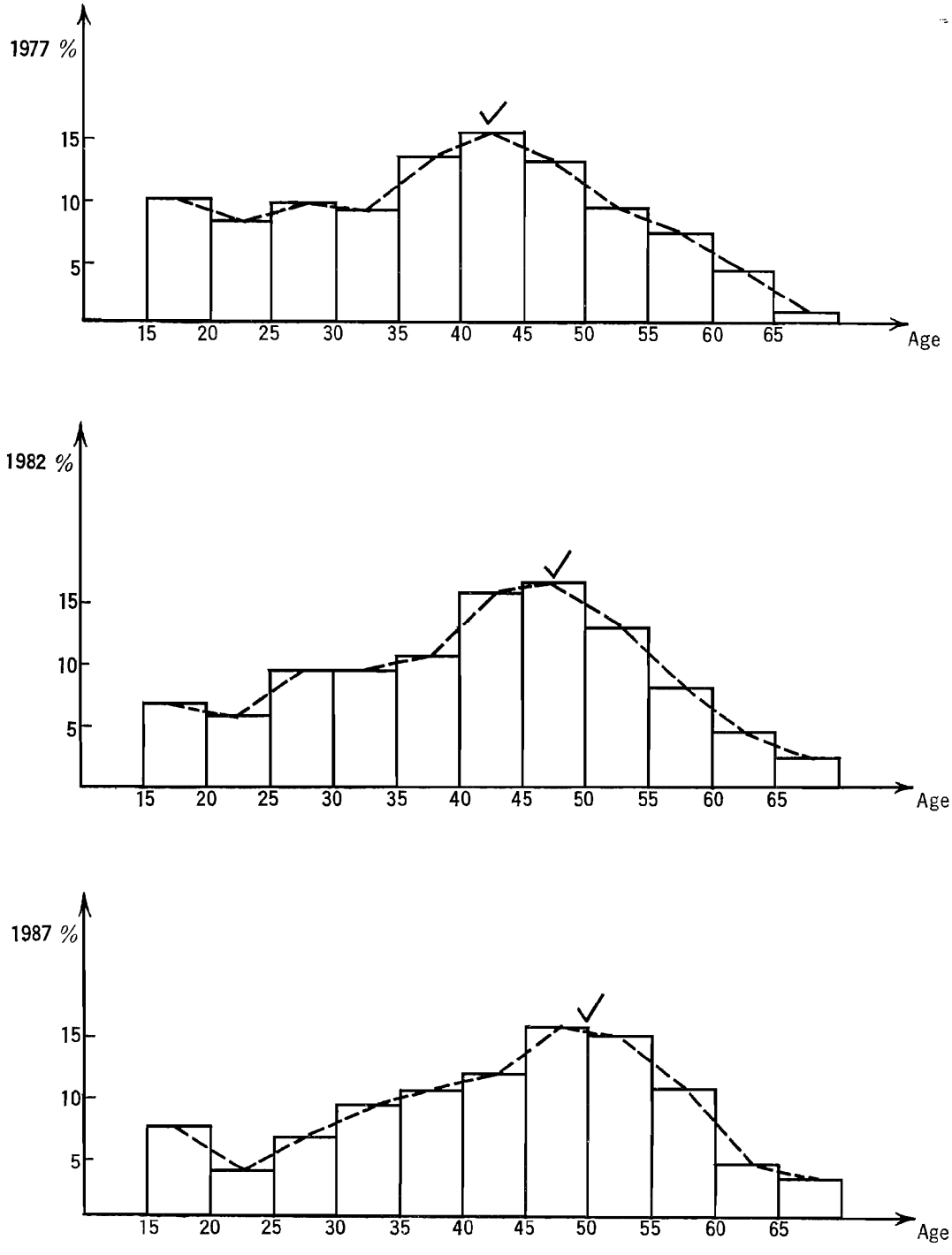

Figure 2. Percentage Distribution of Agricultural Labor Force by Age, 1977, 1982, 1987

In recent years, the rise of average age is a fact. Again this is not the result of outflow of young agricultural labor, it is rather due to the large labor force in the past, which after some years naturally leads to a high average age. In the future, as the existing old age group retires from agriculture, the average age of agricultural labor will decline and maintain at a stable level.

Although the ratio of agricultural production to the total of the economy will decline because of rapid development in the non-agricultural sector, agriculture will continue to play a very important part in the economic system. Labor is a major factor of agricultural production, its equilibrium between supply and demand as well as its quality will have a great bearing on agricultural development. In the text which follows we will propose some short-run and long-run strategies which are aimed at improving agriculture.

1. The Short-run Strategies

(1) Accelerating agricultural mechanization so as to decrease labor demand during busy season: The present labor shortage appears only in busy season. To decrease labor demand in busy season, it is necessary to strengthen the research on agricultural machines and, at the same time, to extend them to the farmers. Another barrier to farm mechanization is the high price of agricultural machines. In order to overcome the difficulties, actions should be taken to lower market price and to promote joint use of agricultural machines. This can not only meet the demand of individual farm but also can raise the utilization rate of farm machinery and lower production cost.

(2) Rearranging farm operation and production structure so as to suit the condition of decreasing agricultural labor: Agricultural production in Taiwan has been characterized by labor-intensive operation. However, as farm labor force decreases, the labor-intensive production method should be substituted by labor-saving operations. This change requires the cooperation from many aspects such as variety improvement and new cultivation techniques, etc. All future experiments in these fields should take labor-requirement into consideration. If farm operations remain as the same of the past, agricultural development will be hampered.

(3) Promoting labor exchange between farm families of different regions and encouraging custom farming so as to resolve the difficulty of labor shortage: At present, the shortage of farm workers is a phenomenon of individual farm family. Hence, if the farm families of different crop patterns can exchange labors, it will not only reduce the difficulty of labor shortage in the farm family, but will also make the use of farm labor more efficiently. This method can be made more

effective by establishing labor exchange service center by local farmers' associations. Farm family may go to the center to register in advance the labor he needs and the labor he can spare, and then an operation schedule can be arranged by a coordination center comprising several service centers. This is a way to increase the utilization rate of agricultural labor and to reduce the seasonal labor shortage of farm families.

2. The Long-run Strategies

(1) Maintaining reasonable profits of agricultural production and improving the working and living environments in rural areas so as to encourage the young labor to remain on the farms: Income and the working and living environments are the major factors affecting the job selection of the young labor. For this reason, improving the working and living environments and maintaining a reasonable profits for agricultural production will attract more young labor to choose agriculture as their occupation. On the other hand, if agriculture profits are relatively low and rural environments fall too far behind the city, young labor will not be interested in agriculture. This could eventually develop a crisis in agricultural development.

(2) Strengthening extension education for middle-aged farm workers: In the coming 20 years, the proportion of the middle-aged farm workers will remain to be high. To enable these persons to pick up modern idea and technique in agriculture, it is necessary to strengthen agricultural extension education. Furthermore, education should be designed in such a way that it suits to the farmers' needs. To fulfill this goal, help from the agricultural research and educational institutes and agricultural experiment stations is very much needed.

Appendix Table 1. Total Employed Persons in Agriculture, 1967, 1972, 1977

Unit: 1,000 person

Age	Total			Male			Female		
	1967	1972	1977	1967	1972	1977	1967	1972	1977
Total	1,722.00	1,634.50	1,614.50	1,168.50	1,076.00	1,094.75	554.25	555.75	519.75
15—19	301.25	230.50	155.50	161.00	122.00	99.75	140.25	108.50	55.75
20—24	157.50	146.25	132.50	85.25	74.00	81.50	72.25	72.25	51.00
25—29	228.25	148.25	151.00	164.50	102.50	107.25	63.75	45.75	43.75
30—34	240.25	195.25	149.25	171.25	134.75	95.25	69.00	60.50	54.00
35—39	228.75	227.25	216.25	161.75	147.75	140.25	67.00	79.50	76.00
40—44	175.00	233.00	249.50	120.00	154.00	161.00	55.00	79.00	88.50
45—49	150.50	178.25	212.25	105.75	121.50	143.25	44.75	56.75	69.00
50—54	115.50	141.50	148.25	91.25	106.00	102.75	24.25	35.50	45.50
55—59	71.50	94.75	114.25	59.00	76.50	88.50	12.50	18.25	25.75
60—64	36.75	30.25	68.75	32.50	28.50	59.25	4.25	1.75	9.50
Over 65 years	16.75	9.25	17.00	15.00	8.50	15.75	1.75	0.75	1.25

Source: The Economic Planning Council, Supplement to the Labor Force Survey Data in Taiwan.

Appendix Table 2. Total Employed Persons in Agriculture, 1977, 1982, 1987

Unit: 1,000 persons

Age	1977			1982			1987		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total	1,614.50	1,094.75	519.75	149.70	1,015.08	481.92	1,388.0	941.20	446.80
15—19	155.50	99.75	55.75	101.26	62.64	38.62	103.45	65.19	38.26
20—24	132.50	81.50	51.00	83.70	56.24	27.46	54.35	35.32	19.03
25—29	151.00	107.25	43.75	139.64	108.05	31.59	91.57	74.56	17.01
30—34	149.25	95.25	54.00	140.34	93.70	46.58	128.09	94.46	33.63
35—39	216.25	140.25	76.00	155.69	90.66	65.03	145.33	89.24	56.09
40—44	249.50	161.00	88.50	230.29	143.18	87.11	167.09	92.55	74.54
45—49	212.25	143.25	69.00	240.80	156.49	84.31	222.06	139.08	82.98
50—54	148.25	102.75	45.50	187.40	132.37	55.03	211.84	144.60	67.24
55—59	114.25	88.50	25.75	119.59	85.97	33.62	151.42	110.75	40.67
60—64	68.75	59.25	9.50	64.15	55.65	8.50	65.16	54.06	11.10
Over 65 years	17.00	15.75	1.25	34.14	30.07	4.07	47.64	41.39	6.25

Note: 1. Assume the yearly emigration rate of employed agricultural labors is 1.5% during 1977–1987.

2. The yearly net emigration rate of each age class from 1977 to 1987 is the average of the periods 1967-1977.

Source: Same as Appendix Table 1.

Population and the Land System in Taiwan*

Yu-kang Mao

I. INTRODUCTION

Due to rapid economic development and outmigration of agricultural labor, agricultural wages have increased greatly in recent years. Consequently, agricultural production costs have been pushed upward remarkably. As agricultural labor decreases, the size of farm has not shown any significant increase. This results in relatively low agricultural labor productivity and enlarges the income gap between farmers and non-farmers. Therefore, the problem of farm size is the bottleneck of agricultural development of Taiwan.

The size of farm is determined, on the one hand, by the man-land ratio, and also by the existing land system on the other. It is very difficult to increase the total area of farmland in Taiwan because of the lack of unexploited arable land. In the past two decades, the area of farmland increased by only 20,000 hectares, but it has decreased in recent years. In 1952, the average area of farmland per farm was 1.29 hectares, but it decreased to 1.02 hectares in 1973. According to reports from agricultural censuses, the number of small farms has gradually increased. For example, the percentage of farms with farmland less than 0.5 hectare was 34.4% in 1955, and increased to 43.9% in 1970. It is estimated that about 70% of farms have less than one hectare of farmland at present.

It is expected that due to outmigration of agricultural population, the size of farm can be expanded in the future. However, because of restrictions of the existing land system, it is unlikely that farm size can be expanded to any significant extent in the near future. Hence, the farm income problem will become more and more serious and it will certainly affect agricultural development in Taiwan.

The primary purposes of this study are to analyze the effects of agricultural population changes on farm organization and operation, and to discuss the relationship between land system and agricultural development. It is hoped that the result of this study will provide useful information for agricultural planning in the future.

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II. EFFECTS OF CHANGES IN AGRICULTURAL POPULATION ON THE SIZE OF FARMS, AGRARIAN STRUCTURE AND TYPE OF FARMING

1. Changes in Agricultural Population:

Taiwan has one of the highest population densities in the world, about 440 persons per square kilometer or 1,140 persons per square mile in 1974. Its population in 1925 was about 4 million. It doubled to 8 million by 1952 and redoubled to 16 million in 1975. Before the Second World War, the total population grew at a rate of 2.6% a year. After the war and especially during the period from 1946 to 1965, the annual growth rate of total population went up and remained at a level of more than 3%. The rapid population increase was mainly due to the drop in the death rate, which fell from 1.8% in 1947 to 0.55% in 1965. Since then, the growth rate of the population has declined, and dropped to 1.8% in 1974. The decrease in the birth rate was the major factor contributing to the slowdown of population growth.

Agricultural population accounted for 56.4% of the total population in 1925. Since then, agricultural population grew at a lower rate than that of total population. Consequently, the share of agricultural population in the total population declined and reached 49.1% in 1940. During the period of World War II and immediately after the war, employment in the industrial sector decreased and many factory workers went back to the farms, thereby greatly increasing the number of agricultural population. The agricultural population accounted for 57.8% of the total in 1946 and 52.9% in 1950. It approached a peak of 6.2 million in 1969, then slowly decreased to 5.8 million in 1974 (Table 1). The annual rate of decrease during 1970 to 1974 was 0.8%, an equivalent of some 50,000 persons a year. In 1974, the agricultural population accounted for only 36.6% of the total population (Tables 2 and 3).

During the post-war period, the number of farm households showed a similar trend as that of agricultural population. It reached a peak of 887,112 in 1969, then gradually decreased to 877,829 in 1974, a decrease of about 9,300 farm households in five years or an average of about 1,860 farm households per year. As shown in Table 3, the agricultural population decreased at a much higher rate than the number of farm households in recent years. This phenomenon might be explained by the fact that rural outmigration largely drew its recruits from the younger generation of farm families, and it also indicates why farm size in Taiwan can not be expanded quickly in the course of industrialization.

Table 1. Total Population, Agricultural Population and Number of Farm Households, 1925-1974

Year	Total population	Agricultural population	No. of farm households
1925	4,147,462	2,339,649	393,777
1930	4,679,066	2,534,404	411,377
1935	5,315,642	2,790,331	419,865
1940	6,077,478	2,984,258	429,939
1946	6,090,860	3,365,688	500,531
1950	7,554,399	3,998,470	638,062
1955	9,077,643	4,603,138	732,555
1960	10,792,202	5,373,375	785,592
1965	12,628,348	5,738,503	847,242
1970	14,675,964	5,996,889	880,274
1974	15,852,224	5,801,522	877,829

Sources: JCRR, *Taiwan Agricultural Statistics, 1901-1965,* Dec. 1966.
PDAF, *Taiwan Agricultural Yearbook,* various years.

Table 2. Agricultural Population as a Percentage of Total Population, 1925-1974

Year	Percentage	Year	Percentage	Year	Percentage
1925	56.0	1946	57.8	1965	45.4
1930	54.2	1950	52.9	1970	40.9
1935	52.5	1955	50.7	1974	36.6
1940	49.1	1960	49.8		

Source: Calculated from Table 1.

Table 3. Average Growth Rates of Total Population, Agricultural Population and Number of Farm Household, 1925-1974

Period	Total population	Agricultural population	No. of farm households
1925—30	2.5	1.6	0.9
1930—35	2.6	2.0	0.4
1935—40	2.7	1.3	0.5
1940—46	0.1	2.0	2.6
1946—50	5.6	4.4	6.3
1950—55	3.9	2.8	2.8
1955—60	3.5	3.1	1.4
1960—65	3.2	1.3	1.5
1965—70	2.5	0.9	0.8
1970—74	1.9	-0.8	-0.1

Source: Calculated from Table 1.

2. The Decrease in the Size of Farms:

The average size of farms in Taiwan was relatively small as compared with other countries in the world. Before 1925, the average size of farms was not known because the number of farm households was not available. From 1925 to 1940, both the number of farm households and area of farmland increased, but the latter increased at a faster rate. As a result, there was a slight increase in the average size of farms. In 1925, the average farm size was 1.97 ha.; in 1940, it increased to 2.00 hectares. During World War II, area of farmland decreased considerably because of war damage. In the meantime the number of farm households continued to increase. Therefore, the average size of farms was reduced remarkably, and dropped to 1.63 hectares in 1945.

After the restoration of Taiwan to the Republic of China, the government made an all-out effort to increase agricultural production. The total area of farmland surpassed the prewar record in 1948, and it increased to 883,466 hectares by 1958. Between 1958 and 1963, much farmland was lost to floods, resulting in a total decrease of farmland. It did not regain its 1958 level until 1964. Since then farmland has increased gradually year after year, and reached 914,963 hectares by 1969. In spite of the slight increase in farmland, the average size of farms continued to decrease, it was 1.03 hectares in 1969. From 1969 to 1973, both areas of farmland and number of farm households showed a decrease due to rapid development of the non-agricultural sectors, and the average size of farm also decreased to 1.02 hectares. In the recession year of 1974, the government encouraged farmers to cultivate the idle farmland, this policy has helped expand the total area of farmland to 917,484 hectares, and the average farm size to 1.05 hectares (Table 4). However, in the long-run, economic development is likely to convert more farmland to non-agricultural use. Thus, if the decrease in the number of farm households cannot be accelerated, it will be very difficult to expand the average size of farms in the future. When the size of farms is limited, it is difficult to increase the productivity of agricultural labor, and the disparity in income between farmers and non-farmers will become more and more significant.

According to various agricultural censuses, the distribution of farms by size is shown in Table 5. In 1960, 37.4% of all farms were below 0.5 hectare in size, 29.1% between 0.5 and 1.0 hectare, 15.4% between 1.0 hectare and 1.5 hectares. Only 18.1% of all farms were larger than 1.5 hectares. The 1965 census shows a similar distribution to that of 1960. But the 1970 census indicates a significant increase in the percentage of the group below 0.5 hectare and a decrease in other size groups. That is 43.9% of all farms were less than 0.5 hectare in size, 27.6%

Table 4. Average Size of Farm, 1925-1974

Year	Total area of farmland Ha.	Number of farm households	Average size of farm Ha.
1925	775,468	393,777	1.97
1930	812,116	411,377	1.97
1935	831,003	419,865	1.98
1940	860,439	429,939	2.00
1945	816,017	500,533	1.63
1950	873,633	638,062	1.36
1955	873,002	732,555	1.19
1960	869,223	785,592	1.11
1965	889,563	847,242	1.05
1970	905,263	880,274	1.03
1974	917,484	877,829	1.05

Source: Same as Table 1.

Table 5. Percentage Distribution of Farms by Size, 1960, 1965 and 1970

Size of farm	1960 census	1965 census	1970 census
Less than 0.5 ha.	37.4	37.9	43.9
0.5—1.0 ha.	29.1	28.8	27.6
1.0—1.5 ha.	15.4	15.0	13.1
1.5—2.0 ha.	8.3	8.1	6.9
2.0—2.5 ha.	4.2	4.2	3.4
2.5—3.0 ha.	2.3	2.4	2.0
3.0 ha. and over	3.3	3.6	3.1
Total	100.0	100.0	100.0

Source: *Report of Taiwan Agricultural Census*, various years.

between 0.5 hectare and 1.0 hectare; 13.1% between 1.0 hectare and 1.5 hectares. Only 15.4% of them had more than 1.5 hectares of farm land. This indicates that during the past decade or so, farms in Taiwan have become smaller and smaller.

Farm size also varies between different localities in Taiwan. An early study[1] based on data obtained from the 1960 agricultural census had shown the average farm size and the coefficient of variation of farm sizes in each township except for cities and townships on remote islands or in the high mountains. Out of a total of 283 townships, there were 160 townships or 56.6% of the total which had an average farm size of from 0.5 hectare to 1.0 hectare. Another 100 townships, or 35.3% of the total, had an average farm size of 1.0 hectare to 1.5 hectares (Table 6).

1) Yu-kang Mao, "A Study on the Problems of Farm Sizes in Taiwan", *Quarterly Journal of Taiwan Land Credit*, No. 4, Vol. 7, December 1970.

Table 6. Number of Townships by Average Size of Farms, 1960

Average farm size Ha.	No. of townships	Percentage
Less than 0.5 ha.	6	2.1
0.5—1.0 ha.	160	56.6
1.0—1.5 ha.	100	35.3
1.5—2.0 ha.	15	5.3
2.0—2.5 ha.	2	0.7
Total	283	100.0

Source: Y. K. Mao, "A Study on the Problems of Farm Sizes in Taiwan," *Quarterly Journal of Taiwan Land Credit,* No. 4, Vol. 7, Dec. 1970.

In other words, 91.9% of Taiwan's townships had an average farm size between 0.5 hectare and 1.5 hectares. There were only 17 townships, or 6% of the total, which had an average farm size above 1.5 hectares. These townships are located either on coastal area or on hillsides. The productivity of land in these areas is generally lower than that of other townships. On the contrary, there were six townships with an average farm size of less than 0.5 hectare, but the land productivity in these townships was generally higher than that of other townships.

The variations in farm size among farms in a township may be expressed by the coefficient of variation, which is the ratio of the standard deviation to the average. The larger the coefficient, the greater is the variation in farm size among farms. Of the 283 townships studied, 36 townships, or 12.7% of the total, had a coefficient of variation below 80; 95 townships, or 33.6% of the total, had a coefficient of variation between 80 and 90; 74 townships, or 26.1% of the total, had a coefficient of variation ranging from 90 to 100; 52 townships, or 18.4% of the total, had a coefficient of variation ranging from 100 to 110. The coefficient of variation of the remaining 26 townships, or 9.2% of the total, was greater than 110. The overall coefficient of variation of farm sizes in Taiwan was 100.6 (Table 7), indicating the degree of significant variation of farm size among farms.

Table 7. Number of Townships by Coefficient of Variation of Farm Size, 1960

Coefficient of variation %	No. of townships	Percentage
Less than 80	36	12.7
80—90	95	33.6
90—100	74	26.1
100—110	52	18.4
110 and up	26	9.2
Total	283	100.0

Source: See Table 6.

Size of farms also varies greatly between different farming regions in Taiwan. The 1960 census data show that the eastern sugarcane region had the largest average farm size, 1.441 hectares, and was followed by the tea region, 1.267 hectares; then the eastern rice region, 1.189 hectares; the Chianan rotation region, 1.018 hectares; and the Miaoli mixed farming region, 1.007 hectares. All other regions had an average farm size of less than one hectare: These were the Taipei double-rice region, 0.997 ha.; the western sugarcane region, 0.995 ha.; the Alishan hillside mixed farming region, 0.988 ha.; the Lanyang double-rice region, 0.964 ha.; the banana-pineapple region, 0.920 ha; and the Taichung hillside mixed farming region, 0.915 ha. The Kaohsiung double-rice region and the Taichung double-rice region had the smallest average size of farms, 0.863 ha. and 0.737 ha. respectively (Table 8). In general, regions with higher land productivity such as the double-rice regions, usually have a smaller farm size. On the other hand, regions with lower land productivity, such as the sugarcane region, the rotation region and the tea region, have a larger farm size. The coefficient of variation of farm size of different regions shows no significant relation with size of the farms. It may indicate that there is no relation between the variation of farm size and land productivity among farms.

Table 8. Average, Standard Deviation and Coefficient of Variation of Size of Farms in Different Farming Regions, 1960

Farming region	Average farm size Ha.	Standard deviation Ha.	Coefficient of variation %
Lanyang double rice region	0.964	0.834	86.5
Taipei double rice region	0.997	0.805	80.7
Taichung double rice region	0.737	0.819	111.1
Kaohsiung double rice region	0.863	0.880	101.9
Eastern double rice region	1.189	1.178	99.1
Tea region	1.267	1.187	93.7
Miaoli mixed farming region	1.007	1.053	104.6
Taichung hillside mixed farming region	0.915	0.844	92.2
Alishan hillside mixed farming region	0.988	1.053	106.6
Banana-pineapple region	0.920	1.029	111.8
Chianan rotation region	1.018	1.063	104.4
Western sugarcane region	0.995	0.963	96.7
Eastern sugarcane region	1.441	1.493	103.6

Source: See Table 6.

3. Agrarian Structure and Need for Land Reform:

Scarcity of land and a surfeit of population together with the concentration of land ownership resulted in the predominancy of tenancy in the agrarian structure of Taiwan before the land reform.

The tenancy system of Taiwan has a long history. By the end of 17th century, after the abolition of "Crown Land" by the Ching Dynasty, a tenancy system was rapidly established. The fifty years of Japanese control over the island showed appreciable progress in industrialization, but brought no remarkable change in agrarian structure. The Japanese government corporations, which occupied the farmers' land by force, made the situation of land concentration more serious and increased the number of tenants. According to the records of the Taiwan Governor-General, land concentration climbed to a peak in 1920-1921, when 42.7 percent of all farm families that cultivated less than half a hectare, and occupied only 5.7 percent of the cultivated land, while 0.05 percent of farm families who owned more than 100 hectares occupied 13.1 percent of the total cultivated area. The keen competition among landless farmers for securing leases gave rise to land-lordism and exorbitant rents. This, in turn, resulted in an unreasonable man-land relationship as well as an unjust landlord-tenant relationship, which prevented economic progress and menaced the social security of the island.

The pre-war tenure situation of 1939, which was taken as the pre-reform basis in Taiwan, appeared no better than that of 1920-21. Out of the total area of 827,869 hectares of cultivated land, 361,342 hectares, or 43.7 percent were operated by owners, while 466,367 hectares or 56.3 percent were cultivated by tenants. In Taipei, Hsinchu, and Taichung, where the land is considered most productive, the percentage of tanancy was higher than in the other places. Side by side with the high percentage of tenancy cultivation were small owners' holdings and fragment units of farms. Owners with less than one hectare comprised 64.7 percent of the total owners, and farm families which cultivated less than one hectare accounted for 56.9 percent of the total. Under the traditional system the tenant had not only to pay an exorbitant rent to the landlord, but also to deposit a large sum of money in order to secure his lease. In some instances, the deposit was as much as two years' rent. Worst of all was the uncertainty of tenure that the system imposed. There was seldom a written contract between landlord and tenant. This made it very easy for the landlord to cancel the lease in order to get a higher rent from other prospective tenants. The rent the tenant paid before land reform was far above the level justified by the productivity of the soil. The average rent was more than half the annual yield. Some rents even went as high as 70 percent. The rate for paddy field was higher than that for dry land. Generally, the higher the grade of the land, the greater the rent charged. Rent was paid mostly in kind, on a share basis. The landlord, as a rule, charged the tenant a fixed amount of rice as rental for paddy land regardless of how small a crop the tenant might raise or what crop he planted.

With a very limited amount of farm land and an irrational tenure system in agriculture, underemployment of farm labor presented a serious problem. Farm operators often found it difficult to meet their living expenses with cash income from farming and had to depend upon off-farm employment to get additional cash income to cover their family expenses. Technological improvements in agriculture was confined to seed improvement, more fertilizer input, and intensified pest and disease control, while low income, low capital input, a surplus labor force and the small size of individual farms constituted the major obstacles to the introduction of modern farm improvements and advancement in agriculture.

To lay the foundations for agricultural development and to seek the solution of some of the problems listed above, the government set out in 1949 and 1953 to implement rent reduction measures and the Land-to-the-Tiller Program, which aimed at raising the farmers' standard of living and putting an end to the evils of the traditional system of land tenure, which also hindered agricultural development.

The land reform carried out in Taiwan consisted of two phases: reduction of exorbitant rental rates on privately tenanted land, sale of public cultivated land, and resale of excessive holdings to tenants.

(1) The Rent Reduction Program: In 1949 Taiwan had 260,000 hectares of private farm holdings under tenancy. Tenants led a desperate life under the pressure of high rents. To alleviate tenant farmers' distress, the Government implemented a rent reduction program on all private tenanted land. Under the program, the Government first established a new and uniform rental rate of 37.5% of the annual main crop yield on the farmland. Then productivity of all farmland was appraised by classifying the land into 26 grades according to productivity. After that, a standard expected yield estimate was assigned to each plot of land and on the basis of this standard the reduced amount of rent was fixed. In addition, new farm lease contract were made between landlord and tenant to replace the old ones and tenure of lease for tenant farmers was lengthened to 6 years. This program was enforced on all the 260,000 hectares of private tenanted holdings, and some 300,000 tenant families benefited. As a result of the program, tenants' income increased, their tenure security was protected and landlord's right of evicting tenants and disposing of lands was restricted. All of this led to a drop in the market value of tenanted land and enabled tenant farmers to purchase tenanted land with their own savings. From 1949 to 1973, a total of 70,000 hectares of tenanted land were purchased directly from landlords by 135,000 tenants.

Taking advantage of this situation, the government proceeded with the Land-to-the-Tiller Program.

(2) The Land-to-the-Tiller Program: The Land-to-the-Tiller Program was undertaken in two steps. The first step was to sell public land to tenant farmers and the second step was to redistribute the excessive private tenanted land among tenant farmers. Both steps were aimed at eliminating farm tenancy, on one hand, and establishing owner-farmers, on the other.

In 1949, Taiwan had a total of 180,000 hectares of public-owned land. These lands were originally owned by Japanese settlers and corporations. In 1951 the Government started to sell its own lands to set an example to private landlords. Since then, several sales have been made by the Government. A total of some 130,000 hectares were sold to 177,000 tenant families from 1950 to 1973. The sales price was set at 2.5 times the annual crop yield, and was to be paid in 20 installments over 10 years.

Along with the sale of public land, the government undertook the second step of redistributing excessive landlord holdings. As a first step, the government surveyed and grouped all land holdings in Taiwan and then enacted "Land-to-the-Tiller Act" to translate the program into action. Under this program, a landlord was allowed to retain a maximum of three hectares of medium grade paddy field or its equivalent for himself. All tenanted lands in excess of this maximum limit were compulsorily purchased by the Government and resold to the incumbent tenants. Therefore, it was only landlords who put their lands to lease who would be affected, not those owners who cultivated their own land. The purchase price was 2.5 times the crop yield. It was paid for by the Government with 70% in commodity bonds and 30% in stocks of four government industries. The Government collects two installments of the resale price in kind from the farmer-purchasers each year. Under this program, a total of 140,000 hectares of excessive land was purchased from 106,000 landlords and resold to 195,000 tenant families at a total price of 1,272,100 metric tons of rice and 433,262 metric tons of sweet potatoes.

One result of land reform is that more farmers own land. Before 1949, the first year when land reform was effected, 39% of all farmers in Taiwan were tenant farmers, 36% were owner-operated farmers and 25% were part-owner farmers. The Land-to-the-Tiller Program reduced tenant farmers to 21% and increased owner-operated farmers to 55% in 1953. In 1974, owner-operated farms increased to 79% of all farms and part-owner farms and tenant farms decreased to 11% and 10%, respectively (Table 9).

As a result of the reform, the increase in the number of owner-farmers in Taiwan matched the increase in the area of owner-cultivated land. Out of a total

area of 681,154 hectares of private cultivated land in Taiwan, 61.4% was cultivated by owners before land reform. Now the area under owner-cultivation has increased to 91%.

If farm ownership means farm security, increased farm ownership in Taiwan would undoubtedly contribute to more agricultural improvement and economic progress, because farmers are more willing to improve land that they own, rather than land that they rent.

Another important change made by land reform in Taiwan is in the size of individual land holdings. Before the implementation of the Land-to-the-Tiller Program, out of 691,154 hectares of private farm lands, 25% of all holdings were below one hectare, 26% between 3 and 10 hectares and 16% over 10 hectares, while the largest share (33%) were holdings between 1 and 3 hectares. After the implementation of the Land-to-the-Tiller Program, area of holdings below 3 hectares was increased from 58% to 77% while holdings over 3 hectares decreased from 42 to 23 percent.

Table 9. Percentage Distribution of Farm Households by Land Ownership, 1925-1974

Year	Owner-operator farm	Part-owner farm	Tenant farm
1925	29.0	30.1	40.9
1930	29.1	30.7	40.2
1935	31.5	30.6	37.9
1940	31.9	31.3	36.8
1945	29.8	29.5	40.7
1949	36.1	25.2	38.7
1953	54.9	24.1	21.0
1955	59.1	23.5	17.4
1960	64.5	21.2	14.3
1965	66.8	20.6	12.6
1970	76.8	12.3	10.9
1974	79.0	11.3	9.7

Sources: JCRR, *Taiwan Agricultural Statistics,* 1901–1965, Dec. 1966.
PDAF, *Taiwan Agricultural Yearbook,* various years.

These measures also affected the number of landowners in Taiwan. In 1952, the year before the implementation of Land-to-the-Tiller Program, there were 611,193 landowners in Taiwan, of which over 93% owned less than 3 hectares and only 7% owned over 3 hectares of land. In 1955, the total number of landowner families had increased to 789,429 families. Out of this number, owners holding less than 3 hectares of land rose to 96%, and those owning more than 3 hectares

of land dropped from 7 to 4%. It is worthwhile to point out here that the land reform program in Taiwan did affect the size of individual land holdings, but, the program did not involve the splitting up of larger owner-operated units of agriculture.

All these trends indicate that the land reform program in Taiwan has reorganized agrarian social structure into a true family farm system, which is essential in developing productive and progressive agricultural system.

4. The Increase of Part-time Farms:

As was mentioned previously, Taiwan is a land of many small farms, most averaging about one hectare. In the process of economic development, the income gap between farm and non-farm sectors has encouraged members of small farm families to seek employment in the cities or nearby towns. According to the agricultural census data of 1960, 1965 and 1970, the percentage of part-time farms increased remarkably in Taiwan. In 1960, 52.4% of all farms were classified as part-time farms and 47.6% of farms were classified as full-time farms. In 1965, part-time farms increased to 68.1% and full-time farms decreased to 31.9%. The 1970 agricultural census showed a further increase in part-time farms and decrease in full-time farms: part-time farms accounted for 69.8%, and full-time farms 30.2% of the total (Table 10).

Table 10 also shows that the smaller the size of farm, the higher the percentage of part-time farms. Taking 1970 as an example, 82.9% of farms of less than 0.5 hectare were part-time farms. However, among farms of more than two hectares, only 43.9% were part-time farms. The data shows that the percentage of large part-time farms has shown a tendency to increase. It may indicate that off-farm income has become more and more important to all farmers in Taiwan.

Table 10. Percentage of Full-time and Part-time Farms by Size of Farms, 1960, 1965 and 1970

Size of farm	1960		1965		1970	
	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time
All farms	47.6	52.4	31.9	68.1	30.2	69.8
Less than 0.5 ha.	30.1	69.9	14.1	85.9	17.1	82.9
0.5—1.0 ha.	55.6	44.4	35.3	64.7	34.5	65.5
1.0—1.5 ha.	63.8	36.2	47.9	52.1	33.6	66.4
1.5—2.0 ha.	66.6	33.4	53.8	46.2	50.7	49.3
2.0 ha. and over	66.7	33.3	58.1	41.9	56.1	43.9

Source: Taiwan Agricultural Census in 1960, 1965 and 1970.

Along with the increase of part-time farms, the share of farm family earnings from sources other than farming has also increased remarkably in Taiwan. Non-farm income made up 34% of average farm family income in 1966, and it increased to 55% in 1971 (Table 11). Wages and salaries were the major sources of off-farm income. The dispersal of factories in the past decade has increased the employment opportunities, and this has enabled rural people to earn more off-farm income.

Table 11. Sources of Farm Family Income (Percentage)

Sources of income	1966	1971
Total income	100.0	100.0
Net agricultural income	66.0	45.0
Net non-agricultural income	34.0	55.0
Wages and salaries	20.1	35.5
Property income	7.2	9.3
Misc. income	2.8	3.2
Others	3.9	6.8

Source: Taiwan Provincial Bureau of Accounting and Statistics, Report on the Survey of Family Income and Expenditure in Taiwan, 1966, 1971.

III. LAND SYSTEM AND CURRENT PROBLEMS OF AGRICULTURAL DEVELOPMENT

The abolition or near-abolition of tenancy has been the ideal of the land reform movement in Taiwan. The law provides for strong tenant occupancy rights. The farm lease contracts of six years' duration can be terminated by the landlord before expiration only if the tenant dies without an heir, or waives his right of cultivation by migrating elsewhere or changing his occupation, or fails to pay a total of two years' rent. This kind of protection extends to tenants even after the expiration of the lease. The law provides that the landlord cannot take back the leased land for his own cultivation at the expiration of the contract if any one of the following conditions exists: The landlord cannot till the land himself; the landlord's income is sufficient to support his family; or the landlord's action in taking back the land deprives the tenant's family of its subsistence. For all practical purposes, this means that tenants can remain on the land undisturbed even after the expiration of the contract. In addition, the maximum rental is fixed at 37.5 percent of the 1948 crop level. As the yield of rice has more than doubled at present, the actual rate of rent is far below the 37.5 percent level set by government. With fixed rental and increased land taxes, tenancy is now very favorable to the tenants and unfavorable to the landlords. In fact, after land reform, the leasing of farmland has ceased to be a device for the adjustment of

farm size in Taiwan. In other words, no more farmland has been leased to tenants for cultivation since land reform in Taiwan. It is one of the reasons for the slow change in farm size despite the fact that the farm population has shown a decrease.

Together with a farm policy emphasizing the protection of owner-farmers, the government has also carried out the following measures:

1. Any sale of owner-cultivated land must be approved by the government and the purchaser must show that he is a bona fide farmer. Purchase of farmland by non-farmers is prohibited.

2. The inheritance of owner-cultivated land by an heir who is capable of cultivating the land with his own labor is encouraged.

3. Whenever any owner-cultivated land is mortgaged, a maximum limit must be set to the claims made against it.

The over-protection of tenants and the strict restriction on the transfer of farmland after land reform have resulted in a rigid land system which can not provide an effective mechanism for enlarging farm size, which, at the present stage of agricultural development in Taiwan, appears to be necessary.

The rapid progress of industrial development has made the income differential between workers in agricultural and in non-agricultural pursuits wider and wider. The reasons for this are many and complicated, but two related factors stand out: small size of farms and inefficient operation.

Table 12 shows the difference in labor productivity between agricultural and non-agricultural workers. The low productivity of agricultural workers is the major reason for the relatively low income of farm families. The inefficiency of farm labor is mainly due to the small size of farm. Owing to the small size of farms, many farmers find it imperative to supplement their incomes with nonfarm jobs found locally or in towns or cities. In either case, friends or relatives are asked

Table 12. Labor Productivity of Agricultural and Non-agricultural Workers

Year	Agricultural workers (NT$) (1)	Nonagricultural workers (NT$) (2)	Ratio (1)/(2)×100
1952	3,424	8,968	38.18
1955	4,987	13,948	35.75
1960	10,071	22,063	45.65
1965	14,692	33,399	43.47
1970	18,635	53,355	34.93
1974	42,980	95,245	45.13

Source: Derived from DGBAS National Income of the Republic of China.

to oversee the farms during the period of their absence, which may range from several days to several weeks. The overseer generally tends such chores as irrigating, draining, minor repairs, thievery, and depredation by animals. However, the more time-consuming tasks, such as plowing, transplanting, weeding or applying chemical pesticides, fertilizers, herbicides, and fungicides, are usually postponed until the owner returns to perform the work himself. Clearly, the longer the delay, the more deleterious are the effects on the crops. One way to avoid such inefficiencies in cultivation is to obviate the need for nonfarm work by increasing the size of the average farm until it can fully support the farm family. Thus the enlargement of farm size is seen as fundamental to increasing farm income, the improvement of rural living standards, and the narrowing of the gap between the earnings of people in the agricultural and nonagricultural sectors.

Agricultural development in any region is profoundly affected by the land system prevailing there. To achieve the maximum rate of agricultural development, a desirable land system should have certain characteristics: [2)]

1. It should encourage farmers to put each field to its most productive use.

2. It should provide adequate incentives to farmers to maintain and increase soil productivity.

3. It should make it possible for farms to change size: (a) in response to changes in technology, e. g., new implements or sources of power may increase the optimum size of the farm units; and (b) in response to changes in the labor force and employment opportunities inside and outside of agriculture.

4. It should provide mobility for farm laborers. It is important that young men who wish to be farmers could have an opportunity to get into farming, desire to farm is an important factor of good farm management. It is equally important that no one be forced to choose farming just because his father was a farmer. The system of land should provide both a way in and a way out. The widespread impression that an appreciable percentage of tenants among farmers is a bad sign often ignores this need. Renting of farm land is a good way for a new farmer who lacks capital to try out his managerial skill. If the rental agreements are reasonable, it is often a good way for the tenant farmer to accumulate working capital and the down payment for the purchase of land.

5. It should be compatible with the welfare goals of the social and political entity. Landownership apparently is a significant cultural and social factor in rural welfare for Taiwanese families, quite apart from the economic efficiency of

2) A. T. Mosher, Technical Cooperation in Latin American Agriculture, The University of Chicago Press.

farming. Therefore, efficiency in production is not the only objective to be sought in a land system.

Finding the best combination of these desirable characteristics of a land system is difficult, and this constitutes part of the complexity of the problems of land reform. Despite this complexity, the land system in any region is an important element in agricultural development. Widespread distribution of land ownership, when attained through a flexible system with a feasible way in and way out of land ownership, appears to be best in an overall sense. This seems to be true even though it increases the task of agricultural extension services since it greatly increases the number of farm operators who must make production decisions.

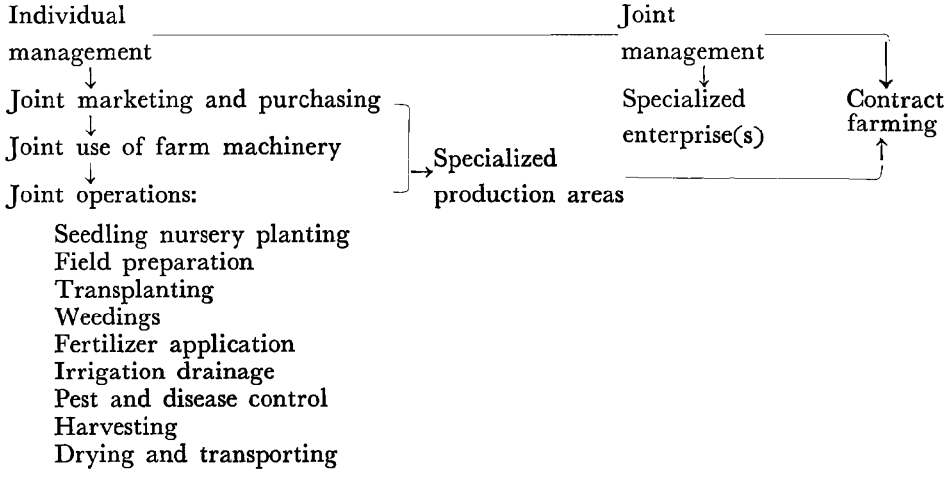
Following the implementation of land reform programs in Taiwan, the land system has become very rigid. It has been noted above that many part-time farmers would rather leave their land to overseers to cultivate on their behalf, but they will not lease their land to other farmers for fear of losing social and economic security. They are afraid that the government may invoke the land reform regulations and eventually force them to give up their land ownership if land is leased to other farmers. Therefore, the enlargement of farm size of a full-time farmer by renting farmland is almost practically impossible in Taiwan today. Moreover, strict restrictions have imposed on the transfer of title, so that a capable young man who wishes to become a farmer will have trouble in obtaining farmland. Consequently, those who wish to acquire industrial land also face the same problems. The original idea behind the restrictions was to prevent concentration of land, but it has also unwittingly prevented more productive use of land, and constitutes a serious bottleneck in agricultural as well as industrial development in Taiwan. Since 1960, several industrial zones have been developed to facilitate the acquisition of factory sites by prospective investors. In rural areas, group farming has been encouraged by the government to promote working efficiency. Farm mechanization has been promoted as a way to realize economies of scale and advance the commercialization of farming. Small landowners have been encouraged to turn over their small pieces of farmland to full-time and large owners for actual cultivation. The small farmer will continue to own his land but he will be free to seek full-time nonfarm employment. The adjustment of farm management under the present land system will be fully discussed in the following section.

IV. THE ADJUSTMENTS OF FARM MANAGEMENT UNDER THE CONDITION OF SMALL FARM SIZE

In the early stage of agricultural development, when population pressure was high, Taiwan was very successful in promoting labor-intensive farming, which led

to high land productivity and adequate capital returns to small farms. But after the non-farm sector was well established, the high level of income in the non-farm sector proved to be a threat to the very existance of small family farms. Farmers, therefore, have been seeking ways to improve efficiency in production and increase their family agricultural income. This involves changes not only in production techniques but also in the management of farms.[3] One significant change in small farm management in Taiwan is the increased participation in group sales of products and group purchase of inputs in order to reduce operating costs. Another is that farmers are also using joint operations and contract farming to broaden their base of operations, and achieve economies of scale. Thirdly, the development of specialized production areas has been encouraged by the government since 1973 (Figure 1).

Figure 1. Stages of Development of Group Action Production Activities in Taiwan



1. Cooperative Sales and Purchases:

Farmers in Taiwan actively participate in cooperatives or farmers' associations that deliver their perishable and non-perishable farm products to domestic markets or to factories for processing for export or domestic consumption. Farm products such as hogs, vegetables, bananas, oranges, mushrooms and asparagus are usually marketed through cooperatives or through the farmers' associations. The cooperatives or farmers' associations also supply farm inputs. Farmers can, of course, either sell or buy through direct commercial channels when it is convenient or profitable to do so. However, today both buying and selling require specialized

3) Shao-er Ong, Emerging New Forms of Farm Management in East Asia, unpublished paper presented at the Group Farming Conference at University of Wisconsin-Madison, June 10-12, 1975.

new combinations of commercial fertilizers, new brands of agricultural chemicals, and new models of machinery and equipment appear in the markets almost every season. New credit facilities permitting buyers to defer payment or pay in installments have become popular but involved interest calculations that may be unfamiliar to the farmer; similarly, he often lacks the requisite knowledge or skills to calculate how to achieve a profit-maximizing position in the complex and ever-changing commodities market. When the small farmer entrusts his organizations with the handling of both buying and selling on a large scale, he usually saves time and money.

2. Joint Operations:

Cooperation in buying and selling is a well-established and well-understood procedure. Much more difficult is the establishment of cooperation in production activities, yet without it there is no way for the small farmers to achieve large-farm efficiency. Farmers must be encouraged to jointly manage operations like plowing or harvesting, or a combination of operations from land preparation to harvesting on adjacent fields by verbal agreement or written agreement. The advantage of such joint operation is that farmers can broaden their land base for management purposes and still keep their individual land. Since farmlands in Taiwan are fragmented and scattered, farmers often need to participate in more than one group.

Joint operations has proved particularly useful for specialized crops in areas where package practices are required. Rice, vegetables and fruits are examples. A typical joint operation emerges when 20 to 30 small farmers, who have a part of their lands adjacent to each other, agree to plan their production jointly and to work together on one operation, multiple operations or a series of opeations which may range from field preparation to harvest. Its purpose, needless to say, is to save labor and to reduce costs. This type of joint operation is organized entirely on a voluntary basis. Members can join or withdraw from the operation any time they wish. Some joint operation teams also jointly own implements and machinery such as power tillers, transplanting machines, sprayers, and others.

In early 1960, agricultural scientists in Taiwan introduced a "package program" of rice cultivation which has resulted in much higher yields. In 1964, the government began to promote joint operations, starting with 100 groups of 2,325 farm families located in 86 townships. This number was rapidly expanded to 296 groups of 7,291 farmers in 1966. The size of each block was also enlarged from 20 hectares to 300 hectares in places where land consolidation projects had already been completed. In 1973, more than 50,000 farmers participated in joint operations

covering a total area of more than 30,000 hectares. The group action in farming has become the most talked about topic among Taiwan farmers. If the energy crisis of the past two years had not sent people back to the farm, thus relaxing the rural labor shortage to some extent, the program of group action in farming would probably have drawn even wider attention.

3. Joint Management and Contract Farming:

Since the rural labor shortage has become serious, both joint management and contract farming are being considered as solutions in Taiwan.

Joint management usually means joint investment and management in a specific enterprise. A few farmers can work together to grow mushrooms, or to raise poultry, hogs, or dairy cattle, with common investment division of duties. The joint enterprise may in fact involve only one activity of the participating farmers, and need not imply joint management of the entire farm. Such relatively new enterprises as mushrooms, poultry, hogs and dairy farming are generally suitable for group action because they are not simple backyard activities, but are highly technical endeavors requiring the pooling of available resources.

Contract farming is different from joint management. It usually involves an agreement (usually written) under which a land owner entrusts another farmer or a corporation with the management of a part or all of his land and shares the profit or loss. The farmer gives up his decision-making authority concerning the use of contracted land. Contract farming has special appeal to the older farmer who wants to hire out his land without affecting his land ownership.

The contract approach can also be applied in a particular operation such as plowing, spraying, harvesting, and transplanting. A contractor, by signing an agreement to do one of these operations for many small farmers, can assure himself a large enough volume of work to make operations viable.

Farmers who wish to enlarge their operational scale in specialized enterprises, such as hogs, poultry, dairy, mushrooms, fruits, or vegetables, can take a further step. That is, some of these capable small farmers may accept the responsibility for cultivating other part-time farmers' land on a cost-sharing basis. This arrangement represents a kind of mutual help between those who suffer from labor shortage and those who are capable of handling a larger specialized operation.

4. The Specialized Production Areas:

In order to promote group action in farming, to increase the efficiency in agricultural production, and to meet the marketing problems of small family farmers,

the government of the Republic of China tried to establish specialized production areas in 1973. It is one of the measures under the Accelerating Rural Development Program; under this measure, all the farms of the same type in a locality are urged to form a specialized agricultural production area in order to facilitate the joint purchase of farm necessities and to perform joint operations, such as land preparations, harvesting, handling, storage and marketing. Thus, every specialized area has become a large production and marketing unit. Through the public facilities in the specialized production areas, the government advises or assists individual farms in producing certain items which are relatively more profitable. At the same time, farmers may continue to engage in side-line productions which they deem fit; this lets them decide the most efficient use of their own farm resources. When incorporating individual farms into specialized production areas, it is very important that farmers be given assistance and guidance regarding organization and production techniques. Agricultural extension and farmers' organizations are instrumental in the promotion of specialized production areas.

Specialized production areas were established to enable each area to use its unique natural endowments in the most productive way, to facilitate the adoption of improved techniques and to provide more convenient marketing facilities. The size of the areas is determined according to climate, and demand for the product as well as production profit. No precise boundaries are set, nor there are any strict organizational rules. Farmers are allowed to adjust and readjust their production methods when environmental and economic conditions change. Farmers in a specialized production area can obtain the benefits of large-scale farming, but still enjoy their managerial independence to a certain degree. Since 1973, 120 specialized production areas including some 20 agricultural products have been established in Taiwan. It is a little too early to evaluate this program at present, because it is still in the trial stage. The speed with which effective multilateral and multilevel decision-making emerges depends on how fully the laws of a country protect the existence of small family farms, how well the non-farm sector continues to absorb rural manpower, whether population growth decreases at an increasing rate, and how widely technological innovations are adopted at the farm level.

Taiwan's strategy for cooperation among farmers has rested upon the farmers' associations, which have been effective partners to the government in the planning and implementation of agricultural and rural development programs. Their declared objectives are to promote the farmers' interests, advance their knowledge and skills, improve their living conditions, and to develop the rural economy. They are organized at three levels: township, county or city and province. Under each

township farmers' association, there are small agricultural units in villages. In 1975, there were 20 county and city associations, 278 township associations, and 4,539 agricultural units, with a total full membership of 671,549, or more than 95 percent of the farmers in Taiwan. On the average, there are 16 small agricultural units in each township, 147 members in each village, and 2,416 members in each township association. Each member represents one household.

Each farmers' association provides economic, credit, extension, and livestock insurance services to its members. Economic services cover a wide range of activities such as fertilizer storage and distribution, rice collection, storage, and processing, purchase and storage of certain other products, and distribution of rationed rice and other supplies to the people in civil service. Through their credit sections, farmers' associations provide loan and savings facilities to their members. One distinguishing characteristic of the farmers' associations is their responsibility for multiple services; extension, economic, and credit services are carried out under one roof. Mainly through those associations, Taiwan farmers have gained much experience in how to cooperate in group actions.

It seems that from now on the management of small farms in Taiwan will become more complicated than that of large farms. The small farmer must increasingly integrate his own decisions with those of others on questions concerning resource use, product disposal and input supplies. All alternative decisions have to be coordinated in order to maximize total profits. It was the rapid development of the non-farm sector which stimulated the awareness of the need to organize cooperative activities in production. To maintain the systems of small family farms and yet enlarge the scale of farm operations, Taiwan farmers are moving from joint operations to joint management and contract farming, with emphasis on specialized production areas. It appears that cooperation is the best way to enlarge farm scale and to achieve the necessary goals in productivity and efficiency.

V. SUMMARY AND CONCLUSION

Despite a high rate of population growth and limited natural resources, Taiwan achieved rapid economic growth after World War II. The economic success was largely attributable to the improvement in agricultural productivity. Farmlands have been used intensively and crop yields have raised to a very high level. During the early years of development, emphasis was placed upon expanding crop production. However, since the early 1950's, production of livestock and poultry has increased far more rapidly than production of crops. A large part of the expanded output of livestock products has been due to the use of imported feeds.

Taiwan's agriculture is characterized by small farm size; farms average about one hectare. As the farm population increased, especially after 1940, the total number of farms also increased but the average size decreased. The number of farms and farm population doubled between 1940 and 1965. In the same period, average farm size decreased by nearly 50 percent, but agricultural output per farm remained at about the same level. Land reform since 1949 has increased the land area operated by owner farmers, resulting in more intensive use of land, higher agricultural productivity, and more output per unit of labor.

Before land reform began in 1949, two-thirds of all farmers were tenants or part-owners, and two-thirds of the fertile and irrigated land was cultivated under lease. Rental rates varied from 50 to 70 percent of the main crop. In addition, tenants often had to pay deposit to obtain the use of land. The basic philosophy of the land reform program in Taiwan was Land-to-the-Tiller, which meant assisting tenants and landless laborers in becoming owner-operators. The ratio of owner-cultivators to the total number of farmers increased from 36 percent in 1949 to 55 percent in 1953 and to 79 percent in 1974. Part-owners decreased from 25 percent in 1949 to 24 percent in 1953 and to 11 percent in 1974. The percentage of tenants also dropped from 39 percent in 1949 to 21 percent in 1953 and to 10 percent in 1974.

Land reform has had a favorable effect on agricultural development. The tenant-turned-land owners often took an active part in local government and group orgnization such as farmers' associations, irrigation associations and cooperatives. While land reform could not solve the problem of increasing population pressure upon limited land resources, it enabled farmers to exercise greater control over their economic and social welfare.

As the average farm size became smaller, the government has tried to enlarge the size of family farms by reducing the size of farm families. But this effort has met little success. In 1965, the average farm family was 6.77 persons, the average size of the family farm was 1.05 hectares. In 1973, the corresponding figures were 6.61 persons and 1.02 hectares, which showed a slight reduction in both family size and the size of farm.

Because of the rapid industrial development in Taiwan, the farm sector has lagged far behind in income. The income gap between the farm and non-farm sectors has encouraged members of farm families with little land to seek employment opportunities in the cities or nearby towns. Hence the share of farm family earnings from sources other than farming has increased considerably. In 1960, 52 percent of the farms in Taiwan was classified as part-time farms; it increased to

70 percent in 1970. Non-farm income made up 34 percent of the 1966 average farm household income, it increased to 55 percent in 1971. As part-time farming has increased, the intensity of land use has decreased. Consequently, the growth rate of agriculture has slowed. The enlargement of farm size is seen as a fundamental way to avoid such inefficiencies in cultivation and to increase farm income. However, land reform in Taiwan has resulted in over-protection of tenants at the expense of landlords. The land system has become so rigid that practically, there is little possibility for change in farm size by renting farmland at present. Most farmers who have obtained non-farm jobs would still like to own their farmland for economic and social security, and will not lease their land to others because of the rigid land reform regulations. Therefore, many farmlands have become idle or are being used extensively. The problem of farm size will become a bottleneck of agricultural development in Taiwan in the future.

A good land system should provide flexibility for the adjustment of farm size in response to changes in economic and technological conditions. It also should be flexible enough to let farmers in and out of farm operation without much difficulty. As a result of land reform in the early stage of economic development the land system lost this kind of flexibility. The revision of land laws and the easing of the rigidity of the land reform regulations is considered necessary to facilitate further agricultural development, and has been suggested by many economists in Taiwan.[4] However, this suggestion has met with strong opposition from land reformers on the ground that the existence of any land tenancy is against the doctrine of Dr. Sun Yat-sen. To avoid the conflict, the government has encouraged farmers to participate in joint operations and contract farming to broaden the base of operations. Some small farmers may prefer to accept the responsibility for cultivating other part-time farmers' land on a cost-sharing basis regardless of the land law. Such arrangement represents a kind of mutual help between those who suffer from a labor shortage and those who are capable of handling a larger farm operation.

Recently, farms of the same type and in the same locality have been urged by the government to form a specialized production area in order to facilitate the joint purchase of farm requisities and to perform joint operations, aiming at increases in the efficiency of production and marketing. Farmers in the specialized production areas can reap the benefits of large scale farming, while still enjoying considerable managerial independence. However, these policies are still at the trial and error stage, and their success will depend on how well they are adapted to the needs of farmers.

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The Policy of Rural Land-use Conversion in Taiwan*

Yu-kang Mao

I. INTRODUCTION

Man has to live upon food which comes mostly from land. But as land is strictly limited and population tends to keep on increasing, a struggle for existence naturally ensues. Largely due to maladjustments in social institutions, unfair distribution of land has been a part of Chinese history - so has been the cry for redress.

The long-time unfair distribution of land created two confronting classes in Chinese society. One was the landlords and the other was the tenants. The former owned land and, along with ownership of land, prestige and political power. The latter was poor and repressed. This undesirable phenomenon was foreseen by many Chinese thinkers and statesmen as a root cause of social discontent that should be eradicated. Consequently, land redistribution was the center of land policy for many years.

When Dr. Sun Yat-sen organized the Tung Meng Hui in 1905, he proclaimed the equalization of land rights as one of the four planks of his political platform. In 1924 he went a step further by advocating a land-to-the-tiller policy as an efficacious means for the solution of the agrarian problem and the attainment of the equalization of land rights. By the land-to-the-tiller policy is meant one which permits the farmer both to have ownership of the land he tills and to enjoy the fruits of his labor. It is an ideal which our ancient philosophers and statesmen evidently had in mind when they proposed the limitation of individual landholdings to forestall concentration of landownership in the hands of a few big landlords.

After the retrocession of Taiwan to China, the Chinese Government undertook to carry out land reform in this province in order to achieve the equalization of land rights and ensure peace and stability. With these ends in view three successive steps were taken: farm rent reduction in 1949, sale of public farm lands in 1951,

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and land to the tiller in 1953. Especially significant was the use of public enterprise stock shares to pay for the lands compulsorily purchased from landlords by the Government under the land-to-the-tiller program. Such a method of compensating the landlords had the effect of converting investments in land into industrial assets and laying the foundation for the industrialization of Taiwan.

Due to rapid industrial development, the economic structure of Taiwan has changed. The tenant system is no longer a problem and the relative importance of the agricultural sector has declined. This has brought about a change in the demand pattern for land and some new problems as well. In summary, these problems include (1) small farm size, (2) idled farm land and (3) conversion of farm land to other uses. The last problem is the major concern of the present paper.

Largely because of population increase and industrial development the demand for land for non-farm purposes has increased substantially. Farm land has been converted to residential and industrial uses. According to the statistics collected by the Ministry of Interior, a total of 55,148 ha. of grades 1-12 farm land was shifted to non-farm use during the period from 1967 to 1973. This figure does not include the area converted from unregistered land, otherwise the total would have been much larger.

The increased demand for land has resulted in some areas in keen competition between agriculture and other industries. Moreover, unregulated construction in farm areas has caused other problems, such as the destruction of irrigation systems and farm roads and industrial pollution. As a result, agricultural production in some areas has been adversely affected.

In order to prevent this situation from becoming worse, the Chinese Government has in recent years issued a number of regulations restricting construction on farm land. The government in 1974 promulgated the Regional Planning Act in order to promote best use of Taiwan land resources.

II. LAND RESOURCES AND THEIR USE

The total area of Taiwan including the Island of Taiwan itself, the Penghu Islands, and adjacent small islands, is 35,961 square kilometers, of which the Island of Taiwan and adjacent small islands account for 99.65% and the Penghu Islands for 0.35%.

For purposes of land administration, all land in Taiwan Province is divided into two kinds: registered and unregistered. The former includes all land, both

public and private, for which the entire procedure of cadastration (including cadastral survey and land registration) has been completed. As such land must have been utilized in one way or another, it is also called utilized land. The second kind of land has not undergone the procedure of cadastration, but has been merely surveyed with regard to its general contour and the results have been tabulated and kept in the files. All unregistered land is owned by the public. Most of it is forest land, and a small part is wild land or river beds and streams.

All registered land is classified, according to its use, into four types and 21 categories. Of those four types, the largest in area is land used for direct production, next comes land used for construction, and then comes land used for communication and water conservancy. Land used for direct production includes seven categories, of which the largest in area is forest land, next come paddy field and dry land and the smallest is swamps and ponds. According to recent statistics, there are 520,763 ha. of paddy field, 398,917 ha. of dry land, 536,990 ha. of forest land, 28,639 ha. of fish ponds, 5,892 ha. of salt fields, 2,809 ha. of pastures and 2,501 ha. of swamps and ponds.

During the past 20 years, population has increased rapidly. As a result, population density has almost doubled, from 261 persons per square kilometer in 1956 to 459 persons per square kilometer in 1976. During the same period, farm land area has increased from 870,000 ha. to 920,000 ha., increased by 1.8%. The slow increase in farm land indicates that Taiwan has exhausted its frontier. It also reflects the strong demand for agricultural resources. In order to promote agricultural development and to produce sufficient food for domestic consumption, the Chinese Government has adopted a policy to increase land productivity on the one hand and to prevent farm land conversion to non-farm use on the other.

III. CHANGE IN FARM LAND OVER THE PAST YEARS

Change in total farm area is determined by the balance of newly reclaimed land and the land converted to non-farm use. Generally speaking, about one half of the increased land came from reclamation of forest land or wild land. Other sources include the public land leased for reclamation since 1969, increased land as a result of underground water development and reclamation of tidal land.

Over the past years, farm land has been converted to other uses which include housing, factories and public facilities. Erosion and floods have also destroyed some farm land. Since 1973, because of good profit in fish culture, a considerable area of farm land has been converted to fish ponds. The area of increased farm

land and farm land converted to other uses during the period 1962-76, are shown in Table 1.

Table 1. Change in Taiwan Farm Land Areas by Factors 1962-76

Factors	1962–76		1962–66		1967–71		1972–76	
	ha.	%	ha.	%	ha.	%	ha.	%
Total area increase	189,625	100.00	28,876	100.00	62,724	100.00	98,025	100.00
Sources of the increase:								
Forest land and wildland reclamation	84,866	44.75	22,836	79.08	32,362	51.59	29,668	30.27
Groundwater development	14,464	7.63	3,366	11.66	6,155	9.81	4,943	5.04
Tidal land and unregistered land development	12,087	6.37	1,244	4.31	7,390	11.78	3,453	3.52
Riverbed reclamation	13,255	6.99	—	—	—	—	13,255	13.52
Aboriginal conservation district development	14,522	7.66	—	—	11,768	18.76	2,754	2.81
Reclamation from disaster area	8,579	4.52	1,993	6.90	2,595	4.14	3,993	4.07
Lease of public land for reclamation	14,040	7.40	—	—	2,454	3.91	11,586	11.82
Others	28,374	14.96	—	—	—	—	28,374	28.95
Total area decrease	147,572	100.00	4,288	100.00	62,661	100.00	80,623	100.00
Factors for the decrease:								
Residence and dryyard	21,388	14.49	640	14.93	11,271	17.99	9,477	11.75
Public facilities	11,398	7.72	281	6.55	6,340	10.12	4,777	5.93
Factory site	19,589	13.27	511	11.92	10,567	16.86	8,511	10.56
Fish pond	4,467	3.03	—	—	—	—	4,467	5.54
Reforestation	13,543	9.18	—	—	811	1.29	12,737	15.80
Erosion and flood	12,740	8.63	2,820	65.76	4,268	6.81	5,652	7.01
Others	64,443	43.67	37	0.86	29,403	46.92	35,003	43.42

Table 2 shows the actual conversion in different areas of Taiwan province during the period 1974-76. Needless to say, the period in question is somewhat too short, but this is the only information we can obtain.

The percentages in the first column are the conversion rates of the past three years when compared with the total farm area at the end of 1973. From the table we can see that the highest conversion rate occurred in Kaohsiung city which was 16.6%. It was followed by Taichung city (6.4%), Tainan city (3.7%), Kaohsiung hsien (2.5%) and Keelung city (2.5%). The last three columns show the distribution of converted land by county and by purpose. Among the three major purposes, residential housing occupied the largest area and Taipei hsien and Tainan hsien accounted for the largest shares. Of the area converted for industrial use, Kaohsiung city occupied 21.7% of the total, next come Taoyuan hsien with 16.3%. The distribution reflected to some degree the speed of economic development of the respective regions.

Table 2. Conversion of Farm Land by Regions, 1974-76

Region	Area of farm land converted to nonagriculture[3]		Farm land converted to residence		Farm land converted to public facilities		Farm land converted to factory site	
	ha.	%[1]	ha.	%[2]	ha.	%[2]	ha.	%[2]
Total	12,233	1.4	5,386	100.0	3,242	100.0	3,605	100.0
Taipei hsien	1,035	2.4	618	11.5	109	3.4	308	8.5
Yilan hsien	691	2.4	381	7.1	162	5.0	148	4.1
Taoyuan hsien	1,005	2.0	385	7.1	33	1.0	589	16.3
Hsinchu hsien	752	1.8	284	5.3	193	6.0	275	7.6
Miaoli hsien	613	1.6	154	2.9	340	10.5	119	3.3
Taichung hsien	577	1.1	235	4.4	169	5.2	173	4.8
Changhwa hsien	951	1.3	461	8.6	289	8.9	201	5.6
Nantou hsien	223	0.4	119	2.2	52	1.6	52	1.4
Yunlin hsien	481	0.6	298	5.5	154	4.8	29	0.8
Chiayi hsien	1,022	1.5	333	6.2	519	16.0	170	4.7
Tainan hsien	1,368	1.4	731	13.6	343	10.6	294	8.2
Kaohsiung hsien	1,447	2.5	419	7.8	245	7.6	783	21.7
Pingtung hsien	452	0.6	182	3.4	89	2.8	181	5.0
Taitung hsien	72	0.2	45	0.8	18	0.6	9	0.3
Hwalien hsien	189	0.5	60	1.1	61	1.9	68	1.9
Penghu hsien	11	0.2	6	0.1	5	0.2	0	0
Keelung city	21	2.5	20	0.4	0	0	1	0
Taichung city	516	6.4	270	5.0	209	6.5	37	1.0
Tainan city	206	3.7	87	1.6	70	2.2	49	1.4
Kaohsiung city	613	16.6	310	5.8	183	5.6	120	3.3

Note: 1) is increase as a percentage of the total farm area at the end of 1973.
2) is allocation percentage, i.e., the share of each hsien (or city) in the province total.
3) is total area of farm land converted for residences, public facilities and factory sites.

IV. MAJOR LAND LEGISLATIONS

The basic and most important land legislation of China is the Land Act which was promulgated in 1930, then a major amendment was made in 1946. After the Chinese government moved to Taiwan the Act was amended two times, respectively in 1955 and 1975. The last amendment involved as many as 19 articles and was the most important amendment ever made.

The Land Act is a very comprehensive law and has provisions concerning land ownership, registration, utilization, purchase, tax and others. However, some provisions are very general. As far as land utilization is concerned, there is an article in Chapter III which states that land administration authorities of hsien (city) governments may codify land within their jurisdiction for various uses based on national economic policy, local requirements and the characteristics of the land. Another article states that land that has already been codified for certain purpose

shall not be shifted to other use except that the conversion be duly approved in advance by the land administration of the hsien (city) government.

Besides the two articles mentioned above, there are no other provisions that deal exclusively with land utilization in the Act. Furthermore, the two articles seem so general in nature that there is little effectiveness in restricting land conversion and in guiding land toward its proper use.

In 1973 the Agricultural Development Act was passed by the Legislative Yuan. This Act takes a more positive attitude toward the utilization of farm land. Article 9 of Chapter II of the Act states that without written consent from the agricultural authorities conversion of farm land to industrial use is strictly prohibited.

In 1974 the Regional Planning Act was enacted. This marked the beginning of a new phase in the evolution of Taiwan's land policy. The purpose of the Act is to promote efficient land use and balanced regional planning. Under this Act a comprehensive plan on land utilization will be made, it will take population, economic development, land utilization, physical construction, resource development and conservation into consideration. Thus the new land policy has become more positive in regulating land use. It may be considered as a supplement to the Land Act.

Since the promulgation of the Regional Planning Act in 1974, a number of regulations concerning the implementation of the Act have also been made. In the meantime, the Ministry of Interior and the Joint Commission on Rural Reconstruction jointly started in 1974 to plan the non-urban land use of Pingtung hsien. The project was completed in 1975 and similar projects are being implemented in other areas.

Although the Regional Planning Act is the principal guideline of government land policy, in the areas where the Act has not been implemented, the government, out of practical necessity, has issued some regulations to govern rational land use. The following are some regulations which are most relevant to this matter.

1. Measures Governing the Restriction on the Expansion of Construction Areas, promulgated in 1973 by the Ministry of Interior.
2. Control Measures Regarding Buildings on the Areas outside City Planning Boundary, promulgated in 1974 by the Ministry of Interior.
3. Instructions on the Enforcement of the Restriction of Construction Areas, in a 1974 official letter from the Ministry of Interior to the Taiwan Provincial Government.

4. Explanations on the Definitions of Farm Buildings and Public Facilities, issued in 1974 by the Ministry of Interior.
5. Control Measures on the Application for Building Farm Houses on the Land of Agricultural District within City Planning Boundaries, issued in 1974 by the Taiwan Provincial Government.
6. Conditions for Change in Land Grade Registration for Highgrade Farm Land on Which Buildings have been Constructed, issued by the Ministry of Interior in 1975.
7. Control Regulations for Land Utilization in the Areas outside City Boundaries, issued in 1976 by the Ministry of Interior.
8. Basic Principles Governing the Conversion of Cultivated Land to Industrial Use, issued in 1976 by the Ministry of Interior.
9. Basic Rules on the Issuance of Permits for Industrial Construction on Farm Land, issued in 1976 by the Taiwan Provincial Government.
10. Important Rules on Issuing Permits for Industrial Land, made public in 1976 by the Ministry of Economic Affairs.

Based on what we have discussed so far, it may be appropriate to divide our discussions about the matter of land use into two stages with the implementation of the Regional Planning Act as the demarcation line. In the areas where the Act has been put into effect, land planning must be carried out in an integrated manner and land use must be based on the purpose codified in the plan. In the areas where the Act has not been implemented, land use is subject to the restrictions of a number of regulations, such as mentioned in the preceding paragraph.

V. LAND USE POLICY BEFORE THE REGIONAL PLANNING ACT

1. Farm Land and Its Protective Measures

According to the Agricultural Development Act of 1973, farm land is defined as the land directly used for the production of crop, forest, fish culture, livestock, and for facilities indispensable to agricultural production such as farm houses, drying ground, farm roads, irrigation and drainage canals. As there is little frontier left on this island, farm land area is very much limited. On the other hand, however, rapid industrialization and population growth have greatly increased the demand for non-farm land. Since land for industrial use is generally more productive than farm land, the conversion of farm land to non-farm purposes is bound to happen. Without legal restriction it could greatly reduce the area of farm land. In addition to

industrial use, farm lands have also been used for residential buildings and public facilities. Other factors which are also responsible for the decrease of farm land area include afforestation, erosion and others, but they will not be discussed in this paper.

The regulations listed in the preceding section were formulated primarily for the purpose of protecting farm land. These regulations are still effective in the areas where the Regional Planning Act has not yet been implemented. In summary the essence of the protective measures are as follows:

(1) Based on the basic principles of the Land Act, hsien (city) government should allocate all the land above grade 12 as farm land and duly inform the landowner about this decision.

(2) All farm land above grade 8 shall not be used for construction or any other non-farm purposes, except for farm owner's house with due approval by the authorities concerned.

(3) Land between grades 9 and 12 shall not be converted to industrial use without the joint approval from the authorities of industry, agriculture, food and land administrations. Conversion to farm houses must be approved by the hsien (city) government. Conversion to public facilities must be approved by the provincial land and agricultural authorities.

(4) Land use in the area already codified shall be strictly restricted. Any devision from the planned use shall be regarded as illegal constructions and subject to heavy penalty.

2. Conversion of Farm Land to Residential Use

In addition to the limitations mentioned in the above, the conversion of farm land to residential use is further subject to other restrictions. However, to facilitate our discussion it is better to divide this matter into two parts: farm land within and farm land outside city boundaries.

(1) Farm land within city boundaries.

According to the Measures Governing the Restriction on the Expansion of Construction Area, construction shall not be permitted in the agricultural districts of the city planning area, but farm building may be permitted. Residential area shall be developed by districts and in phased stages. The districts, which are not planned for immediate development, shall remain as agricultural districts. Application for farm building in the city planning area, according to the regulations promulgated by the Ministry of Interior, is subject to the following restrictions:

(a) Applicant must be an owner-farmer or tenant farmer and must have land in the very district.

(b) Farm buildings shall include houses for self-use and other buildings which are necessary for farm operation.

(c) The farm building shall not be taller than 7 meter and its total construction area shall be less than 5% of the applicant's total land area or not larger than 165 square meters, depending on which is less. The building shall be at least 20 meters away from the city boundary.

(d) To apply for construction of farm building for raising swine, ducks, cattle, rabbits, fish or for growing mushrooms, flowers, vegetables and other crops, the applicant must submit his application along with operation plan, financial statement, construction blue-print and the permit from the government agency which is responsible for this function. But the construction area shall not be larger than 55% of his total farm land.

(e) The government agency which is responsible for construction management should color the constructed land area on its city planning map and inform the land administration agencies of the said district. A construction permit for each piece of land is limited to one only. After that no permit shall be issued to the land regardless of whether or not it has been divided since the first application.

(f) Approved farm construction shall not be converted to other use without proper consent from the authorities concerned.

(2) Farm land outside city boundary

Construction on farm land outside the city boundary is governed by the Control Measures Regarding Buildings on the Areas Outside the City Planning Boundary. The major restrictions are:

(a) No building shall be constructed without permit from the hsien (city) government.

(b) In the area outside city planning, no building shall be constructed on farm land of grade 1—8, except farm buildings constructed for self-use by the landowner himself. As to the land of grade 9—12, construction is prohibited except for self-used farm building, transportation, school, and public facilities.

(c) Applicant for self-used farm building must be the farm owner. The

total construction area shall not be larger than 200 square meters or larger than 5% of his total farm land, depending on which is less. The height of the building shall not be greater than two stories or 7 meters. Applicants for permit to construct farm building need not to submit architectural design. Construction permit may be waived for farm house repairs, improvement and renovation.

(d) To apply for non-farm construction on the land not included in (b), the applicant should submit his application in company with architectural design to the authorities of hsien (city) government. But if the construction area is smaller than 45 square meters and the height is not taller than 3.5 meters, architectural design may be waived. For building renovation, improvement and repairs (smaller than 45 square meters), no construction permit shall be required.

(e) In case of construction of two buildings at the same time or one building with 200 square-meter area on the land not included in (b) its coverage rate shall not be larger than 50%. But construction on the land with a gradient over 30% is prohibited.

(3) While there are various restrictions on the conversion of farm land to residential use, there are also regulations encouraging residential construction in the area that has been zoned for residential use. The encouraging measures include:

(a) Currently used farm land on both sides of the road should be converted to residential use within a certain period of time after public facilities have been completed. The time period is two years for Taipei city and three years for Taiwan Province. Land not used within the time period is subject to idle land tax. The land on both sides of the road refers to the land within 40-75 meters from the road.

(b) To deal with the idled land in the planned residential area, measures shall be carried out in two stages. In the first stage the government will notify the owners who have not utilized their land according to the specified use. After that the government will urge the owners, whose buildings on the land are worth less than 10% of the land value, to take concrete actions in construction.

(c) The government authorities may buy back the land originally owned by the public if the purchaser does not honor the agreement to start construction within 1-1.5 years. If the public land is rented out, the government may terminate the contract and take back the land.

3. Conversion of Farm Land to Industrial Use

(1) The development of industrial districts

Largely due to rapid economic development, industrial demand for land has increased considerably. In view of this trend the Chinese Government since 1959 has become engaged in the development of industrial districts (parks). According to the Statutes for Encouragement of Investment, with permission from the proper authorities, individual investors may rent or purchase farm land for factory construction. This provision was rescinded in 1974 because it had resulted in undesirable distribution of industrial factories. Since then the development of industrial districts has become the sole responsibility of the Ministry of Economic Affairs. In the meantime, residential communities for industrial workers were also planned along with development of industrial districts. Thus the establishment of industrial districts is a planned method to prepare land for industrial use, and it is much more desirable than the previous approach. The basic guidelines for establishing industrial districts are:

(a) In developing industrial districts the authorities concerned should do their best not to use the land between grades 1-8. Attention should also be given to the location factors of the area. To support the policy of not using high grade farm land for industrial purpose, slopeland should be considered first.

(b) The Ministry of Economic Affairs and the Taiwan Provincial Government shall coordinate in developing 800 ha. of industrial district every year. To balance the development of regional economies priority ought to be given to the middle part of this island.

(c) The hsien (city) government should be responsible for the development of industrial districts within city planning boundaries under the supervision of the Provincial Department of Construction.

(d) No industrial district shall be established in the area where an industrial district of similar nature has been set up in an adjacent hsien or city.

(2) Industrial land outside industrial districts

The government basic policy is to use industrial districts for setting up factories. However, if the industrial district is not sufficient to meet the demand, investors may apply, along with proper documents, for a permit to build a factory outside the industrial district. In considering this kind of application, the government take into consideration the following criteria:

(a) The use of high grade (1-8) and consolidated farm land is prohibited.

(b) The approved use shall not cause any damage to the nearby irrigation facilities, farm roads and fish ponds.

(c) Land in the area prohibited from construction shall not be used.

(d) Poor or low productive land shall be used first.

(e) Land that is no longer suitable for farming because of construction or other factors shall be given favorable consideration.

(f) Factories which have been forced to move because of large national construction projects may be given permission to purchase low grade farm land for expansion or building new plant.

4. Conversion of Farm Land to Public Facilities

Generally speaking, land for public facilities is obtained from the land of public ownership. This is especially true with the land for school and government offices. If publicly owned land is not sufficient for the said purpose, private land shall be purchased through city planning or specially approved project with the concurrence by the hsien or provincial assembly. The conversion of publicly owned land to public facilities is based on Article 26 of the Land Act which stipulates that public land can be converted for use of public facilities by government at various levels upon receiving the concurrence of the Executive Yuan. The conversion of private farm land to public facilities can be carried out through two approaches: city planning and purchase or reservation for future purchase under the public construction plan. The details of these two methods are described in the following:

(1) Conversion of farm land through city planning: The Land Act has the following provisions that are relevant to this matter:

Article 90: Land for road, sewage and other public facilities can be reserved in advance according to this Act.

Article 91: Land within the city limits can be divided, according to this Act. into areas for restricted use and areas for free use.

Article 92: For a newly developed city, the government may, according to the City Planning Act, purchase a part or the whole area of the city. After consolidation, these lands may be resold to individuals at the original buying price. The government may purchase land in phased periods and resell the land by district.

Article 93: Land which has been planned for road or other public facilities according to city plan may be reserved for purchase and prohibited from any construction except that for temporary purposes.

According to the above-mentioned articles, the conversion or the reservation of farm land for conversion to public facilities used of a new city is made possible.

(2) Purchase of private land for public facilities.

According to Article 208 of the Land Act, the government may purchase private farm land for the following purposes:

(a) National defense
(b) Transportation
(c) Public utilities
(d) Irrigation
(e) Public sanitation
(f) Government office and other public construction
(g) School, education and philanthropy
(h) State enterprise
(i) Other government supported business

According to Article 213 of the Land Act, farm land may also be designated as "Reserved for Future Purchase" for the following purposes:

(a) Development of roads
(b) Construction of public utilities
(c) New city
(d) National defense

"Reserved for future purchase" refers to the land that is reserved for certain project that has not been started. Reservation of land area should be approved by the authorities concerned. No construction which may hinder future purchase shall be allowed to be undertaken on the land.

Land purchase must be approved by the authorities concerned. If the sponsoring agencies are the five Yuans and the offices directly under the Yuans, the approving agency is the Executive Yuan. If the sponsoring agencies are provincial offices, hsien government and offices under their supervision, the approving agency is the Provincial Government. After the approval, the Provincial Government should report this matter to the Executive Yuan for recording.

Having approved the purchase, the Executive Yuan and Provincial Gov-

ernment should notify the hsien (city) government where the land shall be purchased. Upon receiving the notification, the hsien (city) government should make the matter known to the public and inform the landowners as well as other persons who also have a right in the land. Construction cannot be started until all the compensation is duly paid. In addition to land price, the purchasing agency should also be responsible for all the expenses resulting from the movement of improvements on the land. Land price is set by the hsien (city) government.

5. Problems in the Conversion of Land Use

Judging by the measures and regulations concerning land conversion in the previous sections, one would be inclined to think that the land use policy seems to be able to meet practical needs, and to attain an desirable management of farm land. However, the real situations were not so good as we had expected. Problems continued. In the context which follows we will give a brief discussion of them.

(1) Many problems arose from the conversion of farm land to industrial use. The establishment of industrial districts was aimed at providing a suitable place for industrial set-ups. It was hoped that in so doing undesirable use of land could be avoided. Unfortunately, the establishment of industrial districts has not met the industrial demand, either because of inconvenient location, or because of lack of public facilities. Consequently, there were continued use of high grade farm land for facilities on the one hand, and idled space in the industrial districts on the other. For example, a total of 1,012 ha. of land were for factories in 1972, of which only 208 ha. belonged to the industrial districts, and the remaining 804 ha. were outside the industrial districts. As we know, the industrial businessmen still can convert farm land into factory buildings subject to the restricting regulations we described before. However, owing to the ambiguity or inefficient implementation of these regulations, many investor failed to use his land in the manner he had applied for. Still worse, some opportunists even bought land for some speculative purposes under the guise of securing an industrial area. An investigation on the utilization of 6,848 ha. of industrial land revealed an undesirable situation, for 40% of the land was not used as applied for. In order to avoid the above-mentioned problem, the screening authority for land conversion applications should strengthen its efforts to minimize the loopholes. Furthermore, a repurchase measure against the converted farm land, if it fails to meet the required use, may be of some help to forestall this kind of problem.

(2) Another problem stemmed from the out-of-date classification of land. In order to protect agricultural production resources, the land use policy in Taiwan prohibits the use of high grade farm land for nonagricultural uses. This is good

if the grading system is completely in accordance with the actual land productivity. But the grade classification in Taiwan was formulated in the Japanese period. It is more than 30 years old. Thirty-years is a long time. Over that period both economic and social situations have changed. Thus, the land record book may have obvious gaps with respect to the actual situation. Consequently, to use that record as a basis for making conversion decisions may result in inefficient land utilization. Moreover, low-grade farm lands may be scattered in location in some areas. If they are used for industrial factories, great harm may be done to the adjacent high-grade land. Therefore, in order to protect farm land, conversion decisions should be made based on up-to-date land classification, and restrictions should be carried out by district or zone.

(3) As regards the agricultural land converted to construction land, the Ministry of Interior has promulgated several control regulations. The general principles governing the application for agricultural construction within the urban agricultural zone are stated in the Control Measures of 1974. There are other control measures governing the construction on the land outside city planning boundaries. The problem is that many of the measures have ambiguous meanings and are difficult to enforce. In some areas, due to the roughness in the division of land use zones, development has been jeopardized. Besides, the control measures were not available until 1974, by that time damage had already been done in some areas.

(4) The problems resulting from the conversion of farm land to public facilities are many. Due to the lack of necessary information, public land is poorly managed in Taiwan. Much public land is illegally occupied by private individuals or idle. The situation leads to contradictory problems, i.e., lack of public land for public facilities use on the one hand, and much public land poorly managed on the other. Available data indicate that, in 1974 there were 315 ha. (valued at NT$280 million) of provincial land illegally occupied, and another 170 ha. (valued at NT$140 million) were idle. During the same year, there were 107 ha. of prefectural land which were illegally occupied, and 324 ha. idle. If the national public lands were also included, the problem of illegal occupation and idle land would become much more serious.

VI. REGIONAL PLANNING ACT AND ITS IMPLICATIONS ON THE POLICY OF LAND UTILIZATION

The Regional Planning Act was first drafted in 1962. It had been revised many times before it was submitted to the Legislative Yuan. The Act was enacted by the Legislative Yuan in 1973 and put into effect next year.

The purposes of the Act are:

(1) To meet the requirements of speedy economic development
(2) To make the best use of limited land and natural resources
(3) To promote the welfare of the country and the people
(4) To obtain the following results in land utilization
    (a) To achieve rational distribution of land utilization and increase agritural and industrial production
    (b) To prevent and minimize the occurrence of environmental disruption and insure the space for people's activities, work and recreation
    (c) To promote a balanced development between the city and the country
    (d) To help the development and conservation of natural resources
    (e) To match economic growth with the development and utilization of national resources.

To facilitate the implementation of the Regional Planning Act, supplementary regulations have been formulated. These include Detailed Regulations on the Implementation of the Regional Plan; Regulations on the Organization of the Regional Planning Committee; Regulations on Non-urban Land Utilization Control; Operational Guidelines for Preparing Zone Maps of Non-urban Land Utilization and Codification of Land Use.

For the same purposes, Taiwan was divided into seven regions based on the administrative boundaries, natural environment, population distribution, city planning, structure of various industries and other factors. The seven regions are:

(1) Northern Taiwan area which covers Taipei city, Keelung city, Taipei hsien, Taoyuan hsien.
(2) Hsinchu-Miaoli area which covers Hsinchu hsien and Miaoli hsien.
(3) Middle Taiwan area which covers Taichung city, Taichung hsien, Changhwa hsien and Nantou hsien.
(4) Chiayi-Yunlin area which covers Chiayi hsien and Yunlin hsien.
(5) Southern Taiwan area which covers Kaohsiung city, Tainan city, Kaohsiung hsien, Tainan hsien, Pingtung hsien, and Penghu hsien.
(6) Yilan area which covers Yilan hsien.
(7) Eastern Taiwan area which covers Taitung hsien and Hwalien hsien.

1. Land Utilization Under the Regional Plan

The main function of the regional plan is to promote conservation and efficient use of land and natural resources. It also aims to make the best allocation of land

resources in order to meet the demands of both agricultural and non-agricultural activities. Of course, this is not an easy task. The achievement of these purposes relies on the thorough implementation of the land utilization plan and land utilization control.

The land under the regional plan is divided into urban land and non-urban land. The utilization of urban land is controlled by the law of city planning. The utilization of non-urban land is mainly concerned with farm land. The plan's chief purpose is to obtain the most efficient utilization. Under the regional plan, non-urban land will be first divided into different categories according to their uses. Then a regional map will be prepared based on the classification. After this plan is made public, all land must be used as it is planned.

2. Codification of Non-urban Land Utilization

The non-urban land is divided into eight land use zones in accordance with the zoning principles of the regional plan. They are:

(1) Special Agricultural Zone. This zone is defined as the area of good farm land or the area where important agricultural investments have been made, such as land consolidation, irrigation and drainage facilities, or the land which is presently engaged in rice production.

(2) General Agricultural Zone. Farm land not included in the special agricultural zone.

(3) Industrial Zone. The designation of industrial zone shall be approved by the responsible agricultural, industrial and land administration authorities. Its purpose is to promote industrial development. But in the meantime, the regional plan should do its best to spare fertile farm land.

(4) Village Zone. This refers to the area where farm people live but the number of population has not reached the standard for city or township.

(5) Forest Zone.

(6) Slope Land Conservation Zone.

(7) Scenic Zone.

(8) Other Land Use Zone or Special Zone.

3. Classification of Land Use by the Major Purposes

(1) Type A Construction Land: For building farm houses and other farm facilities in the agricultural zone.

(2) Type B Construction Land: For construction use in the village zone.

(3) Type C Construction Land: For construction use in the forest zone, slope land conservation zone and scenic zone.

(4) Type D Construction Land: For construction use of factories and related industrial facilities.

(5) Arable and Pastoral Land: For crop and livestock production.

(6) Forest Land.

(7) Fish culture land.

(8) Salt industry land.

(9) Mine.

(10) Pottery.

(11) Transportation land.

(12) Irrigation land.

(13) Recreation.

(14) Historical site.

(15) Ecosystem conservation land

(16) National defense and protection.

(17) Cemetery land.

(18) Land for special purposes.

Based on the principles of the Regional Planning Act, a pilot project on non-urban land planning has been carried out in the southern part of Taiwan. Some results are shown in Table 3 and 4.

Table 3. Area Distribution by Land Use Zones in Southern Taiwan

Land Use Zone	Total		Pingtung hsien		Kaohsiung hsien		Tainan hsien	
	Ha.	%	Ha.	%	Ha.	%	Ha.	%
Special agricultural zone	113,382	30.2	37,862	24.9	22,198	27.2	53,322	37.5
General agricultural zone	72,335	14.3	28,506	18.8	11,712	14.4	32,117	22.6
Village zone	7,438	2.0	2,778	1.8	1,236	1.5	3,424	2.4
Industrial zone	1,483	0.4	673	0.4	213	0.3	597	0.4
Forest zone	10,781	2.9	1,665	1.1	1,610	2.0	7,506	5.3
Slopland conservation zone	157,935	42.1	76,380	50.3	42,045	51.6	39,510	27.8
Scenic zone	5,423	1.4	1,424	0.9	402	0.5	3,597	2.5
Other utilization of special zone	6,850	1.8	2,507	1.7	2,097	0.6	2,246	1.6
Total	375,626	100	151,194	100	81,512	100	142,320	100

Source: The Ministry of Interior.

Table 4. Area Distribution by Land-Use Types in Southern Taiwan, 1975

Types of Land Use	Total		Pingtung hsien		Kaohsiung hsien		Tainan hsien	
	Ha.	%	Ha.	%	Ha.	%	Ha.	%
Type A. B. C. construction land	9,911	2.6	3,643	2.4	1,986	2.4	4,282	3.0
Type D construction land	1,609	0.4	528	0.4	495	0.6	586	0.4
Agricultura d pastoral land	193,254	51.5	81,587	53.8	33,703	41.4	77,964	54.8
Forest and fish culture land	95,960	25.6	57,430	37.8	17,074	21.0	21,464	15.1
Salt, mine and pottery land	2,779	0.7	46	0	499	0.6	2,234	1.6
Transportation & irrigation land	13,317	3.6	3,004	2.0	1,932	2.4	8,381	5.9
Others	58,783	15.7	5,557	3.7	25,823	31.7	27,403	19.3
Total	375,626	100	151,794	100	81,512	100	142,320	100

Source: Compiled from the data of the Ministry of Interior.

4. Land Use Restriction under the Regional Planning Act

As we have just mentioned, the regional plan divided non-urban land into eight land use zones, 17 different utilizations. Within each zone land utilization is strictly regulated. As shown in Table 5, the special agricultural zone and general agricultural zone are chiefly codified for farming and pastoral purposes; the industrial zone is mainly codified for industrial purposes; and the village zone is primarily codified for construction or recreation purposes, etc.

Land utilization within each zone is limited. Some original utilizations may be converted to other uses, but some may not. A detailed land use conversion codification is shown in Table 6.

According to Article 5 of the Control Regulations for Land Utilization in the Areas Outside City Boundaries after land use codification, the hsien (city) government shall be responsible for general supervision and the township (chen) government, shall be in charge of regular inspection. If misuse of any kind should be found, the township (chen) government should report the case to the hsien (city) government.

VII. ECONOMIC COMPARISON BETWEEN AGRICULTURAL AND INDUSTRIAL LAND USE

Needless to say, there is a considerable difference between agricultural and industrial production. Although land, labor and capital are three basic factors of production, their combinations are different in different industries. Agriculture is an industry which relies heavily on land while industry relies very much on capital. This difference in their basic nature makes the comparison very difficult. According to the Report on Farm Record-keeping in 1976, the annual income for agricultural

Table 5. Codification Principles of Land Utilization

Principles of codification / Classification of land use / land use zone	Type A construction land	Type B construction land	Type C construction land	Type D construction land	Agriculture and pastoral land	Forest land	Fish culture land	Salt industry land	Mine industry land	Pottery industry land	Transportation l and	Irrigation land	Recreation land	Historical site land	Ecosystem conservation land	National Protection and conservation	Cemetery land	Land for special purpose enterprise	Note
Special agricultural zone	△			△	V	X	X	X	△	X	V	V	△	V	V	V	△	V	Mainly for the codification of agricultural and pastoral land
General agricultural zone	V			△	V	V	V	△	△	△	V	V	V	V	V	V	V	V	Same as above
Village zone		V		△	V	V	V	X	X	X	V	V	V	V	V	V	△	V	Mainly for the codification of type B construction land
Industrial zone				V	V	V	X	X	X	△	V	V	V	V	V	V	X	V	Mainly for the codification of type D construction land
Forest zone			△	△	V	V	V	X	△	X	V	V	V	V	V	V	△	V	Mainly for the codification of forest land
Slopeland conservation zone			△	△	V	V	V	X	△	V	V	V	V	V	V	V	V	V	Same as above
Scenic zone			△	△	V	V	V	X	X	X	V	V	V	V	V	V	△	V	Mainly for the codification of recreation and forest land
Other utilization or special zone																			

Note: (V) Codification is permitted under the present condition of utilization.

(△) Codification must be approved by the authoriti s concerned.

(X) Codification is not allowed under the present condition of utilization.

Table 6. The Various Land Use Conversion Codifications

Classification of codification / Principle of codification conversion / Land use zone	Type A construction land		Type B construction land		Type C construction land		Type D construction land		Agricultural and pastoral land		Forest land		Fish culture land		Salt industry land		Mine industry land		Pottery industry land		Transportation land		Irrigation land		Recreation land		Historical site land		Ecosystem conservation land		National protection land		Cemetery land		Land for special purpose	
	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out
Special agricultural zone	X	O	X	O	X	O	X	O	O	+	X	O	X	O	X	O	+	+	X	O	++	+	++	+	X	O	++	+	++	+	++	+	X	O	++	+
General agricultural zone	+	O	X	O	X	O	X	O	O	+	+	+	+	O	+	O	+	+	+	O	++	+	++	+	+	O	++	+	++	+	++	+	+	O	++	+
Village zone	X	O	O	O	X	O	X	O	+	+	X	+	X	O	X	O	X	+	X	O	++	+	++	+	O	+	++	+	++	+	++	+	X	O	++	+
Industrial zone	X	O	X	O	X	O	O	+	++	+	++	+	X	O	X	O	X	+	++	O	++	+	++	+	++	+	++	+	++	+	++	+	X	O	++	+
Forest zone	X	O	X	O	+	O	X	O	+	+	O	+	+	+	X	O	+	+	X	O	++	+	++	+	+	+	++	+	++	+	++	+	+	+	++	+
Slope-land conservation zone	X	O	X	O	+	O	X	O	+	+	O	+	+	+	X	O	+	+	+	O	++	+	++	+	+	O	++	+	++	+	++	+	+	+	++	+
Scenic zone	X	O	X	O	+	O	X	O	+	+	+	+	+	O	X	O	X	+	X	O	++	+	++	+	O	+	++	+	++	+	++	+	+	O	++	+
Other utilization or special zone	+	O	X	O	X	O	X	O	O	+	O	+	+	O	+	+	+	+	+	O	++	+	++	+	+	O	++	+	++	+	++	+	+	O	++	+

Remark: 1. The conversion codification of land use should be limited that permissible within the original land use zone.
2. (O) means conversion is allowed.
3. (X) means conversion is prohibited.
4. (+) means conversion is allowed subject to the permission of the provincial authorities.
5. (++) means conversion is allowed subject approval by the central government.

production was NT$126,000 per ha. The cost of production was NT$60,000. The balance was NT$66,000 per ha. If we look at the information from the Agricultural Production Cost Survey in 1976, the result was even more disappointing. The total net annual profits per ha., according to the said source, were only NT$14,116.

Information about industrial production can be found from the Report on Industrial and Commercial Surveys in 1976. According to the survey, there were 55,863 units manufacturing enterprises in Taiwan in 1976. On average, each production enterprise occupied about 0.683 ha. of land. Based on the information from the survey, it is estimated that the production value per ha. amounted to NT$20 million. After deducting expenses, the net profit averaged about NT$3.4 million. Of course, the figures varied with different industries. The details are shown in Table 7.

Table 7. Land Productivity of Manufacturing Industries in Taiwan

	Area per plant (ha.)	Production value per ha.	Production expenses per ha.	Capital employed at end of 1976 per ha.
Grand average	0.683	20,256,000	16,885,000	18,058,000
Government		20,004,000	9,216,000	33,887,000
Private		20,304,000	18,340,000	15,056,000
Food manufacturing	0.494	14,895,000	13,317,000	12,219,000
Textile manufacturing	2.490	11,993,000	11,094,000	11,247,000
Garment manufacturing	0.120	91,541,000	90,229,000	30,780,000
Wood, bamboo, willow with manufacturing	0.182	64,192,000	61,721,000	56,714,000
Printing and publishing	0.344	11,351,000	8,028,000	7,339,000
Plastic product manufacturing	0.194	44,730,000	41,199,000	24,986,000
Metal product manufacturing	0.055	87,064,000	75,800,000	45,782,000
Machinery	0.345	7,684,000	7,032,000	6,397,000
Electrical machinery and repairing, manufacturing	0.397	105,334,000	95,156,000	50,879,000
Transport equipment manufacturing and repairing	0.297	61,249,000	48,529,000	78,539,000

Note: Plant area includes the land for plant, warehouse, dormitories, office and others.
Source: Report on Industrial and Commercial Surveys, 1976.
Ministry of Economic Affairs, Republic of China.

Mainly based on the difference in productivity in terms of dollar value, there has been an argument favoring conversion of farm land to industrial use. It is argued that we need not worry about a shortage in food supply, since in a market economy food can be bought with industrial goods. Theoretically, the argument is plausible, but the world economy is not as ideal as the theory. Sometimes you cannot buy what you want. This is especially true during a period of world crisis and for the commodities of basic human needs. Furthermore, agriculture is not only the source of food supply, but also an important component in the quality

of life. Man simply cannot live in a place constantly surrounded by concrete buildings. He also lives on something other than food and shelter. Agriculture is an important sector in the world ecosystem. Human beings can hardly afford to break the chain of the environmental cycle. Viewed from this point, the existence of agriculture is not only necessary but almost indispensable.

VIII. CONCLUSIONS

Largely because of historical circumstances the principles of the early land policy focused mainly on the distribution of land ownership. As to the policy toward land use, emphasis was placed on the unification of ownership and use rights. The land reform program carried out in the early 1950's clearly reflects this thought.

Taiwan's economic development during the past 25 years has been phenomenal and, as a result, its structure has undergone substantial changes. Agriculture is no longer the major sector, and industrial development has overtaken agriculture.

Economic structural change has brought about changes in the demand pattern for land. Changes in demand pattern gave rise to new problems in land use. The new problems caught the government off guard. The old laws were not complete enough to deal with these problems. Thus, when situations became serious, temporary regulations were issued. Unfortunately, some regulations were promulgated too late, they were not in effect until some damages had been done.

The enactment of the Regional Planning Act marks the beginning of a new period as far as land policy is concerned. It also reflects the government's determination to deal with the problem of future land utilization. Regional planning is an integrated approach, and during the planning process all the factors affecting land use are taken into consideration. The first-phase implementation in southern Taiwan has proved successful. It is hoped that continued implementation of regional planning will lead to balanced development between city and rural areas and to optimum allocation and efficient utilization of land.

Farm Family Income Distribution by Region in Taiwan*

Terry Y. H. Yu**

Farm family income consists of agricultural income and non-agricultural income. The share of non-agricultural income is continuously increasing and is inversely related with farm size. The higher the ratio of non-agricultural income, the lower the degree of farm family income inequality. The results of this study indicate that a large portion of farm family income inequality is attributable to interregional variation of farm family income. Regional development programs can contribute toward improving the income distribution within the agricultural sector through the strengthening of farmers' non-farm employment opportunities.

I. INTRODUCTION

The pioneering work of Simon Kuznets suggested two hypotheses concerning the distribution of income. The first is that income becomes more evenly distributed during the later phases of economic growth when incomes rise. The second hypothesis is that income is more equally distributed within the agricultural sector than within the nonagricultural sector.[1] These hypotheses have been tested against empirical data in different countries with various conclusions.

In their study on the time path of income distribution, Fei, Ranis and Kuo found that, recognizing the existence of a "turning point" around 1968, the so-called Kuznets thesis concerning an inverse U-shaped pattern of distribution over time applies, although it is much less pronounced in Taiwan than in other less-developed countries. The Gini ratio for the whole economy shows a slightly increasing trend between 1964 and 1968 and declines consistently and markedly thereafter.[2] Chang Han-yu's similar findings showed that the inequality among farm families increased for the period 1964-1968, and decreased for most years thereafter.[3] In addition,

* Condensed from a paper of the same title presented at the Seminar on Distribution of Income and Expenditure in Asian Countries sponsored by the Institute of Economic Research, Hitotsubashi University, Tokyo, Japan, September 5-7, 1977.

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1) Kuznets, Simon, "Economic Growth and Income Inequality," *American Economic Review*, 47: 1-28, March 1955.

2) Fei, John C. H., Gustav Ranis, and Shirley W. Y. Kuo, "Growth and the Family Distribution of Income by Factor Components: The Case of Taiwan," Yale University Economic Growth Center, Discussion Paper No. 223, (Mimeo), March 1975.

3) Chang, Han-yu, "Income Disparity under Economic Growth in Taiwan: Over Time Changes and Degree as Compared with Other Countries," paper presented at the Second Asian Regional Conference of International Association for Research of Income and Wealth held at Manila, Philippines, April 3-7, 1977.

the farm family Gini ratios were found to move up and down during the period 1968-1975, and in many years they ran in a different direction than those for nonfarm families and the economy as a whole. In this connection, Kuo Wan-yong's conclusion may be especially noteworthy: "Income distributions of farm and nonfarm families both improved during the period 1964-1972. However, the speed of equalization for farm families was less than that for nonfarm families. The farm families which previously had a narrower inequality than nonfarm families turned to a wider inequality in 1972."[4]

In order to explore in more detail the factors which might contribute to the inequality of the farm family income distribution, the composition of regional variations in total farm family income will be analyzed. Since farm family income consists of incomes earned from farm as well as off-farm activities, it may be hypothesized that if one of the components of farm fomily income is distributed more unequally than the other, then interregional differences and shifts over the course of time in the composition could explain some of the forces affecting the distribution of farm family income.

As rural development planning is becoming increasingly regional in Taiwan, analysis of regional income distribution is worth attempting in view of the pressing need to work out priorities in rural development programs under the policy guidelines of equitable growth. More specifically, the purposes of this paper are:

(1) to investigate the distribution of farm family income by agricultural region in Taiwan,

(2) to analyze the factors responsible for both the *average* (position) and *dispersion* (shape) of farm family income distribution, and

(3) to draw policy implications from the results of this study.

II. DATA AND PROCEDURES

There are three main published sources of information concerning farm family income in Taiwan, they are, namely, Report on the Survey of Family Income and Expenditure (starting 1964), Report of Farm Record-keeping Families (starting 1960), and Report of Survey Study of Taiwan Farm Income (starting 1952). While the former two sources are made public annually by the Provincial Government, the latter is compiled as a survey study project carried out every five years by National

4) Kuo, Wan-yong, "Income Distribution by Size in Taiwan Area—Changes and Causes," in "Income Distribution, Employment and Economic Development in Southeast and East Asia," The Japan Economic Research Center, Tokyo, and The Council for Asian Manpower Studies, Manila, Vol. 1, pp. 80-153, July 1975.

Chung Hsing University and National Taiwan University with JCRR support. Occasionally, university professors make small-scale sample surveys of farm income. The most recent survey of this kind is the 1975 Taiwan farm family income survey conducted by the Department of Agricultural Economics, Chung Hsing University.

In regard to agricultural regions, most demarcations are quite rough and vary with purposes of study. In the Farm Income Survey, 13 agricultural regions are identified on the basis of criteria such as climate, geography, soil, irrigation facilities and cropping patterns. These regions are:

(1) Yilan Rice Region
(2) Taipei Rice Region
(3) Taichung Rice Region
(4) Kaohsiung Rice Region
(5) Eastern Rice Region
(6) Tea Region
(7) Miaoli Mixed Farming Region
(8) Taichung Mixed Farming Region
(9) Alishan Mixed Farming Region
(10) Banana and Pineapple Region
(11) Chianan Mixed Farming Region
(12) Western Sugarcane Region
(13) Eastern Sugarcane Region

The Farm Record-keeping Project reclassified Taiwan into eight agricultural regions based primarily on the information contained in the 13 agricultural regions, with demarcations adjusted to fit township boundaries. In 1975, there were 60 townships with 480 farm families participating in the project among whom 468 farm families finished their record-keeping work. The eight agricultural regions are:

(1) Northern Rice Region
(2) Middle Rice Region
(3) Southern Rice Region
(4) Tea Region
(5) Southwestern Mixed Farming Region
(6) Southwestern Sugarcane and Rotation Region
(7) Banana and Pineapple Region
(8) Eastern Mixed Farming Region

Until 1963, the farm record-keeping families were distributed only in the northern, middle, and southern rice regions. The farmers in the eastern and other special crop regions did not take part in the project. The record-keeping project, however, was expanded to the whole province in 1964.

Demarcation of agricultural regions can also be made according to prefecture boundaries. Professor Erik Thorbecke in his study of Taiwan's agricultural development identified seven agricultural regions on the basis of criteria similar to those used by the Farm Record-keeping Project, except that the regions were composed entirely of different prefectures. His reasoning was that agricultural statistics relating to production and to some inputs are available on an annual basis in Taiwan at the prefecture level. These regions, including in parentheses the prefectures they embrace are, moving from the north to the southwest:[5]

(1) Northern Rice Region (Taipei, Yilan, Taoyuan)
(2) Tea Region (Hsinchu, Miaoli)
(3) Central Rice Region (Taichuug, Changhua)
(4) Banana-pineapple Region (Nantou)
(5) Southwest Rice-sugarcane Region (Yunlin, Chiayi, Tainan)
(6) Southern Rice Region (Kaohsiung, Pingtung)
(7) Eastern Mixed Region (Taitung, Hualien)

For the purposes of this study, and due to the availability of farm income data, all three classifications of agricultural regions as mentioned above will be used in the analysis of income distribution.

While various measures of income inequality such as coefficient of variation, Kuznets index, Oshima index, Theil index, Decile index and Quintile index may be used for study of income distribution, Gini concentration ratio or Gini coefficient is by far the most popular one. The Gini coefficient is defined as the proportion of the total area below the diagonal line of perfect equality, i.e., between the diagonal and the Lorenz curve.[6] The coefficient ranges from 0 denoting perfect equality to 1 denoting perfect inequality. The larger the coefficient, the more unequal is the income distribution. The Gini coefficient increases with the number of income brackets used to estimate it.

III. STRUCTURE OF FARM FAMILY INCOME

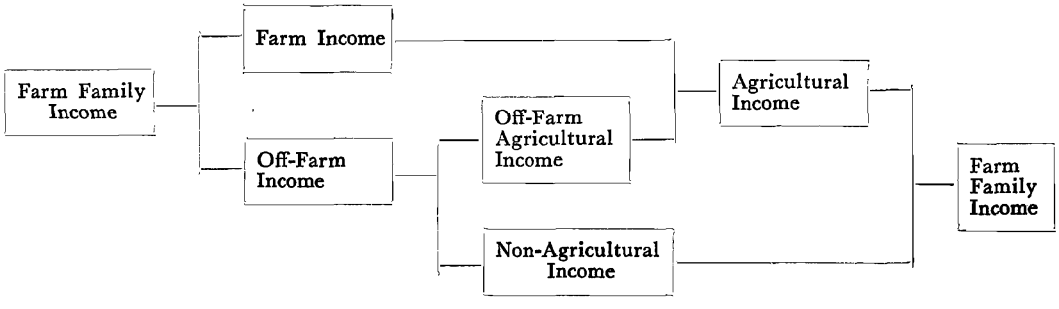
In this study, a farm family refers to a family whose head is registered as a

5) Thorbecke, Erik, "Agricultural Development of Taiwan" (preliminary draft), Cornell University, 1977.
6) U. S. Department of Commerce, Bureau of the Census, "Trends in the Income of Families and Persons in the United States: 1947-64," Technical Paper 17, Washington, U. S. Government Printing Office, 1967.

farmer. A farmer is a person who is engaged directly in agricultural production. Since all members of a farm family are not directly engaged in agricultural production, the farm family income is composed of all income received by members of the farm family, including both income from farm and nonfarm or off-farm activities. Total off-farm receipts contain (a) off-farm labor earnings, (b) rental or property income, (c) income from sideline activities, and (d) other nonfarm receipts.

Farmers may work for others farms, they may also hire out their work animals or farm machines. Income earned from these activities are classified as off-farm income, but they are nevertheless derived from agricultural sector. Thus, off-farm income may be broken down into two broad sources, namely off-farm agricultural income and nonagricultural income. A simplified structure of farm family income is shown in Figure 1.

Figure 1. Composition of Farm Family Income



1. Sample Variation

Estimate of income earned by farm family and nonfarm family alike can hardly claim exact and perfect. Different samples normally generate different results. Table 1 summarizes the information obtained from three sources for 1975.

Average farm family income was higher for the Farm Record-keeping Project than in other samples mainly because the cultivated land per farm was larger for the recordkeeping families. Farms with larger land area can be looked upon as bonafide farmers as they earn more income from farming activities. The Survey of Family Income and Expenditure resulted in lower income per farm household due primarily to smaller farm size as indirectly indicated by the smaller size of farm household in the sample. This inference is also supported by the fact that average non-agricultural income of this sample is greater than average agricultural income which is usually the case for smaller farms. The Survey of Farm Family Income in 1975 turned out figures in between the other two samples. This survey, as well

as other farm income surveys, is generally taken as more representative of real farm economic status because the sample was drawn at random, stratified by agricultural region and farm size.

Table 1. Farm Family Income in Taiwan, 1975

Item \ Source of Data	Survey of Farm Family Income	Survey of Family Income & Expenditure	Farm Record-keeping Project
No. of farm households	500	2,674	468
Persons per farm household	6.86	6.03	7.72
Cultivated land per farm (hectare)	0.89	na*	1.37
Per household:			
Farm family income	103,434	86,061	158,505
Agricultural income	52,149	39,853	90,763
Non-agricultural income	51,286	46,208	67,742
Per person			
Farm family income	15,078	14,272	20,532
Agricultural income	7,601	6,609	11,757
Non-agricultural income	7,476	7,663	8,775

Note: *na denotes information not available.

2. Comparison with Nonfarm Family

Direct comparison of income levels between farm and nonfarm families can be made based on the Report on the Survey of Family Income and Expenditure.

Farmers' income has always been lower compared to their nonfarm counterpart. Relative income per farm household dropped from 95% in 1966 to 80% in 1975. On a per person basis, relative income of farmers decreased with some year-to-year fluctuations from 69% to 67% during the same time period (see Table 2).

Table 2. Comparison of Farm and Nonfarm Family Income in Taiwan

Year	Farm Family		Nonfarm Family		Farm Family as % of Nonfarm Family	
	Per Household	Per Person	Per Household	Per Person	Per Household	Per Person
1966	32,320	4,509	34,080	6,464	95	69
1968	31,966	4,757	44,603	8,214	72	58
1970	35,439	5,350	49,089	8,894	72	60
1971	40,858	6.191	51,629	9,650	79	64
1972	49,033	7,540	60,010	11,341	82	66
1973	54,352	8,533	73,957	14,170	73	60
1974	82,980	13,180	98,257	19,263	84	68
1975	86,061	14,274	108,086	21,285	80	67

Source: Taiwan Provincial Bureau of Accounting and Statistics: "Report on the Survey of Family Income and Expenditure," annual edition, 1966–1968 Taipei City inclusive, 1970 and later Taipei City exclusive.

As noted earlier, net income of farm families includes earnings from both agricultural and non-agricultural sources. It also includes adjustment for the value of the physical changes in crop and livestock inventories. There is enough evidence to show that farm size as measured by cultivated land area is the most critical factor determining farm income.

3. Contribution of Non-agricultural Income

Taiwan's average farm size decreased from 1.26 hectares in 1952 to 0.89 hectares in 1975; more than 40% of the farmers had less than 0.5 hectares at that time. Since small farms cannot earn enough from farming to support their family, they have to find nonfarm supplementary employment. Census statistics show an increase in part-time farms since the early 1960s. As a result, the contribution of nonfarm work to farm family income rose from about 18% in 1964 to approximately 46% in 1976. The share of non-agricultural income to total farm family income is inversely related with size of farm. For farms with 0.49 hectares and below, non-agricultural income contributed more than 70% to the 1976 farm family income, while for those with more than 2 hectares of cultivated land, the share of non-agricultural income was 30% (see Table 3).

Table 3. Non-Agricultural Income as Percentage of Farm Family Income 1964-1976

Unit: %

Year	Total Average	0.49 Ha. & Below	0.50—0.99	1.00—1.49	1.50—1.99	2.00 Ha. & Above
1964	18.14	35.35	23.59	15.09	13.84	10.29
1965	19.43	35.29	24.80	17.86	15.20	11.81
1966	18.32	42.51	20.42	19.85	14.31	12.35
1967	18.70	41.52	19.68	17.57	18.85	12.12
1968	19.94	45.38	24.66	16.92	18.60	14.03
1969	28.95	54.54	37.65	25.99	24.56	19.00
1970	27.73	51.86	35.23	25.68	22.07	19.63
1971	28.15	53.26	32.78	23.79	28.49	22.17
1972	39.41	62.98	50.89	39.39	34.69	25.80
1973	41.31	67.58	47.31	42.47	38.60	25.45
1974	37.32	64.72	44.17	35.42	33.21	25.58
1975	42.73	69.94	51.05	43.97	38.47	25.99
1976	46.28	70.37	57.86	44.88	38.89	30.19

Source: Taiwan Farm Record-keeping Project.

4. Changes in Inequality of Farm Family Income Over Time

Although the farm record-keeping data may not be representative of the general

farm economy in Taiwan at any given point in time, it can nevertheless provide us with reasonably reliable information on the changes in the distribution of farm family income over time.

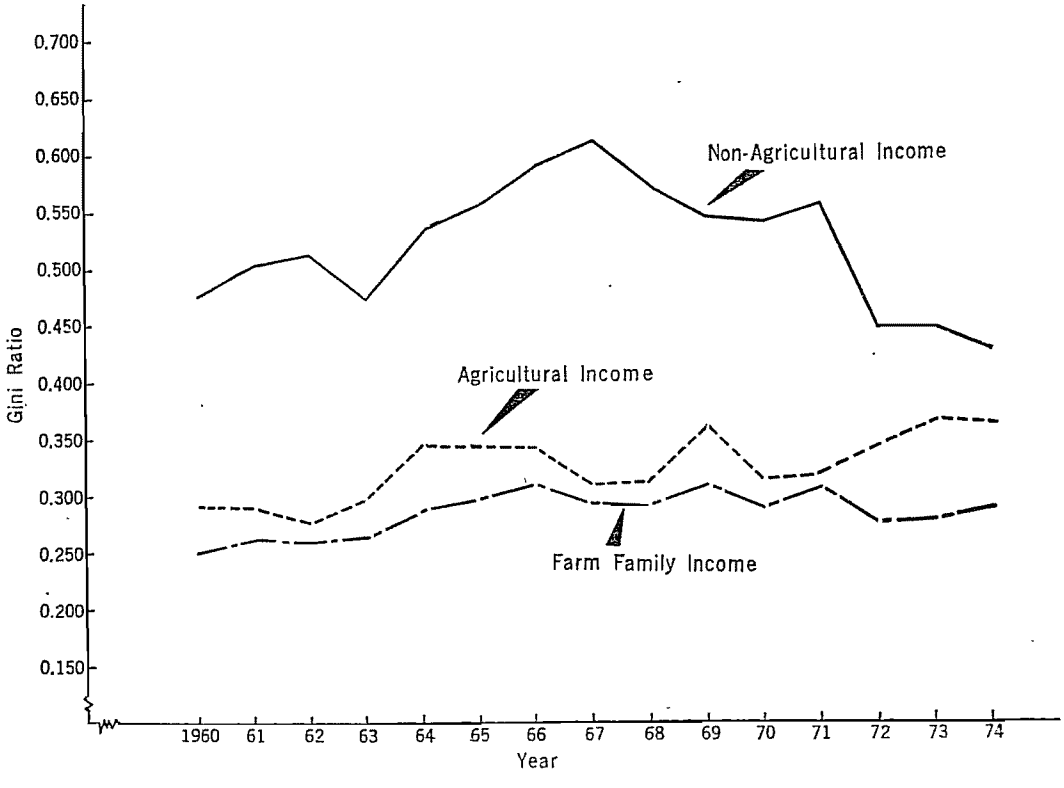
As far as the data goes, the Gini ratio of total farm family income shows a significantly increasing trend between 1960 and 1969 and declines slightly thereafter, though a mild rising trend is observed for the period 1972 to 1974 (Table 4 and Figure 2). This phenomenon seems consistent with Kuznets' thesis, and is pretty

Table 4. Gini Ratios of Farm Family Income by Sources of Income 1960-1974

Year	Farm Family Income	Agricultural Income	Non-agricultural Income	Year	Farm Family Income	Agricultural Income	Non-agricultural Income
1960	0.250	0.290	0.476	1968	0.290	0.311	0.573
1961	0.261	0.288	0.501	1969	0.309	0.357	0.547
1962	0.258	0.276	0.513	1970	0.287	0.312	0.543
1963	0.263	0.297	0.474	1971	0.305	0.318	0.559
1964	0.286	0.343	0.531	1972	0.275	0.344	0.448
1965	0.296	0.344	0.557	1973	0.277	0.362	0.448
1966	0.308	0.341	0.590	1974	0.287	0.361	0.427
1967	0.292	0.308	0.618				

Source: Computed from the Report of Farm Record-keeping Families in Taiwan, various issues.

Figure 2. Changes in Farm Family Income Distribution



much in accord with the findings of Fei and his associates.[7] The same tendency also holds for the Ginis of farm family's non-agricultural income, but with sharp decline of the Gini after reaching its peak in 1967.

Changes in the inequality of farmers' agricultural income are somewhat different from those of total farm family income and the non-agricultural component. The agricultural Gini increases before 1969, decreases in 1970, but experiences a consistently rising trend between 1971 and 1974.

Taken together, changes in the distribution of farm family income components suggest that, for farm families, the increased share of non-agricultural income certainly contributes to an improvement in the equity of their distribution of family income.

IV. REGIONAL CHARACTERISTICS OF FARM FAMILY INCOME DISTRIBUTION

Regional variation of farm family income distribution was analyzed utilizing the farm record-keeping data. Estimated Gini coefficient for each agricultural region was compared with regional agricultural growth rates computed by Professor Thorbecke.

Thorbecke computed the agricultural growth rates for each region for the two subperiods 1952-65 and 1965-74. Volume figures for agricultural production were obtained from various issues of Taiwan Agricultural Yearbook for the benchmark years, 1952, 1965 and 1974, by prefectures and consolidated into the seven agricultural regions. The volume figures were then multiplied by the average prices prevailing over the period 1952-75 which were used as weights and the growth rates computed for the two periods. As noted previously, the Farm Record-keeping Project demarcated eight agricultural regions, but Thorbecke grouped Taiwan into seven agricultural regions. Thorbecke did not identify Southwestern Mixed Region in his analysis. For the purposes of this study, the annual growth rates of Southwestern Mixed Region for the period under study were assumed to be the same as those of the Rice-sugarcane Region because these two regions virtually fall in the same prefectures.

It is interesting to observe the relationships between the growth rates and the Gini ratios by agricultural regions (Table 5). The findings may be summarized as follows:

(1) The two southern regions displayed significantly higher growth rates of total agricultural output in the two subperiods than obtained for Taiwan as a whole. In contrast, the two northern regions (i.e., the Northern Rice and the Tea Regions) performed much worse than the average of Taiwan.

7) Fei, et. al., op. cit.

Table 5. Relationship between Agricultural Growth Rates and Gini Ratios by Region

Region	Growth Rate and Gini Ratio	Annual Growth Rate* (%)	Gini Ratio at End of Period**		
			Farm Family Income	Agricultural Income	Non-agricultural Income
1. Northern Rice Region	1952—65	3.7	0.214	0.246	0.569
	1965—74	2.8	0.315	0.413	0.459
2. Central Rice Region	1952—65	4.1	0.268	0.293	0.550
	1965—74	3.0	0.265	0.348	0.374
3. Southern Rice Region	1952—65	5.6	0.387	0.409	0.638
	1965—74	4.7	0.289	0.363	0.378
4. Tea Region	1952—65	3.1	0.228	0.274	0.542
	1965—74	1.8	0.254	0.372	0.432
5. Southwestern Mixed Region	1952—65	5.2	0.308	0.390	0.509
	1965—74	4.0	0.231	0.329	0.382
6. Rice-sugarcane Region	1952—65	5.2	0.284	0.334	0.548
	1965—74	4.0	0.306	0.325	0.460
7. Banana-pineapple Region	1952—65	3.7	0.306	0.365	0.561
	1965—74	3.5	0.242	0.371	0.388
8. Eastern Mixed Region	1952—65	6.0	0.322	0.387	0.456
	1965—74	2.2	0.252	0.262	0.379
Total for Taiwan	1952—65	4.5	0.296	0·344	0.557
	1965—74	3.5	0.287	0.361	0.427

Note: *Annual growth rate was computed by Prof. Erik Thorbecke: Volumes of agricultural production were multipled by the average prices prevailing over the period 1972–75 which were used as weights and the growth rates computed for the two periods. Thorbecke did not identify the Southwestern Mixed Region in his study. The annual growth rates of the Southwestern Mixed Region were assumed to be the same as those of the Rice-sugarcane Region because these two regions fall in the same prefectures.

**Gini ratios were computed by the present author on the basis of farm record-keeping data.

(2) The Gini ratios of non-agricultural income were greater than that of agricultural income and total farm family income for all agricultural regions. Gini ratios of agricultural income were greater than that of farm family income for all regions during the time periods under consideration.

(3) The Gini ratios of non-agricultural income dropped significantly from 1965 to 1974 for all agricultural regions and for Taiwan as a whole. Farm family's non-agricultural income became more equal during the period from 1965 to 1974.

(4) Five out of the eight regions experienced a decline in inequality of total farm family income from 1965 to 1974, thus resulted in a drop of Gini ratio for Taiwan as a whole from 0.296 to 0.287 during the same time period.

(5) While four out of the eight regions demonstrated a decline in inquality of agricultural income, in the other four regions an increase of Gini ratios was observed

for the period from 1965 to 1974. The Gini of agricultural income became larger, indicating that the weight of increasing inequality was greater than the decreasing inequality in the agricultural regions.

(6) Growth rates of agricultural production varied significantly among regions. While in all regions the growth rates dropped from 1952-65 to 1965-74, the two southern regions displayed significantly higher growth rates of total agricultural output in the two subperiods than obtained for Taiwan as a whole. This phenomenon, in general, reveals a relative shift in resources away from the Northern Rice and the Tea Regions towards the Southwest Rice-sugarcane and the Southern Rice Regions.

(7) In the later subperiod, i.e., in 1965-74, there existed a quite clear inverse relationship between agricultural growth rates and farm income inequality. Growth rates of the two northern regions were lower than that of the two southern regions, but the Gini ratios of agricultural income of the two northern regions were higher than that of the two southern regions in 1965-74 period. This seems to imply that equity can be efficient. In the earlier period of 1952-65, high growth rates as observed in the Eastern Mixed, the Southern Rice and the Southwest Mixed Regions were accompanied by greater inequalities both in agricultural income and total farm family income distributions.

Factors Affecting Regional Farm Family Income

Intensity of land use is one of the important factors influencing farm income. Multiple-cropping indices differ significantly among agricultural regions. For the year 1972, the multiple-cropping index ranged from 160 in the Eastern Rice Region and Eastern Sugarcane Region to 254 in the Kaohsiung Rice Region, averaged out 182 for the province as a whole. It is generally conceived that intensive land use by multiple-cropping practices is one of the most effective approaches to creating additional income for the farmer. Previous study found a positive correlation between Gini coefficients and multiple-cropping indices in the Taichung Rice Region.[8]

The importance of off-farm sources of farm family income is readily reflected in the structure of farm family income discussed earlier in this paper. In a study of the rural nonfarm sector in Taiwan, Ho concluded that "the increased employment opportunities outside of agriculture not only help to raise the income earned by farm households but contributed also to a more equal income distribution,"[9] This conclusion is substantiated by Lin's cross-section study. Based on the Survey

8) Lee, C. S., et. al., "Impact of Multiple-cropping Diversification on Farm Income in Taiwan," The Philippine Economic Journal, Vol. XIV, Nos. 1 and 2, 1975, pp. 77-87.

9) Ho, S.P.S., "The Rural Non-farm Sector in Taiwan," World Bank, Studies in Employment and Rural Development, No. 32, Washington, D. C., September 1976.

of Family Income and Expenditure data, Lin's inter-prefecture analysis of farm family income distribution indicates that the main factors affecting the Gini ratio of farm family income in Taiwan are, in descending order.[10]

(1) Average farm family income (negative).
(2) Variance of number of gainful workers in farm family (positive).
(3) Average per family expenses of agricultural extension education (positive).
(4) Average number of off-farm workers in farm family (negative).
(5) Capital-labor ratio (positive).

It is worthwhile to note that the positive correlation between average expense per farm for agricultural extension and the Gini ratio. This relationship implies that the extension programs as implemented through farmers' association might have been biased in favor of big farmers. Introduction of most new varieties, new cultural techniques and new farm tools can be more readily accepted by large and commercialized farms than small and subsistence farms. Extension programs that are really effective thus tend to enlarge the inequality of farm family income distribution. Since there exist qualitative and quantitative differences in resource endowments among agricultural regions, degree and speed of technological diffusion are apt to vary among regions, and thus resulted in widening income differentials. Based on his review of evidence, Ruttan observed that "where the technology has been introduced in areas characterized by a reasonable degree of equity in the distribution of resources, the effect has been favorable both in terms of productivity and equity. When the technology has been introduced in areas characterized by great inequality in the distaibution of resources, the productivity impact has been weak and the pattern of inequality has been reinforced."[11]

Nevertheless, when the average farm family income rises, the Gini ratio will tend to decrease, as evidenced by the negative relationship between Gini ratio and average farm family income.

More variables can be tested to measure their effect on farm family income. Farm size, area planted to rice, number of employed persons, average year of schooling, and total months farm family members work off-farm, all are found to be important, though their explanatory power varies among agricultural regions. An attempt was made to identify two most influential factors from the five variables listed above, it was found that farm size and the total months the farm family

10) Lin, D. C., "A Study on the Farm Family Income Distribution in Taiwan" (in Chinese), unpublished M. S. Thesis, Research Institute of Agricultural Economics, National Chung Hsing University, June 1973.
11) Ruttan, Vernon W., "Induced Institutional Innovation and the Green Revolution," paper presented at the Conference on Strategic Factors in Rural Development in East and Southeast Asia, sponsored by the Council for Asian Manpower Studies held at Pasay City, Philippines. December 18-22, 1976.

members work off-farm have the higher scores of counting (frequency) as is shown in Table 6.

In terms of agricultural income, the government's price policy plays a critical role in the determination of income level and its variation among regions. In general, the regions of double rice cropping get the highest total agricultural income per unit area of cultivated land, maximum revenues being realized where double cropping of rice is supplemented by some winter crops which are associated with relatively fertile soils and adequate irrigation water. From Table 7 it can be seen that both agri-

Table 6. The Two Most Important Factors Affecting Farm Family Income by Agricultural Region

(In order of importance judged on the basis of "Beta" Coefficient)

Variable / Region No.	(1) Farm Size in Ha. of Cultivated Land	(2) Ratio of Area Planted to Rice to Total Crop Area	(3) No. of Employed Persons in Farm Family	(4) Average Year of Schooling of Farm Family Members	(5) Total Months Farm Family Members Worked Off-farm
1			2	1	
2	2				1
3	1				2
4		2			1
5	2				1
6	2		1		
7				2	1
8			1	2	
9			2	1	
10	2		1		
11	2				1
12	1				2
13	2	1			

Source: Computed from 1975 Farm Family Income Survey data, Research Institute of Agricultural Economics, National Chung Hsing University.

Table 7. Comparison of Agricultural Income by Region

Item / Region	Cultivated Land Per Farm (Hectares)	Agricultural Income (NT$)		Index of Agricultural Income	
		Per Farm	Per Ha.	Per Farm	Per Ha.
1. Northern Rice Region	1.36	88,315	64,937	101.5	105.3
2. Central Rice Region	1.08	89,365	82,746	102.7	134.1
3. Southern Rice Region	1.32	99,129	75,098	114.0	121.7
4. Tea Region	1.45	57,122	39,394	65.7	63.9
5. Southwestern Mixed Region	1.46	88,126	60,360	101.3	97.8
6. Rice-Sugarcane Region	1.48	97,638	65,971	112.2	106.9
7. Banana-pineapple Region	1.29	65,363	50,669	75.1	82.1
8. Eastern Mixed Region	2.36	94,322	39,967	108.4	64.8
Total for Taiwan	1.41	86,991	61,696	100.0	100.0

Source: Computed from Report of Farm Record-keeping Families in Taiwan, 1974.

cultural income per farm household and per hectare of cultivated land are higher in the rice regions than in non-rice regions. Average agricultural income per farm household in the Eastern Mixed Region is relatively high mainly because of relatively larger size of farm.

The higher income in rice regions is apparently a result of government price support program. The guaranteed prices for japonica and indica rice in 1974 were set at NT$10 and NT$8.5 per kilogram which were, respectively, 66 percent and 49 percent more than those in 1973, and allowed farmers with an average 25 percent profit margin. Higher rice purchase prices provide a strong incentive for the farmers to increase production.

V. CONCLUSIONS AND POLICY IMPLICATIONS

The results of this study can be summarized in the following points:

1. As agricultural regions are characterized by cropping patterns that are determined primarily by natural-technological conditions, farmers within agricultural regions are endowed with similar income potential from farming activities. Thus, farm family's agricultural income is more equally distributed within agricultural regions than among agricultural regions.

2. The ratio of farmers' non-agricultural income to total farm family income is inversely related to farm size. Nonfarm sources of income allow farm families with small holdings to close the income gap between small and large farms, and hence, have the effect of reducing relative inequality within the agricultural sector. In other words, the higher the ratio of non-agricultural income, the lower the degree of farm family income inequality.

3. As a result of rural industrialization, more off-farm employment opportunities have become available to the relatively poor and small farm families. Until very recently, this development has helped to reduce the inequality of farmers' non-agricultural income, even though the distribution of non-agricultural income is quite uneven among regions. Off-farm employment may have become more selective as the industries have shifted from labor intensive to capital and technology intensive during the recent past.

4. Rates of agricultural output growth vary among agricultural regions, exerting direct impact on the distribution of agricultural income of the farm families. However, there are possibilities for a substantial reduction of the so-called conflict between

growth and equity.[12] Within the agricultural sector, "equity can be efficient."[13]

5. In striving to raise farm family income to an "equitable level" (compared with nonfarm families), attention should be paid to inequality within the agricultural sector. For income inequality as measured by Gini coefficient within agricultural sector has not been reduced at a speed parallel to the non-agricultural sector.

6. A large portion of farm family income inequality was attributable to inter-regional variation of farm family income. Regional development planning can contribute a great deal to improve income distribution within the agricultural sector. Improvement in income distribution is preferred because reduction of inequality of personal income is one of the most important means of attaining social justice which is taken as a basic policy guideline in development planning.

7. Since the share of non-agricultural income in farm family income has continuously increased, and the distribution of non-agricultural income seems to have become more unequal, regional or area development program must take into consideration farmers' employment opportunities outside of agriculture. Off-farm opportunities not only help to raise income earned by farm families but also contribute to more equalized distribution of farm family income. Designing or demarcation of agricultural regions, such as the establishment of specialized agricultural areas, ought better be based on some predetermined priorities which are set up by looking into regional income potential from both farm and nonfarm points of view.

8. In order to facilitate implementation of a regional development program, more accurate regional socio-economic as well as natural-physical information is needed, and up-to-date income data and the factors affecting farmers' income need to be systematically surveyed and recorded on a regional basis. A regional data bank should be established with full support. To accelerate rural and agricultural development, more location-specific programs should be designed. Without details and accurate data at micro-level, preferably at township or village level, development planning can hardly meet the policy objective of "growth with equity."

12) Fei, et. al., op. cit.

13) Grant, James P., "Growth from Below: a people-oriented development strategy," Overseas Development Council, development paper 16, December 1973.

Food Consumption in Taiwan

Yueh-eh Chen*

I. FOOD BALANCE SHEETS

Information on food and nutrient availability in Taiwan did not become available till 1956 when the preparation of food balance sheets was started by the Joint Commission on Rural Reconstruction (JCRR). Since then, food balance sheets have been prepared and published annually with continued improvement. Their preparation involves three steps:

(1) Collection of Data on Total Available Supply

Foodstuff availabilities are estimated on the basis of domestic yields, imports and exports, with adjustments for change in stocks. The total available food supplies are used for seed, animal feed, manufacturing, and human food, or simply wasted. Thus, the food availability for human consumption is obtained by deducting from the total available supply the amount used as seed, animal feed, and raw materials for manufacturing, or wasted on the farm and in the course of distribution.

(2) Calculation of Per Capita Food Availability

The amounts of various foods and food groups available on a per caput basis are calculated by dividing the total food supply available for human consumption by the number of mid-year population which in Taiwan means population at the end of June. In the calculation of per capita food availability, the portions of refuse (inevitable parts), such as bones, egg shells, skins of fruits, the outer leaves and roots of some vegetables, are not excluded. Thus, the per capita food availability is calculated on the basis of the retail weight, i.e. "as purchased", or as brought into the kitchen, and cannot be regarded as actual intake because of the inevitable loss through preparation and cooking.

Two series of per capita food availability are available: one on an annual basis, the other on a daily basis.

(3) Calculation of Per Capita Daily Nutrient Availability

Based on step (2), the daily availabilities of calorie, protein, and certain nutrients on a per caput basis are further calculated by using the criteria adopted in

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the USDA report "Composition of Foods Used in Far Eastern Countries" to measure the nutrition contents of all foodstuffs.

The food balance sheet so prepared gives information on: (1) total food availability, (2) per capita annual and daily food availability, and (3) per capita daily nutrient availability. It has become the main, if not the only, source of providing detailed information on food and nutrient availabilities in Taiwan today.

II. FOOD AND NUTRIENT AVAILABILITIES

The food consumption pattern of Taiwan underwent very significant changes in the last two decades, of which the most noticeable were increase in the consumption of high-grade non-starchy foods, such as meat, eggs, fruits and vegetables, and decrease in that of inferior goods, such as cereals and other starchy foods. The per capita consumption of meat in 1976 reached a record high of 31.6 kg, which was an increase of 17 percent over that in the previous year, or 2.5 times as large as that of two decades ago. The great increase in per capita meat consumption is mainly attributable to the rapid expansion of hog production. The per capita consumption of pork in 1976 was 21.4 kg, which made up more than two-thirds of the year's total meat consumption. Egg consumption on a per capita basis was nearly 6 kg in the same year, showing an annual increase of 12 percent, or 3.7 times that of two decades ago. Per capita amounts of fruits and vegetables consumed in 1976 were 62.1 kg and 118.4 kg, respectively. Bumper harvests in the year were the main factor in increases in the consumption of fruits and vegetables by 12.7 percent and 7.8 percent, respectively. People now consume less inferior goods than before; in the consumption of cereals and other starchy foods in 1976 there were decreases by 3.6 percent and 22.7 percent, respectively. Cereal consumption reached a saturation point of 167 kg in 1969, and then gradually dropped to 156 kg in 1976. The annual consumption of white rice per head was over 130 kg for the last two decades even as high as 141.5 kg in 1967, but it fell to 128 kg in 1976 and is expected to decline further. Decrease in the consumption of sweet potatoes has been most remarkable, in 1976 the per capita consumption was less than 8 kg, which was only 12 percent of that two decades ago.

Energy and protein intakes are two important yardsticks for measuring a people's nutrient level. In Taiwan, the average daily diet provided 2,233 calories in 1956 and 2,719 calories in 1976, showing an increase of 21.8% during the two decades. Starchy foods (of which rice is the most important) are contributing a declining share in the total calorie intake. The share was 75 percent in 1956 and dropped to 58 percent in 1976. Evidently, increased income and changed food consumption

patterns are the best explanations for the relative decrease in calorie intake from starchy foods. The protein intake has on the other hand shown con- siderable increase. It was only 54 grams per capita per day in 1956 and climbed to 76 grams two decades later. Increased utilization of animal proteins was even more significant. The per capita daily animal protein intake rose in the same period from 13.5 grams to 26.7 grams, showing an increase of nearly 100 percent. This means that the share of animal proteins in the total protein intakes was raised from 25 to 35 percent during the last two decades.

Table 1. Per Capita Annual Food Availability

Unit: Kg.

Food item	Taiwan, China					Japan	Korea
	1956	1966	1975	1976	1976/1956 %	1975	1975
Cereals, of which:	150.2	156.3	162.1	156.3	+ 4.1	122.1	192.9
Rice, polished	132.6	137.4	130.4	128.1	− 3.4	88.1	119.8
Wheat flour	16.6	16.6	24.3	20.8	+ 25.3	31.5	30.0
Other starchy foods, of which:	66.7	47.2	14.5	11.2	− 83.2	17.8	35.0
Sweet potato	64.2	44.5	10.2	7.7	− 88.0	4.8	23.7
Pulses, nuts, and seeds	10.9	13.5	19.0	19.2	+ 76.2	9.9	9.5
Sugar	9.4	11.7	14.6	16.3	+ 73.4	26.2	5.2
Vegetables	58.4	52.7	109.8	118.4	+ 102.7	127.0	62.5
Fruits	14.5	26.2	55.1	62.1	+ 328.3	59.9	13.9
Meat, of which:	12.8	17.8	27.0	31.6	+ 146.9	16.8	9.2
Pork	11.0	13.2	17.5	21.4	+ 94.6	6.5	2.8
Eggs	1.6	2.6	5.2	5.9	+ 268.8	15.8	3.9
Sea products	18.8	28.8	35.6	35.3	+ 87.8	68.2	29.8
Milk, fresh	6.0	5.1	15.9	18.4	+ 206.7	53.3	3.1
Oils and fats	3.7	5.0	9.0	10.0	+ 170.3	12.1	2.6
Total energy (Cal.)	2,233	2,403	2,672	2,719	+ 21.8	2,467	2,390
% of starchy foods	75.2	70.2	61.5	58.0		52.0	75.4
Total protein (gm)	53.9	62.3	74.7	75.9	+ 40.8	78.8	71.1
Animal protein (gm)	13.5	19.3	24.6	26.7	+ 97.8	35.8	16.8
% of animal origin	25.0	31.0	32.9	35.2		45.4	23.6

Sources: (1) "Taiwan Food Balance Sheet", JCRR.
(2) "Food Balance Sheet of Japan, 1975", (In Japanese) Ministry of Agriculture and Forestry, Japan.
(3) "Food Balance Sheet, 1975" Ministry of Agriculture and Fisheries, Republic of Korea and FAO Korea Association.

The above statistics testified to a considerable improvement in the average daily diet in the period under review. The daily diet in Taiwan is superior in both quality and quantity to that in the Republic of Korea. People in Taiwan consume more superior goods such as meat, milk, fruits, vegetables, etc., but less

cereals and other starchy foods than those in Korea. The per capita consumption of other starchy foods in Korea is more than three times that in Taiwan. The Koreans consume less rice, but barley (known as one kind of coarse grain) makes up 20 percent of their cereal consumption, the per capita cereal consumption in Korea is thus still 20 percent higher than that in Taiwan. Consumption of foods other than cereals and starchy foods in Korea is on the other hand far below that in Taiwan. The amounts of meat and milk consumed in Korea are only one-third and one-fifth those in Taiwan.

Table 2. International Comparison of Per Capita Daily Intake of Energy and Protein in 1973

Country	Energy intake				Protein intake		
	Energy (Cal.)	Taiwan =100	% of starchy foods	% of animal origin	Protein (gm.)	Taiwan =100	% of animal origin
Rep. of China (Taiwan)	2,706	100.00	60.99	15.20	73.7	100.00	34.84
Austria	3,332	123.13	27.88	31.93	87.8	119.13	61.39
Denmark	3,229	119.33	24.22	33.26	92.2	125.10	71.04
France	3,219	118.96	27.80	32.15	102.7	139.35	65.24
W. Germany	3,238	119.66	25.51	33.66	88.0	119.40	65.34
Italy	3,343	123.54	42.06	21.60	105.3	142.88	46.44
Netherlands	3,176	117.37	24.97	30.60	88.8	120.49	65.20
Norway	3,011	111.27	28.83	30.09	85.0	115.33	64.24
Portugal	3,297	121.84	43.68	16.32	93.2	126.46	41.85
Spain	2,829	104.55	36.55	24.46	90.2	122.39	50.89
Sweden	2,760	102.00	27.10	34.06	83.9	113.84	68.65
Switzerland	3,296	121.80	26.64	31.77	92.5	125.51	62.16
U. K.	3,130	115.67	28.18	31.37	87.9	119.27	62.12
Canada	3,158	116.70	24.67	33.85	95.9	130.12	67.78
U. S. A.	3,316	122.54	21.26	35.89	103.6	140.57	70.08
Brazil(2)	2,820	104.21	51.35	12.73	66.8	90.64	32.04
Chile(2)	2,560	94.60	49.30	17.38	65.9	89.42	42.49
Columbia(2)	2,140	79.08	44.02	18.74	50.0	67.84	51.00
Venezuela(2)	2,430	89.80	50.91	16.91	59.7	81.00	43.89
Israel(2)	2,990	110.50	38.33	19.83	91.5	124.15	48.42
Sri Lanka(2)	2,340	86.47	62.39	3.89	49.1	66.62	17.31
India(2)	1,990	73.54	70.35	5.48	49.4	67.03	11.34
Indonesia(2)	1,920	70.95	78.13	2.34	42.8	58.07	12.15
Japan	2,513	92.87	52.05	13.73	78.8	106.92	43.78
Korea	2,634	97.34	82.19	5.69	80.0	108.55	19.25
Pakistan(2)	2,410	89.06	74.90	7.59	54.9	74.49	18.03
Philippines(3)	2,040	75.39	69.51	10.78	53.2	72.18	38.72
Australia(1)	3,048	112.64	28.02	36.88	100.8	136.77	68.75
New Zealand(1)	3,232	119.44	26.27	38.30	106.7	144.78	68.98

Notes: (1) 1972, (2) 1970, (2) 1969.
Sources: (1) "Production Yearbook", FAO.
(2) "Food Consumption Statistics", OECD.
(3) "FoodB alance Sheet of Japan, 1975", (In Japanese), Ministry of Agriculture and Forestry, Japan.
(4) "Taiwrn Food Balance Sheet, 1973", JCRR.

The calorie and protein intakes in Taiwan amount to about 30 to 40 percent higher than those in most other Asian countries. However, the intakes of animal proteins and of calories from non-starchy foods are still considered inadequate and the nutrition value of the diet is still inferior in quality as compared with Western countries or even with Japan. While the per capita calorie intake is higher in Taiwan than in Japan, both total protein intakes and the portion of animal protein of Japan exceed those of Taiwan. The Japanese consume milk, eggs, and sea products two to three times as much as in Taiwan. Taiwan's per capita rice consumption has passed its saturation point and begun to decrease, but it is still 128 kg in 1976 as compared with 88 kg in Japan (Table 1). The calorie and protein intakes in the developed countries are about 20 percent and 40 percent higher than those of Taiwan. Starchy foods provide about 60 percent of the total calorie intake in Taiwan, but they make up less than 30 percent of the same intake in most developed countries.

Improvements in consumption patterns in recent years have been cause for the decline of food self-sufficiency rates. Prior to 1969, domestic food production was able to meet domestic food requirements and food self-sufficiency was around 100 percent. The rate was as high as 107.8 in 1964 and 106.0 percent in 1966, but it dropped to 87 percent in recent years. This means that about 13 percent of domestic requirements in recent years have to be met with imports. Wheat, corn, and soybeans are the major food items whose domestic requirements have depended heavily on imports. In 1976, their self-sufficiency rates were 0.2, 5, and 6 percent, respectively. It can be concluded that expanded grain imports were an important explanation for the declining food self-sufficiency rate. The recently developed domestic dairy industry has been able to maintain the self-sufficiency in milk at 15-20 percent in recent years. The sea products have also shown considerable improvement in their self-sufficiency. In the early 1950s, more than 10 percent of

Table 3. Self-sufficiency Rates of Major Foods*

Food item	1956	1966	1976	Food item	1956	1966	1976
Cereals, of which,	100.6	95.0	64.6	Vegetables	100.0	161.6	134.3
Rice	112.0	105.3	108.3	Fruits	120.8	238.4	117.6
Wheat	12.2	9.6	0.2	Meat	100.0	100.1	103.4
Corn	75.2	44.3	5.1	Eggs	100.0	100.8	101.8
Other starchy foods	100.0	100.9	101.4	Sea product	97.8	104.9	121.0
Sugar	836.1	650.4	306.0	Milk	3.3	20.4	15.1
Pulses, nuts and seeds	57.9	50.3	20.8				
of which, soybean	26.2	25.6	5.7	Total food	99.9	106.0	86.6

Source: Calculated from "Taiwan Food Balance Sheet", JCRR.

* Self-sufficiency rate refers to the percentage of domestic production in total domestic requirement. Current price of each food item was used as weight to calculate aggregate rate.

domestic demand for sea foods came from foreign sources but the situation has entirely changed in the recent years as about 20 percent of Taiwan's sea products are now exported to foreign markets.

III. CHANGES IN GRAIN CONSUMPTION

Cereal consumption as indicated in Table 1 is limited to the amount directly consumed by human beings; it does not include the portion for indirect consumption through livestock feeding. In spite of the fact that the per capita direct consumption of cereals and beans has shown a downward trend during the last decade, their total demand has shown marked increase. In the mid-sixties, annual demand for cereals and beans amounted to 2.8 million metric tons, as compared with the domestic production of 2.5 million metric tons. Thus the annual net imports were around 0.3 million metric tons, or 12 percent of the total demand. However, in recent years, the annual demand for cereals and beans has increased substantially, reaching 6.1 million metric tons vs. 2.8 million metric tons in domestic production. Since the domestic production has failed to keep pace with the increase of total demand, the net import (total import minus total export) of cereals and beans has as a result soared greatly. The average annual net import of cereals and beans has in recent years amounted to 3.3 million metric tons, equivalent to 54 percent of the total demand. The remaining 46 percent of the total demand was supplied by domestic production (Table 4). Consequently, the self-sufficiency rate of cereals and beans has decreased by 42.7 percentage points, from 88.3 percent to 45.6 percent during the last decade.

Prior to 1967, population growth was the major factor in increased demand for cereals and beans, for they were used primarily for direct human consumption. But since then, increased income has added to demand for cereals and beans. From

Table 4. Supply of and Demand for Cereals and Beans

Period	Domestic production (A)	Total requirements (B)	Net imports (B−A)	Rate of self-sufficiency (A/B)
	(1,000 m/t)	(1,000 m/t)	(1,000 m/t)	(%)
I. Amounts:				
1953 (1952–54 ave.)	1,697.1	1,896.9	199.8	89.5
1965 (1964–66 ave.)	2,485.0	2,814.7	329.7	88.3
1975 (1974–76 ave.)	2,785.5	6,103.0	3,317.5	45.6
II. Changes:				
1965—1953	+ 787.9	+ 917.8	+ 129.9	− 1.2
1975—1965	+ 300.5	+3,288.3	+2,987.8	− 42.7

Note: Total requirements=Domestic production+Imports−Exports

1953 to 1965 (three-year averages of the data centered at the years shown), total requirements for cereals and beans increased by 0.9 million metric tons, and the population expanded by 43.5 percent. Increase in the demand for cereals and beans resulting from population growth accounted for 0.8 million metric tons, or 90 percent of the increase in total demand. The remaining 0.1 million metric tons, or 10 percent of the increase in total requirements was attributed to the increase in per capita consumption. The situation has, however, been reversed since then. During the last decade, increase in demand for cereals and beans was 3.3 million metric tons, of which only 0.7 million metric tons or 20 percent of the increase in total demand was caused by population expansion. The remaining 2.6 million metric tons, or 80 percent of the increase, was due to the increase in per capita consumption. Consequently, per capita consumption of cereals and beans increased from 217 kg in 1965 to 382 kg in 1975, showing an increase of 80 percent.

Table 5. Factors Affecting the Increase in Demand for Cereals and Beans

Unit: 1,000 m/t

Affecting factors	1965—1953[1)]	1975—1965[1)]
A. Increase in total requirements[2)]	917.8 (100%)	3,288.3 (100%)
1. Due to population growth	825.2 (90%)	655.8 (20%)
2. Due to increase in per capita consumption	92.6 (10%)	2,632.5 (80%)
B. Increase in domestic production	787.9	300.5
C. Increase in net import (A−B)	129.9	2,987.8

Notes:

1) Three-year averages of the data centered at the years shown.

2) Total requirement in 1953 and 1965 was 1,896,900 metric tons and 2,814,700 metric tons, respectively.

Population growth during the periods of 1953–1965 and 1965–1975 was 43.5% and 23.3%.

Increase in total requirement due to population growth:

1,896,900 m/t×43.5%=825,200 m/t

2,814,700 m/t×23.3%=655,800 m/t

Increase in total requirement due to increase in per capita consumption:

917,800 m/t−825,200 m/t=92,600 m/t

3,288,300 m/t−655,800 m/t=2,632,500 m/t

Increased income and change in the consumption pattern have resulted in great improvement in the national diet, the demand for livestock products has become very strong, and therefore the indirect consumption of cereals has increased tremendously. In the mid-sixties, the annual requirements of cereals were about 2.5 million metric tons, of which only a small portion (about 4 percent) was used for animal feeding. Most of the rest was consumed directly by human beings. But in recent years, feed consumption has increased rapidly and amounted to two million metric tons, or about 40 percent of the total cereals demanded for the period. In 1953–1965, 90 percent of the increase in cereals was used as human food, but during the last

decade, 70 percent of the increase was used as animal feed. Per capita direct consumption of cereals has remained around 200 kg during the period under review, but the indirect consumption of cereals used as animal feed has increased substantially from 3 kg in 1953 and 8 kg in 1965 to 127 kg in 1975. In 1975, cereal consumption per head amounted to 330 kg, of which 38 percent was for indirect consumption as compared with 4 percent in 1965.

Table 6. Demand for Cereals and Beans by Usages

Period[2]	Cereals[1]			Beans	Grand total
	Total	For food	For feed		
I. Total requirements (1,000 m/t):					
1953	1,758.7	1,731.7	27.0	138.2	1,896.9
1965	2,546.7 (100.0%)	2,440.2 (95.8%)	106.5 (4.2%)	268.0	2,814.7
1975	5,269.2 (100.0%)	3,245.2 (61.6%)	2,024.0 (38.4%)	833.8	6,103.0
II. Increase in total requirements (1,000m/t):					
1965—1953	+ 788.0 (100.0%)	+ 708.5 (90%)	+ 79.5 (10%)	+129.8	+ 917.8
1975—1965	+2,722.5 (100%)	+ 805.0 (30%)	+1,917.5 (70%)	+565.8	+3,288.3
III. Per capita consumption (Kg.):					
1953	195	192	3	15	210
1965	196	188	8	21	217
1975	330	203	127	52	382
IV. Increase in per capita consumption (Kg):					
1965—1953	1	− 4	5	6	7
1975—1965	134	15	119	31	165

Notes:
1) Cereals for food purpose include brown rice and wheat.
Cereals for animal feed include corn, millet, barley and sorghum.
2) Three-year averages of the data centered at the years shown.

Direct consumption of cereals usually generates four to six times the amount of calories as they would if converted to livestock products[1]. But owing to consumer

1) Roughly speaking, increase in one kilogram of meat requires four to five kilograms of feed grains. Furthermore, the energy content per unit of meat, on the average, is a little lower than that of feed grains. Thus on the calorie basis, to produce one calorie of meat requires about four to six calories of feed grains. Energy content per 100 grams of meat and feed grains is as follows:

Commodities	Energy content	Commodities	Energy content
	Cal./100 grams		Cal./100 grams
Meat:		Feed grains:	
Pork	359	Corn	355
Beef	225	Barley	349
Mutton	142	Millet	300
Poultry	223	Sorghum	292

preference for livestock products, their demand for livestock products, and therefore, the indirect consumption of grains have been increasing. During the last decade when the economy witnessed a rapid growth, the consumption pattern in Taiwan was characterized by a shift from heavy dependence upon grains and starchy foods directly to more consumption of meat, milk and eggs.

There is a high correlation between income and direct consumption of cereals. In the developing countries, people consume more cereals as their income rises. But in the developed nations, the per capita direct consumption of cereals goes down as income increases. Chart A shows the international cross-section relationship between per capita income and per capita direct cereal consumption of 1973. It is evident that changes in cereal consumption in most countries are very much in accordance with a certain path as shown in the chart, except for Japan and Italy. The per capita cereal consumption in Korea, the Philippines, Sri Lanka, Pakistan and India in 1973 was higher than that in 1963-1965. This means that the per capita direct consumption of cereals for those countries has not yet reached a saturation point, thus cereal consumption will continue to increase while income rises. In other words, the per capita cereal consumption and income in those countries have a positive correlation between them. The countries on the right-hand side of the line CD are developed countries with a per capita annual income of more than US$2,000, and the cereal consumption per capita per annum in most of them showed a downward trend during the period from 1963-1965 to 1973 regardless of an already low level of cereal consumption. The per capita consumption of cereals in Taiwan has already reached its saturation point as indicated earlier, thus the per capita cereal consumption will decline as income rises. Besides the income level, land utilization and dietary habits also greatly affect cereal consumption. The fact that Japan and Italy are two main rice producing countries may explain why the per capita cereal consumption in these two countries is relatively high as compared with their income.

(September 19, 1977)

Table 7. International Cross-section Relationship between Per Capita Income and Per Capita Annual Consumption of Cereals

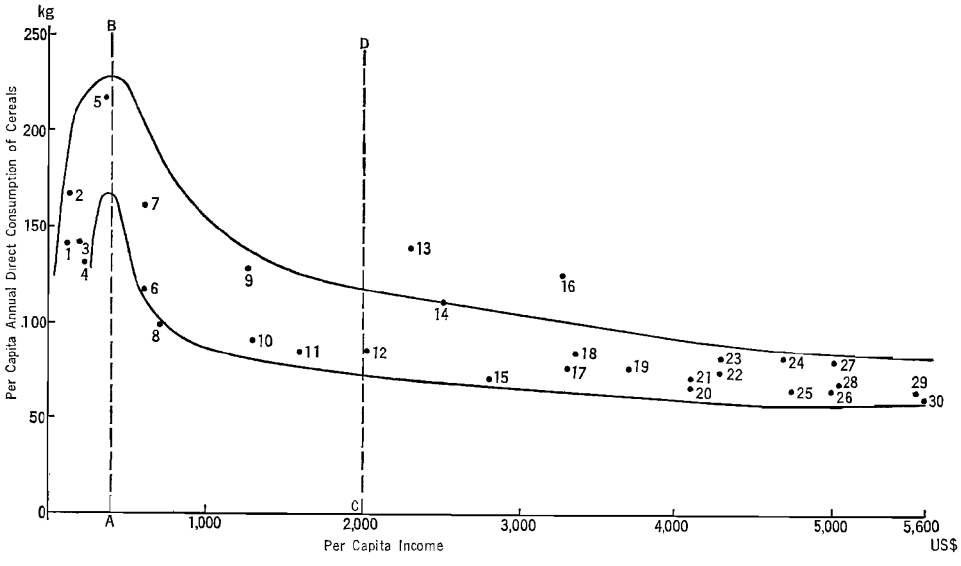
Country	Per capita income of 1973 (US$)	Per capita annual consumption of cereals (Kg.)	
		1972	1963-65
1. Rep. of China	604	161.6	155.0
2. Sweden	5,596	61.3	69.4
3. U. S. A.	5,554	63.5	65.3
4. W. Germany	5,040	67.5	74.1
5. Australia	5,025	78.8(1)	83.6
6. Denmark	5,004	64.6	74.8
7. Canada	4,751	66.4	70.4
8. Switzerland	4,697	80.7(1)	89.1
9. Belgium	4,287	81.4	85.0
10. France	4,286	74.5	91.3
11. Norway	4,115	71.2	74.5
12. Netherlands	4,103	65.7	73.7
13. New Zealand	3,711	76.7(1)	86.1
14. Austria	3,350	84.3	98.9
15. Finland	3,312	77.7	93.1
16. Japan	3,292	124.1	147.1
17. U. K.	2,817	71.9	78.5
18. Israel	2,526	111.0(3)	108.4
19. Italy	2,298	138.3	131.4
20. Ireland	2,009	86.9	101.8
21. Spain	1,606	84.3	101.8
22. Venezuela	1,307	92.0(3)	83.2(5)
23. Portugal	1,261	126.7	125.6
24. Brazil	712	99.3	91.3
25. Chile	590(1)	117.2(3)	116.8(5)
26. Korea	344	221.2	188.0
27. Philippines	230	132.0(4)	127.8
28. Sri Lanka	189	140.5(3)	131.4
29. Pakistan	122	181.0(3)	165.7
30. India	117	140.2(3)	139.1

Notes: (1) 1972, (2) 1971, (3) 1970, (4) 1969, (5) 1964-1966.

Sources: 1. Per capita income:
"National Income of The Republic of China, 1976". DGBAS, China.

2. Per capita annual consumption of cereals:
   a. "Production Yearbook", FAO.
   b. "Food Consumption Statistics", OECD.
   c. "Food Balance Sheet of Japan, 1975", (In Japanese), Ministry of Agriculture and Forestry, Japan.
   d. "Taiwan Food Balance Sheet", JCRR.

Chart A. International Cross-section Relationship between Per Capita Income and Per Capita Annual Cereal Consumption



1. India
2. Pakistan
3. Sri Lanka
4. Philippines
5. Korea
6. Chile
7. Rep. of China
8. Brazil
9. Portugal
10. Venezuela
11. Spain
12. Ireland
13. Italy
14. Israel
15. U. K.
16. Japan
17. Finland
18. Austria
19. New Zealand
20. Netherlands
21. Norway
22. France
23. Belgium
24. Switzerland
25. Canada
26. Denmark
27. Australia
28. W. Germany
29. U. S. A.
30. Sweden

Taiwan's Food Processing Industry*

Hsi-huang Chen

I. INTRODUCTION

Agricultural progress in the Republic of China on Taiwan has been very successful under a policy of balanced and coordinated development of agriculture and industry. Agriculture supplies raw materials for the industrial sector which, in turn, provides new jobs for surplus labor in rural areas and consumer goods to meet domestic requirements. This policy has been able to substantially expand the export of both agricultural and industrial commodities. Although the Republic of China is undergoing intensive industrial development, it still leans heavily on agriculture. The major principles governing agricultural production are: (1) attainment of food self-sufficiency and improvement of the nutritional level of the people; (2) promotion of diversified agricultural exports in coordination with overall foreign trade effort; (3) provision of adequate raw materials to support the food processing industry.

The country's food processing industry has no doubt served as a stimulant to rapid economic growth in recent years. Close coordination exists between agricultural production and the food processing industry, setting a good example of a joint effort by both the agricultural and industrial sectors. Agricultural outputs such as sugarcane, mushrooms, pineapples, and asparagus become industrial inputs, while industrial outputs such as fertilizers, pesticides, and farm machines become agricultural inputs. The more the agricultural sector advances, the greater its dependence upon the development and modernization of the manufacturing industry becomes. More importantly, the progress of the food processing industry has promoted the diversification of agricultural export and has earned much foreign exchange to nourish the economy.

The major food processing industries in the Republic of China are sugar refining, food canning, rice milling, wheat flour milling, and vegetable oil extraction. The sugar and canned food industries are the most important. The former has a long history while the latter was later to develop.

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II. THE GROWTH OF FOOD MANUFACTURE IN THE NATIONAL ECONOMY

In spite of its relatively small-scale production and less advanced production technology, food manufacture on Taiwan has been expanding steadily since 1961. From 1961 to 1975, industrial production grew at an annual 15.4 percent compared with 16.2 percent for the manufacturing industries. Annual growth rates for food, beverages and tobacco were 3.2 percent, 11.0 percent and 3.83 percent, respectively.

The share of food manufacture in the manufacturing industries as a whole declined from 27.1 percent in 1961 to 22.4 percent in 1965 and to 12.5 percent in 1976, while the share of the manufacturing industries in GDP increased from 17.3 percent in 1961 to 20.8 percent in 1965 and 29.8 percent in 1976. This significant increase in manufacturing's share of the GDP was due to rapid growth in chemical products, metal, machinery, and transport equipment. Food, however, did not play a positive role in contributing to this increase but rather a negative one in slowing down its growth.

Table 1. Index Number of Industrial Production and Relative Importance of Food Manufacture

	1961	1965	1970	1975	1976
Index (1971=100):					
All items[1)]	20.4	33.9	80.6	150.4	187.9
Manufacturing as a whole	18.3	31.1	79.3	149.4	187.9
Of which:					
Food, beverages & tobacco	59.3	80.5	92.7	107.5	125.8
Of which:					
Food	60.6	84.7	92.2	94.6	112.4
Beverages	40.5	52.5	92.1	174.5	205.6
Tobacco	74.1	82.6	97.5	125.4	132.0
Share of manufacturing in GDP (%)	17.3	20.8	26.8	28.4	29.8
Share of food manufacture[2)] manufacturing as a whole in terms of GDP (%)	27.1	22.4	13.0	11.5	12.5

Source: *Taiwan Industrial Production Statistics Monthly* and *National Income of the Republic of China.*

Notes: 1) Including mining, manufacturing, electricity, gas and water, and building construction.
2) Including beverages.

The share of food in the gross value added of food manufacture (including beverages and tobacco) declined from 54.7 percent in 1961 to 37.3 percent in 1971 although in absolute terms it increased from NT$3,941 million to NT$4,813 million during the same decade. The share of beverages (soft drinks) rose from 2.8 per-

cent to 3.6 percent while its gross value soared from NT$202.3 million to NT$-465.9 million in the same period. The high income elasticity of canned drinks consumption has increased beverage consumption during the rapid economic growth period. Tobacco consumption has likewise risen conspicuously.

The number of manufacturing workers more than doubled from 600,000 (or 16.9 percent of the total labor force) in 1965 to 1,184,000 (or 20.6 percent) in 1976. Those engaged in food and beverage manufacture in 1976 numbered 115,359, representing 9.8 percent of the total number of manufacturing workers.

III. DEMAND FOR AND SUPPLY OF MANUFACTURED FOODS

Per capita income in Taiwan expanded threefold from US$205 in 1965 to US$700 in 1975. The effects of income on consumption varied greatly among commodities. Low and even negative income elasticities were obtained for staple foods such as rice, wheat flour, and sweet potatoes. The percentage of calories from staple foods decreased from 70.2 percent in 1964 to 61.5 percent in 1974.

However, high-income elasticities were obtained for animal products, whose calorie yield vs. total calorie intake rose from 10.8 percent in 1964 to 14.5 percent in 1974. Similar increases were also noted for protein and fat intake. Per capita consumption of sugar also rose rather steadily in the decade under review due to increased income and supplies in domestic markets.

Table 2. National Average Net Food Supply Per Capita in Terms of Nutrients

Item	1964		1974		1976	
	Per Day (calorie)	Percentage Share	Per Day (calorie)	Percentage Share	Per Day (calorie)	Percentage Share
Total calories	2,364	100.0	2,780	100.0	2,771	100.0
Of which:						
Staple foods[1)]	1,658	70.2	1,708	61.5	1,577	56.9
Foods of animal origin[2)]	254	10.8	403	14.5	439	15.8
Sugar & sweets	101	4.3	158	5.7	172	6.2
Fats & oils[3)]	156	6.6	200	7.2	243	8.8
Others	194	8.2	311	11.2	340	12.3
	(Grams)		(Grams)		(Grams)	
Total proteins	59.5	100.0	74.2	100.0	75.9	100.0
Of which:						
Animal proteins	17.5	29.4	24.7	33.3	26.7	35.2
Fats	48.5	—	66.7	—	73.4	—

Source: *Taiwan Food Balance Sheet, 1935-1976,* JCRR Nov. 1977.

Notes: 1) Including cereals, potatoes and starchy and other staple foods.
2) Including meat, eggs, milk and fish and excluding butter, tallow and lard.
3) Fats and oils include both vegetable and animal origins.

The daily total calorie intake of an average Taiwan resident therefore rose from 2,364 to 2,780 during the period 1964-1974. In 1976, the calorie intake both in actual amount and in share of total calorie intake decreased in staple food consumption and increased in animal products, sugar and others. However, the total calorie intake showed a slight drop due to the drastic decrease in staple food consumption during the last few years.

Chinese cuisine preferences might explain why changes in consumption patterns and calorie intake showed no significant increase in canned foods consumption. Most people in Taiwan still prefer home cooking to eating out; domestic consumption of canned foods is therefore quite limited. Canned food for annual domestic consumption is estimated at only 2.7 million cases, representing only 16 percent of total production.

One economic paradox that persists in Taiwan, as perhaps elsewhere, is that inferior canned foods or those that fall short of export requirements are sold in local markets and superior products are exported to earn foreign exchange.

1. Export of Major Processed Agricultural Products

Canned foods from Taiwan are for the most part exported to the United States, West Germany, Japan, the United Kingdom, Belgium, the Netherlands, etc. A smaller portion is exported to Hong Kong and Southeast Asian countries.

During the period 1964-1976, the total value of agricultural exports increased from US$277.6 million to US$1,070.5 million. However, the percentage in the total export value of agricultural exports declined from 59.1 percent to 13.1 percent during the same period, mainly because accelerated economic growth and increased per capita income.

Among the agricultural exports, processed products amounted to around 65 percent in this period. Major processed agricultural exports included sugar, canned pineapples, mushrooms, asparagus, mandarin oranges and preserved vegetables.

Usually the biggest foreign exchange earner, sugar fetched US$266.5 million in 1975 even as sugar prices fluctuated in the world market and production patterns changed in Taiwan.

A major export item for two decades, canned pineapple however underwent a sinking percentage in agricultural export due to an increase in production of competitive canned foods such as vegetables and fruits. The value of canned pineapple exports increased slightly from US$13.9 million in 1964 to US$20.7 million in 1974 and to US$14.1 million in 1976.

Table 3. Agriculturrl Exports of Republic of China

(Unit: US$1,000)

Item	1964	1970	1974	1975	1976
Primary agricultural products	80,744	140,675	191,881	281,651	402.456
Rice	18,030	2,594	1,312	3	13
Vegetables	8,965	7,597	10,686	10,449	23,746
Banana	33,344	38,149	19,997	20,492	18,987
Pineapple, fresh	35	4,939	1,142	2,649	1,580
Citrus	2,322	4,069	8,940	7,210	7,456
Other fruits, fresh	—	1,522	1,797	1,983	2,729
Flax, jute, sisal, ramie & hemp	2,357	1,355	1,956	1,235	657
Poultry feathers	2,402	3,778	4,178	5,180	13,333
Hog & meat	237	6,555	32,767	21,178	72,481
Sea products	2.192	61,368	90,107	186,379	223,249
Medicinal herbs	440	961	632	974	1,918
Tobacco	1,008	2,773	4,217	6,869	7,941
Others	4,559	1,826	14,280	17,050	28,366
Processed agricultural products	196,832	228,508	655,283	626,441	668,052
Sugar & sugar preparations	135,403	47,554	300,758	266,488	158,771
Tea	8,426	14,284	15,392	18,522	17,677
Pineapple, canned	13,911	20,153	20,653	14,408	14,146
Other fruits, preserved & canned	6,180	13,588	39,971	42,684	66,617
Mushrooms, canned	15,817	33,646	44,998	49,030	58,037
Asparagus, canned	411	33,339	84,918	77,905	99,703
Vegetables, preserved	—	15,374	39,917	37,225	105,026
Citronella oil & citronellal	—	—	3,328	225	38
Peppermint & camphor	1,818	1,915	18,368	7,737	7,705
Timber products (excl. plywood)	13,566	30,862	29,543	46,856	54,548
Bamboo products	1,300	2,078	5,057	5,022	6,629
Bamboo shoots	—	8,494	18,393	19,804	—
Sea products, preserved	—	—	21,208	19,798	35,549
Other preseerved products	—	7,221	12,779	20,737	43,606
Total agriculturl export	277,576	369,183	847,164	908,092	1,070,508
Total export	469,468	1,561,652	5,512,776	5,301,786	8,155,595
% of agriculture in total	59.13	23.64	15.35	17.13	13.1
% of processed agricultural products among total agricultural exports	70.91	61.90	77.35	68.98	62.41

Source: Rural Economics Division, JCRR.

The export value of canned mushrooms rose from US$15.8 million in 1964 to US$58.0 million in 1976 which more than tripled in 12 years. The Republic of China is reputed to be the world's largest exporter of canned mushrooms.

A relatively new product, canned asparagus, achieved a phenomenal increase of moae than 200 times from 1964 (US$0.41 million) to 1974 (US$84.9 million). The export value fell slightly to US$77.9 million in 1975 and increased again to US$99.7 million in 1976. The export of preserved vegetables, a traditional Chinese food, was also developed only in recent years. Its value rose from US$15.4 million in 1970 to US$39.9 million in 1974, to US$37.2 million in 1975, and to US$105.0 million in 1976.

Canned food products seem to have higher income elasticities than raw farm products in foreign markets, hence their great potentials for increased production in the Republic of China. However, to further expansion of such exports, a greater effort has to be made to overcome the difficulties resulting from the restrictions imposed by the importing countries.

2. Agricultural Imports

Cereals (mostly wheat and corn), oilseeds (chiefly soybeans), dairy products, and tobacco account for the bulk of the country's agricultural imports.

Imports of total merchandise increased from US$428.0 million in 1964 to US$-7,599.0 million in 1976, an increase of more than 17 times. This upsurge in imports was due to the rapid growth in the national economy during these ten years. Of the total agricultural imports during the period 1964 to 1976, the food component increased from US$41.2 million to US$681.8 million mainly due to a developing animal industry, which in turn brought on higher demand for imported cereals.

Wheat imports jumped from 30,085 m.t. to 598,522 m.t. during the same period, chiefly because of population increase and a gradual increase in the consumption of wheat flour proportionally. Likewise, imports of barley and maize for animal feed increased very rapidly from 9,652 m.t. to 322,865 m.t. and from 8,627 m.t. to 1,861,104 m.t., respectively, during the period 1964-1976. Imports of other cereals also soared during the decade under review. Domestic production of cereals except rice has been negligible owing to unfavorable climatic and land conditions. As a result, supply of locally-produced cereals except rice accounted for less than 10 percent of actual needs.

Since consumption of beverages and tobacco has high income elasticities, their demand has had a remarkable increasing trend. Consumer preference for foreign beverages and manufacturers' demand for high quality tobacco to upgrade domestic tobacco products have resulted in increased importation of these commodities, which rose from US$2.4 million in 1964 to US$31.7 million in 1976, reflecting both higher prices and increased volumes.

Oilseeds (mainly soybeans) and vegetable oil imports have since 1964 shown marked increase, which may be the result of a shift of consumer preference from animal oils and fats to vegetable oils and fats. As mentioned above, because of unfavorable climatic and land conditions supplies of oilseeds and vegetable oils depend mainly upon imports. The value of such imports increased from US$31.6 million in 1964 to US$260.8 million in 1976, an almost sixfold increase in ten years.

IV. MARKETING, PRICES AND COSTS OF MAJOR MANUFACTURED FOODS

1. Marketing of Major Manufactured Foods

As only a limited amount of canned products is sold locally, marketing of these products is rather simple. In general, food distributors or wholesalers place orders for canned foods with food canneries and sell them to food retailers or establishments or direct consumers such as restaurants and hotels. Sometimes, food retailers order the needed commodities directly from canneries. Prices of canned goods usually do not fluctuate very much as the margin of profit for both wholesalers and retailers is rather narrow.

Export of canned foods is much more complicated. Canneries qualified to export foods are registered with the foreign trade authorities. To ensure orderly marketing of certain canned items such as pineapples and mushrooms, an export quota for each cannery is set by the foreign trade authorities. However, cannering plants are free to process and export other canned foods. Most of them handle the export business themselves, but a number of small food canneries sign contracts with larger plants to handle exports on their behalf. Some food canneries also sign contracts with well-known foreign firms overseas or in Taiwan, to act as their sales agents in expanding export trade.

For some agricultural commodities, the entire marketing process (from collection to exportation) is handled by cooperatives. For others, however, cooperative marketing covers only the activities at the assembly end. Bananas, oranges and fresh pineapples are typical examples of the former and mushrooms and asparagus of the latter.

Since most of the preserved agricultural products flow through similar marketing channels for both domestic and export markets, sugar and pineapples are used as examples in the description of the marketing scheme that follows.

The Republic of China's annual sugar production averages about 850,000 m.t., of which about 700,000 m.t. is exported. The balance is retained for domestic

consumption. Sugar export is handled by the Taiwan Sugar Corporation (TSC). While the domestic sugar market is open to cane farmers and sugar dealers under terms of free competition, TSC may sometimes intervene in domestic sugar marketing to protect the interests of both producer and consumer by adjusting the quantity of sugar to be traded in the local market. Generally, TSC tries to maintain the domestic sugar price at a high level as an incentive to encourage farmers to plant more sugarcane.

Sugar for domestic marketing comes from two sources: contract cane farmers and TSC. According to the contract the farmers' share of sugar may be resold to TSC for export at a certain percentage or sold to local sugar dealers for domestic consumption.

Unlike the export channeling of other processed farm products, TSC seldom sells sugar to foreign buyers through local exporters, thus saving on commission charges and boosting foreign sales more effectively. The Republic of China joined the International Sugar Agreement in 1954, obtaining an annual export quota of 650,000-750,000 m.t. Sugar for export comes mostly from TSC's own stock, including that processed from TSC's farms and TSC's share (45 percent) of farmers' sugar in the form of processing charges.

On the other hand, pineapples are mostly exported in canned form. Although the export of fresh pineapples has increased in recent years, as to Japan by fruit marketing cooperatives and the Provincial Farmers' Association, the volume has been rather small compared with total pineapple export. Raw pineapples for canning are collected jointly by the various canneries at prices determined by the Taiwan Provincial Canners' Association. Each cannery is assigned a quota for canned pineapple production which forms the basis for the quantities of raw pineapples and containers it will be allotted. In some exceptional cases, raw pineapples may be supplied to the canning factory by country buyers and shippers. The canned product is exported either directly by canners or by trading firms.

Those canned for domestic consumption or rejected at the time of export inspection are sold on the local market. Various kinds of fruit dealers handle the domestic marketing of pineapples.

The marketing channels for sugar and pineapples are illustrated in Figures 1 and 2.

Figure 1. Marketing Channels for Sugarcane and Sugar

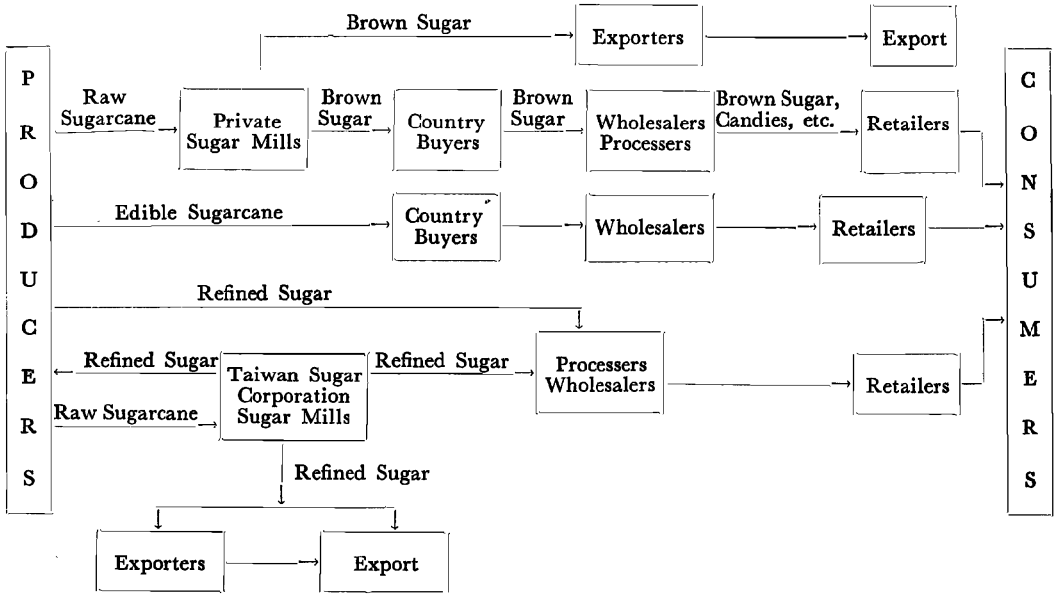
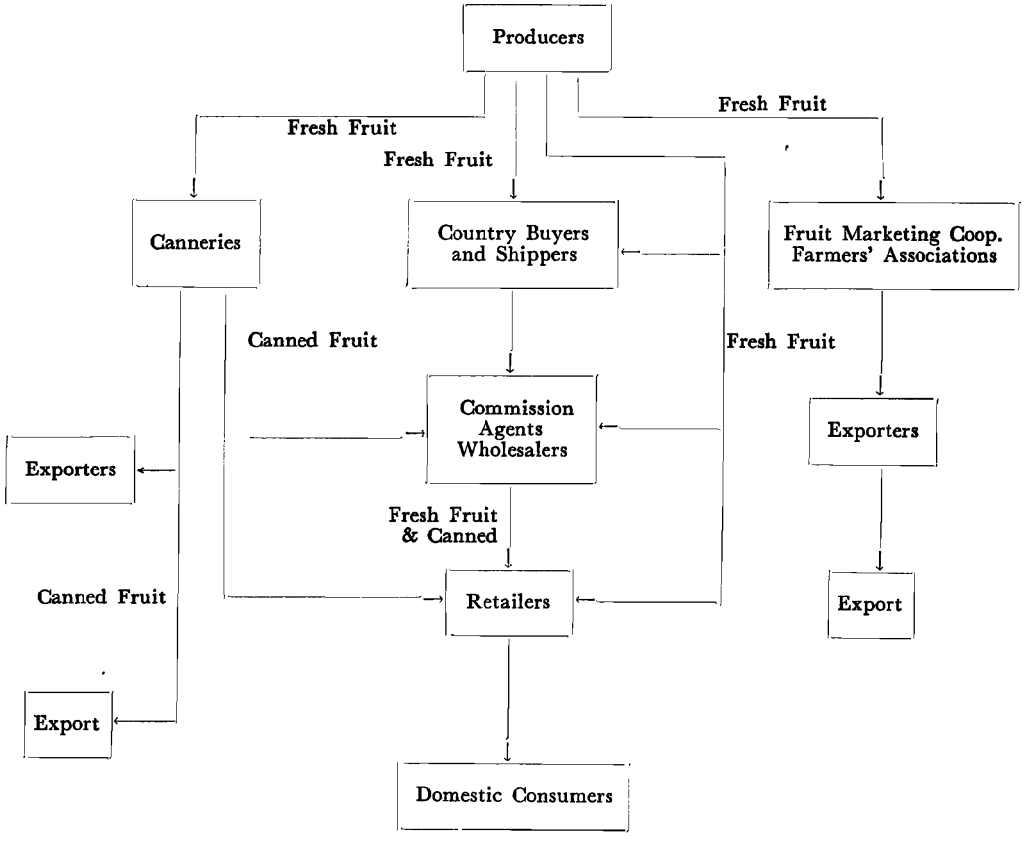


Figure 2. Marketing Channels for Pineapple



2. Prices and Costs of Major Manufactured Foods

Demand elasticities and the forces that influence prices of manufactured foods in the Republic of China destined for foreign markets determine the extent to which the country can increase its volume of export. When demand elasticities are high in foreign markets, the volume of export can be increased only with slight reduction in export price. On the other hand, if demand elasticities are low, total revenue from foreign exchange from a larger volume of export is likely to be less than from a smaller export volume under conditions of higher elasticity of demand.

As canned food prices rose in foreign markets, the Republic of China enjoyed an opportunity to expand manufacture of foods during the decade 1964 to 1974. For instance, the export price of canned pineapples was US$5.02 per case in 1964, US$5.09 in 1969, US$5.35 in 1973, and US$9.34 in 1974. Similarly, canned asparagus increased in price from US$12.36 per case in 1964, to US$14.75 in 1973, and to US$24.28 in 1974. During the same period, canned mushroom price rose from US$13.31 per case in 1964 to US$14.53 in 1973, and to US$16.59 in 1974. The increase in export prices in 1974 was due to the worldwide inflation that year.

The food processing industry greatly influences the availability of raw materials in the Republic of China. When canners stop packing certain crops because of cost problems or decreased demand in the international market, the price of farm products will drop, unless the local market can absorb surplus production. As demand by food processers improves, the price of raw materials goes up.

With 1971 as base year, the wholesale price index in the Republic of China increased from 82.2 in 1960 to 99.9 in 1970, to 180.4 in 1974, although dropping 171.3 in 1975. Food prices increased more rapidly than other items, showing an

Table 4. Index Numbers of Food Prices

(Base year: 1971=100)

	Weight	1970	1973	1974	1975	1976
Wholesale prices						
All items	1,000	99.9	128.3	180.4	171.3	176.0
Foods	231.95	97.5	121.1	175.3	191.1	191.0
Of which: manufactured foods	107.80	—	—	158.2	161.4	164.3
Retail prices						
All items	1,000	97.3	111.4	164.3	172.9	177.2
Foods	427.07	92.3	117.4	185.3	199.0	198.1
Of which: manufactured foods	84.58	—	—	172.9	183.6	198.6

Source: *Commodity-Price Statistcs Monthly, Taiwan District, Republic of China,* No. 60.

index of 191.1 by 1975. Manufactured foods shared a slightly lower increase rate of 158.2 in 1974 and 161.4 in 1975. The low rate of increase for prices of manufactured foods in the domestic market was due mainly to unfavorable consumption habits at home.

Production costs for major manufactured goods increase rapidly in view of low yield and high wage rates. No accurate production cost data is available for this report as this information is not easily obtained from manufacturers. However, the percentage distribution of production costs is shown below (Table 5).

Table 5. Estimated Breakdown of Cost of Production for Canned Pineapple and Asparagus, 1975

(As percent of total)

Item	Canned Pineapples Standard Case (3×36 cs)	Canned Asparagus (No. A3×24 cs)
Direct material	69.86	69.79
Of which:		
Largest raw material	26.38	50.99
Second largest raw material	11.37	2.46
Container	32.11	18.56
Direct labor	9.30	8.45
Factory overhead costs	11.40	9.96
Manufacturing costs	90.56	88.19
Distribution costs	3.91	4.36
General administrative costs	5.53	7.45
Total cost	100.00	100.00

V. PROCUREMENTS OF RAW MATERIALS FOR FOOD MANUFACTURE

Most cereal processing industries in the Republic of China depend mainly upon imported raw materials. More than 90 percent of the principal raw materipals for the manufacture of soybean products, flour and baked goods, edible oil, beer and chocolate products (which are all produced for domestic consumption only) is imported. In comparison, manufactured foods for export mostly dopend on domestic raw materials from individual farmers.

The Republic of China's canned foods are maufactured primarily for export owing to the limited domestic market. The world market situation, however, is by no means entirely to the Republic of China's advantage. Keen competition and wild price fluctuations of canned foods on the world market together with the fact that the Republic of China has no preferential foreign market constitute serious

problems in foreign trade. Production must be geared to world market demand; too much production is just as bad as too little. The effort must therefore be guided by an overall, well integrated and coordinated production plan.

Most food processer draw the needed raw materials from individual farmers, particularly in the areas where the canneries are located. They contract with farmers to purchase the needed products at a fixed price announced before the crop is grown. To ensure a constant supply of raw materials for canning, a number of food canneries operate farms of their own.

Though a contract of this kind is strictly a matter between processer and farmer, the Government finds it impossible to remain aloof. To protect the farmers' interests and stabilize raw material supply, the Government has to step in and offer assistance to and exercise supervision over farm operations, the signing of contracts and the determination of purchasing prices. In addition, the Government acts as an arbitrator when there are disputes between the two parties. Farmers' organizations also take an active part in bringing about agreements between farmer and processer. For purposes of this report two types of contract production are discussed.

1. Contract Production for Pineapples

To promote the contract production of pineapples, a three-man supervisory team is organized in each county, one from the agriculture section of the county government, one from the water-conservancy station in the county government and the third from the agricultural affairs office of the Taiwan Canneries Association. On the farmers' side, farmers production teams are organized as counterparts of the three-man supervisory team.

The contract gives the processer the right to purchase at a fixed price for each grade all the fresh fruits the contract farmer is going to produce. The actual amount to be purchased, the specifications of the product to be purchased and the price quotations are subject to final decision by the processer in question on the basis of on-the-spot investigations. In turn, the farmers receive the following assistance from food processers: (1) production loans extended each year; (2) fertilizer loaned to farmers; (3) insecticides and pest control chemicals loaned on condition that the farmers will employ them properly under the direction of the processers' technical representatives.

Once the contract is signed, it must be fully honored. Should a farmer break any provision of the contract, the loans shall be recalled in addition to a fine of 50 percent or over.

2. Contract Production for Mushrooms

To guarantee a constant supply of raw materials, canneries usually enter into contracts with mushroom growers. It is also to the farmers' advantage because the contract provides him with a reliable market for his product at a guaranted price. The canneries may sign contracts separately with individual farmers. However, in most instances canneries conclude agreements with the local farmers' associations which act as the growers' representatives.

The quantities of fresh mushrooms to be delivered each day are specified in the contract, and the purchase price is guarnteed. The methods of payment are agreed upon in advance. All fresh mushrooms must be delivered through an inspection station to which the cannery and the farmers' association each appoints an inspector to insure impartiality and fairness.

The contract, once signed, demands absolute observance from both parties. Should it be violated by either party, the violator is to be held responsible for all losses incured against the other party due to the breach of the contract.

VI. THE MANAGEMENT OF FOOD MANUFACTURING PLANTS

In 1975, there were in Taiwan[1] about 300 food processing plants, of which 26 canned pineapple, 80 canned mushrooms, 116 canned asparagus, 27 packed frozen foods, and 21 produced dehydrated products. The majority of them were registered companies and most were family owned or jointly owned by two more families. Even though the typical company is controlled by the stockholders and board of directors, actual operation is usually in the hands of the president or general manager. It will be some time before the industry hires persons trained in business administration or industrial management. At present, most of the companies have the major stockholder as chairman of the board of directors or the president regardless of his training.

There are five large canning companies which are owned by people with diversified interests. Some owners have sugar refinery, flour mills, vegetable oil refinery, and can manufacturing businesses. Others are engaged in such businesses as plywood, paperboard, preserved fruit, and hotels as side lines. There are also owners who have invested simultaneously in canning, freezing, and freeze-drying plants.

1) These are plants licensed by the Bureau of Commodity Inspection and Quarantine as to specific standards qualified for export. They are considered as relatively large units with modern equipment. The 1971 Industrial and Commercial Census, on the other hand, indicates more than 13,000 food processing establishments (as shown in Appendix Tables 4 and 5) which comprise food processing plants of all sizes and regardless of licensing for exportable standards.

The Industry Bureau classifies food plants as follows:

Size	Percent Distribution	Fixed Capital	No. of Workers
Small	72.6	Less than NT$8 million	Less than 10
Medium	20.0	NT$8—15 million	10—49
Large	7.4	Above NT$15 million	50 or more

The large and medium size plants are relatively well-equipped with modern equipment and apply more modern management techniques. Most food plants which produce sugar, tobacco, wine, canned food, and wheat flour belong to the large and medium sized groups. Small food plants are usually traditional family-type businesses.

Most large food plants generally have a modern organization responsible for planning, organizing and coordinating of all activities, and adopt up-to-date management techniques. Medium and small plants, however, have been less responsive to the adoption of modern management systems. This may be attributed to the fact that a small business is generally more resistant to innovation, limited in potential, and less flexible under pressure than its corporate counterpart for the simple reason that the family based organization tends to be defensively concerned about its own immediate needs and security. This continuing business mentality is probably the most important factor inhibiting desirable changes in the operation of small food processing enterprises.

Table 6 shows foreign enterprises or joint ventures which are presently in operation in the field of food manufacture in the Republic of China.

Table 6. Foreign Capital Investment in Food Manufacture

Branch of Manufacture	Foreign Enterprise (No. of cases)	Joint Venture (No. of cases)	Estimated Sum of Foreign Capital (NT$ million)	Approximate Share in Total Investment in Each Branch of Food Manufacture (%)
Slaughtering of livestock		1	27.840	25.52
Processing & preparation of meat produccts		4	38.360	51.85
Dairy products manufacturing		3	23.029	6.09
Canning & preserving of meat & sea foods	1	1	1.252	1.92
Canning & preserving of fruits & vegetables		2	22.800	0.57
Flavoring products manufacturing		1	14.700	2.11
Feed for animals		1	39.000	1.74
Non-alcoholic beverage manufacturing		2	4.005	0.55
Popcorn, bromelin paste, chewing gum	2	3	21.104	
Total	3	18	192.090	0.56

Source: Foreign Trade Association.

VII. PLANT OPERATION AND MANAGEMENT PROBLEMS

Since the production of raw materials is limited by seasonal variations, food plant capacity cannot be fully utilized all year round. The most important seasonal crops such as tomatoes, mushrooms, and asparagus are also the most important factors influencing plant operation. Likewise, imported raw materials such as soybeans, wheat, and coconuts also limit plant operation when their supply is inadequate or comes in irregularly.

In general, about 80 percent of the Republic of China's food plants operate more than 200 days annually. The others operate less than 200 days per year. Most plants are operated eight hours per day. With respect to production capacity, those plants with a daily output of less than 500 cases represent 34 percent of the total; those that produce between 500 and 1,000 cases represent 25 percent, and above 1,000 cases, 41 percent. Annually, more than half of all food plants produce more than 100,000 cases; 29 percent of them produce between 30,000 and 100,000 cases, and 21 percent produce less than 30,000 cases.

The popular containers of processed foods are made of tin plate or glass. Polyethylene pouches, laminated plastic pouches, paper cartons, and aluminum foil are used for frozen and dehydrated foods. Tin cans are available from 12 can manufacturing companies. Both hot-dip and electrolytic tin plates are used. There are nine plants making glass containers for food processing. Tin cans and glass containers are easily available in the Republic of China. The canner must make plans ahead of time, usually several months before the packing season. After approval by the Ministry of Economic Affairs, canners may buy the cans from the Taiwan Supply Bureau which supplies tin plate to manufacturers. The canners can designate can manufactures for their empty cans.

Polyethylene, nylon, cellophane and polyester plastics are manufactured likewise for food containers. Wood, paper-board, and bamboo containers are sometimes used for fresh fruits and vegetables. Tin plate is imported, but other raw materials for packing are domestically produced. There is no serious difficulty in obtaining packaging materials.

Among the more serious manpower problems in food manufacture is a lack of managers, engineers, and technicians. The need is felt therefore for more investment in training such manpower in agricultural and related fields, such as botany, plant pathology, entomology, animal husbandry, nutrition, microbiology, business management, plant management, quality control, and marketing.

The Food Processing Institute in Hsin-chu City is responsible for introducing

technical knowledge, trouble shooting, and product development. This Institute's pilot plant is equipped to do research work on canning, dehydration, freeze-drying, quick freezing, vacuum concentration, etc.

VIII. LEVELS OF FOOD PROCESSING TECHNOLOGY

The FAO expert Dr. B. S. Luh has observed that although the Republic of China's food processing industry is doing a good job in producing conventional canned foods, there are many newer methods of food processing that need to be introduced for future development, as described below:

1. Means for recovery of flavor componds in fruit concentrates would be desirable. A good portion of the volatile aromatic compounds in fruits is lost during processing and vacuum evaporation. Equipment for recovery of volatile aromatic compounds in fruit concentrates should be developed and installed.

2. Modern technology for quick frozen foods calls for a rapid freezing system. The individually quick frozen (I.Q.F.) method utilizes the fluidized freezing process at $-30°C$ to $-90°C$. Food pieces can be separated from each other readily when needed. Pea pods, mushrooms, asparagus, strawberries, and many others need to be frozen by the I.Q.F. method.

3. Food freezing with the use of liquid nitrogen and liquid freon needs to be developed.

4. The high-temperature short-time aseptic canning process for banana puree, corn, fruit concentrates and strained vegetables should be increasingly utilized by the food industry. There is a need to look into new canning methods which can produce strained foods of superior quality.

5. Instant breakfast cereals such as puffed rice, oats, corn flakes, wheat flakes and many other similar puffed foods should be developed in the Republic of China.

6. More effort should be made to promote food packaging in polyethelene, paper, cellophane, and aluminum foil. These can be utilized by combining them with laminated pouches.

IX. GOVERNMENT PARTICIPATION IN FOOD MANUFACTURE

1. Government Assistance to the Canned Foods Industry

Establishment of canneries—All food canneries that export their product directly and indirectly are established in accordance with Government requirements. Canneries which do not meet the required standards are not allowed to produce any product for export.

There are also national standards for controlling the quality of canned foods. The quality of cans and packing cartons is also strictly controlled. All products must meet the minimum requirements specified by the national standards, be placed in approved containers and packed by the approved mothods if they are to be exported.

Procurement of raw materials—In order to further upgrade the quality of processed foods, the Government has authorized the Taiwan Supply Bureau, a provincial agency, to import and allocate the required tin plates of high quality to registered food processers. Sugar and salt are also distributed by the Government at tax-free prices to food processers who produce canned foods for export.

Financial assistance—Pineapple, mushroom, and asparagus growers and canners alike have easy access to low-interest fiinancial assistance from the Government while engaged in farm production and food canning. The banking institutions which specialize in agricultural loans are the Land Bank of Taiwan and the Cooperative Bank of Taiwan. Taiwan Sugar Corporation also extends loans to its contract pineapple farmers. Low interest export loans are extended by the Bank of Taiwan to food canneries engaged in the export business.

Product improvement—As a step to guarantee the quality of export canned foods, all outbound products must pass the Bureau of Commodity Inspection and Quarantine's scrutiny to comply with national standards. Such inspection is usually carried out twice, once at the cannery and again at the port of departure. Those cans failing to pass the inspection may not be shipped abroad.

Pertinent world market information is usually collected by Government representatives abroad. Consumer preference and the national standards of importing countries are carefully studied. This information, after being properly reviewed, is passed on to farmers and processers through relevant Government agencies.

2. Government Regulations

Canning plants—The Government has established regulations regarding environmental sanitation, factory buildings, washrooms, water supply, inspection of canned foods, and technicians. Medium-sized canneries are normally expected to employ at least two college graduates with scientific training to take charge of production, quality control, and plant sanitation. The capacity of washers, conveyors, exhausters, double seamers, boilers and other equipment must be adequate.

Food additives—The Ministry of the Interior and the Taiwan Provincial Government in January 1968 issued a set of regulations on the use of food additives in processed foods. Standards concerning food additives for processed foods were also proclaimed. Food additives are limited only to those which will maintain or improve the nutritive value of foods, prolong or stabilize their shelf life, improve

their color, aroma and texture, and facilitate processing procedures.

Food additives are registered, tested, and inspected by the Ministry of Interior before they can be used in processed foods. The food processer must declare on the label the name and quality of food additives used in the preparation of the product. Permission for manufacturing or importing food additives is given for ten years and is renewable.

Export regulation—Processed foods must meet national quality standards as inspected by the Bureau of Commodity Inspection and Quarantine. The processers must be qualified to export their products based on their plant facilities and availability of raw materials.

X. CONCLUSION

Although the food processing industry in the Republic of China has developed quickly since 1960, it is now facing many obstacles to further advancement. The most serious problems lie with foreign markets. The developed countries importing agricultural products sometimes impose import quotas. The Republic of China moreover has no preferential foreign market for its canned foods. In the meantime, competition from other countries is becoming more acute, so that the export of agricultural products is getting increasingly difficult. Thus the Republic of China must exert more effort toward making further progress in agricultural production, improving food processing facilities, stimulating food research, encouraging investment in the food processing industry, and carrying out an effective marketing program. The following steps need to be adopted to solve the difficulties faced by the country in its food processing industry:

1. The Government and research agencies concerned should strengthen their research and experimentation on export foods processing.

2. The relevant agencies should collect samples and information on canning machines from foreign countries or import new canning machines.

3. The agencies concerned should introduce new knowledge and innovation in food canning.

4. Special research agencies ought to be established so as to develop new products and improve canning techniques.

5. It is necessary to investigate the world market situation and develop new markets for canned foods and to circulate international market information to food packers.

6. Improvement of quality and reduction of production costs of canned foods are necessary for packers to compete in the world market.

Appendix Table 1. Shares of Different Sub-Groups in Gross Value Added of Food Manufacture[1]

ISIC[2]	Industry Branch	1961		1971	
		Gross Value Added (NT$ million[3])	Share (%)	Gross Value Added (NT$ million[3])	Share (%)
31	*Food, beuerages & tobacco*	7,208.572	100.00	12,917.577	100.00
311–312	*Food manufacturing*	3,940.751	54.67	4,813.088	37.26
3111	Slaughtering, preparing & preserving meat	N.A.	N.A.	48.729	0.38
3112	Dairy products	N.A.	N.A.	115.560	0.89
3113	Canning & preserving fruits & vegetables	476.541	6.61	927.733	7.18
3114	Canning, preserving & processing of fish, crustacea & similar foods	N.A.	N.A.	14.391	0.11
3115	Vegetable & animal oils & fats	226.836	3.29	129.728	1.00
3116	Grain mill products	137.213	1.90	209.209	1.62
3117	Bakery products	711.455	9.87	437.249	3.38
3118	Sugar factories & refineries	1,720.917	23.87	2,091.089	16.19
3119	Cocoa, chocolate & sugar confectionery	121.747	1.69	71.320	0.55
3121	Food products not elsewhere classified	536.042	7.44	1,155.283	8.94
	Of which:				
	Flavoring essence manufacturing	N.A.	N.A.	733.090	5.68
	Flavoring products manufacturing (flavoring essence excluded)	N.A.	N.A.	107.126	0.83
3122	Prepared animal feeds	N.A.	N.A.	— 387.203	— 3.00
313	*Beverages*	1,339.888	18.59	N.A.	N.A.
3131	Distilling, rectifying spirits	N.A.	N.A.	N.A.	N.A.
3132	Wine industries	839.086	11.64	N.A.	N.A.
3133	Malt liquors & malt	298.554	4.14	N.A.	N.A.
3134	Soft drinks & carbonated water industries	202.248	2.81	465.898	3.61
314	*Tobacco manufactures*	1,927.931	26.74	7,638.591	59.13

Source: *General Report, 1961 Industrial & Commerceial Censuses of Taiwan,* the Republic of China, Vol. III and *The 1971 Industrial & Commercial Censuses of Taiwan and Fukien Area,* ROC, Vol. III.

Notes: 1) Coverage: These figures relate to manufacturing establishments of all sizes.

2) International Standard Industrial Classification of All Economic Activities.

3) Exchange rates: 1961 and 1971, US$1.00=NT$40.00.

Appendix Table 2. Annual Production of Major Manufactured Food[1]

Food Group	Unit	1961		1971	
		Quantity	Value (NT$ million[2])	Quantity	Value (NT$ million[2])
Food items:					
Meat products.					
Canned meat & poultry	std. case	Box: 8,609	14.106	37,936	30.462
Dairy products:					
Milk powder	m.t.	N.A.	N.A.	1,432	92.179
Fruit products:					
Canned pineappie	std. case	Box: 2,897,313	555.560	4,502,079	859.015
Canned citrus fruits	std. case	Box: 292,359	102.387	803,651	166.032
Jam & other canned fruits	std. case			710,344	151.646
Vegetable products:					
Canned asparagus	std. case			4,433,380	1,390.848
Canned mushroom	std. case			3,200,365	1,763.797
Canned bamboo-shoot	std. case	Box: 709,156	198.862	1,510,478	210.981
Other canned vegetable	std. case			1,543,777	325.215
Marine products:					
Canned fish & shell	std. case	Box: 30,938	9.634	83,923	73.246
Edible oils & fats:					
Bean oil	m.t.	18,102	234.037	56,377	992.324
Peanut oil	m.t.	13,898	193.193	10,741	210.358
Cereal products:					
Wheat flour	m.t.	189,064	1,066.326	355,261	1,617.489
Sugar & sugar products:					
Brown sugar	m.t.	20,492	118.651	24,211	116.976
Refined sugar	m.t.	851,855	2,990.014	620,722	3,094.085
Molasses	m.t.	180,035	111.622	126,800	101.604
Yeast	m.t.	8,317	58.386	2,545	41.234
Tea & tea products:					
Selected tea	m.t.	14,958	330.583	30,284	744.426
Seasoning:					
Flavoring essence	m.t.	3,374	351.448	13,184	1,018.797
Refined salt	m.t.	N.A.	N.A.	134,882	191.194
Glutamic acid	m.t.	N.A.	N.A.	3,816	117.741
Other foods:					
Instant noodle	case	N.A.	N.A.	5,387,748	326.707
Bean cake	m.t.	N.A.	N.A.	447,955	1,863.120
Peanut cake	m.t.	90,964	480.293	18,990	93.983
Ice cream	m.t.	21,151	95.605	7,446	88.769
Beverages:					
Liquor (except beer)	h.l.	901,368	1,036.204	1,111,032	2,558.461
Beer	h.l.	127,878	315.475	771,524	1,848.726
Carbonated water (L)	1,000 doz.	2,999	122.368	9,326	444.445
Carbonated water (M & S)	1,000 doz.	1,998	40.978	13,424	439.755
Fruit juice	1,000 doz.	N.A.	N.A.	4,208	161.290

Source: *The 1971 Industrial & Commercial Censuses of Taiwan and Fukien Area*, ROC, Vol. III and *General Report, 1961 Industry & Commerceial Censuses of Taiwan*, the Republic of China, Vol. III.

Notes: 1) Coverage: These figures relate to manufacturing establishments of all sizes.
2) Exchange rates: 1961 and 1971. US$1.00=NT$40.00.

Appendix Table 3. Market Prices of Major Manufactured Foods

Unit: Wholesale prices: NT$[1]
Export prices: US$

Item	Domestic or External	Specification[2]	Unit	1969	1973	1974	1976
Canned pineapple	Domestic	W	No. 3 tin per doz.	72.21[3]	79.16[2]	115.40[2]	136.67[2]
	External	E	Std. case	5.09[1]	5.35[1]	9.34[1]	10.08[1]
Canned mushsoom	Domestic	W	No. 4 tin per doz.	N.A.	83.33[2]	106.35[2]	126.04[2]
	External	E	Std. case	14.02[1]	14.53[1]	16.59[1]	20.75[1]
Canned asparagus	Domestic	W	No. 4 tin per doz.	N.A.	107.52[2]	125.28[2]	131.32[2]
	External	E	Std. case	11.59[1]	14.75[1]	24.28[1]	24.88[1]
Canned bamboo s hoot	Domestic	W	No. 2 tin per doz.	N.A.	N.A.	262.39[2]	204.44[2]
	External	E	Std. case	4.56[1] (No. 5 tin)	4.79[1]	6.09[1]	6.11[1]
Canned mandarin orange	Domestic	W	No. 4 tin per doz.	53.58[2]	N.A.	112.98[2]	103.67[2]
	External	E	Std. case	4.66[1]	5.99[1]	7.11[1]	7.99[1]
Canned young sweet corn	Domestic	W	No. 4 tin per doz.	N.A.	N.A.	118.67[2]	122.50[2]
	External	E	Std. case	11.23[1]	12.04[1]	13.16[1]	11.07[1]
Fruit juice	Domestic	W	Natural fruit juice (orange) "Black Pine" without bottle per doz.	45.27[2]	44.45[2]	56.94[2]	60.20[2]
	External	E	Std. case	4.00[1]	5.03[1]	8.97[1]	8.59[1]
Canned tomato products	External	E	Std. case	4.49[1]	9.07[1]	11.07[1]	8.44[1]
Canned marine products	Domestic	W	Canned eel square tin per doz.	N.A.	62.74[2]	121.18[2]	124.83[2]
	External	E	Std. case	N.A.	41.20[1]	49.96[1]	32.34[1]
Sugar	Domestic	W	Average of 1st & 2nd grade 0.6 kg	6.28[4]	7.14[4]	8.84[4]	8.52[2]
	External		Metric ton	87.47[4]	184.94[4]	595.22[4]	303.20[4]
Salad oil	Domestic	W	Vegetable oil (3 kg cask, produced by Taiwan Sugar Co.) per cook	N.A.	N.A.	142.99[2]	134.61[2]
Flavoring essence	Domestic	W	"Wei Chuan," Taiwan "Tool" bag per 100 kgs	883.75[3]	1.013.34[2]	1,107.20[2]	843.32[2]

Source: 1) Taiwan Exports of Canned Food, 1964, 1969, 1973, 1974 and 1976.
2) *Commodity-Price Monthly Taiwan District, Republic of China.*
3) *Republic of China Monthly Commodity-Price Statistics,* No. 132, 1969.
4) Presented by Taiwan Sugar Company.

Notes: 1) Exchange rates: 1969, US$1.00=NT$40.10 1973, US$1.00=NT$38.10
1974 and 1976, US$1.00=NT$38.05
2) W indicates wholesale prices and E export prices, f.o.b.

Appendix Table 4. Number, Output, Etc. of Food Manufacturing Establishments, 1961 and 1971

Item	Number of Establishments	Number of Persons Engaged (1,000)	Value of Gross Output (NT$ million)	Value Added (NT$ million)	Gross Fixed Capital Formation (NT$ million)
Manufacturing as a whole					
1961	52,252	435.6	37,743	19,302	21,549
1971	44,092	1,201.5	242,940	59,908	187,565
Food, beverages & tobacco					
1961	14,991	98.6	14,801	7,204	7,740
1971	13,184	145.6	49,517	12,918	31,493
Food					
1961	13,571	84.4	10,135	3,941	6,615
1971	13,029	131.3	37,871	5,587	23,196
Beverages					
1961	1,412	8.8	1,616	1,340	673
1971	117	4.0	1,002	466	616

Source: *General Report, 1961 Industrial & Commercial Census of Taiwan,* the Republic of China, Vol. III and *The 1971 Industrial and Commercial Census of Taiwan and Fukien Area,* Republic of China.

Appendix Table 5. Food Manufacturing Establishments by Number of Workers, 1971

Item	Establishments		Persons Engaged		Gross Output	
	Number	Share (%)	Number	Share (%)	Value (NT$ million)	Share (%)
Manufacturing as a whole						
Under 5 workers	25,226	57.2	77.2	6.4	15,112	6.2
5 to 9	4,829	11.0	36.3	3.0	4,096	1.7
10 to 19	5,951	13.5	75.7	6.3	9,207	3.8
20 to 49	2,216	5.0	50.7	4.2	7,944	3.3
50 to 99	2,119	4.8	77.3	6.4	11,702	4.8
100 to 199	1,676	3.8	110.8	9.2	16,849	6.9
200 to 499	1,707	3.9	393.4	32.7	63,121	26.0
500 and over	368	0.8	434.2	36.1	114,909	47.3
Total	44,092	100.0	1,201.5	100.0	242,940	100.0
Food beverages & tobacco						
Under 5 workers	11,279	85.6	27.3	18.8	10,296	20.8
5 to 9	406	4.6	4.5	3.1	1,109	2.2
10 to 19	613	4.6	7.5	5.2	2,252	4.5
20 to 49	200	1.5	4.6	3.2	2,624	5.3
50 to 99	167	1.3	6.1	4.2	2,697	5.4
100 to 199	122	0.9	7.7	5.3	2,788	5.6
200 to 499	149	1.1	27.2	18.7	6,740	13.6
500 and over	48	0.4	60.8	41.8	21,013	42.4
Total	13,184	100.0	145.6	100.0	49,517	100.0

Source: *The 1971 Industrial & Commercial Census of Taiwan and Fukien Area,* Republic of China.

Appendix Table 6. Average Scale and Productivity of Food Manufacturing Establishments, 1961 and 1971

Item	Average per Establishments			Average per Employee		
	No of Persons Engaged	Value of Gross Output (NT$1,000)	Value Added (NT$1,000)	Value of Gross Output (NT$1,000)	Value Added (NT$1,000)	Remuneration (NT$1,000)
Manufacturing as a whole						
1961	8.3	722	369	122.3	62.6	10.0
1971	27.3	5,510	1,359	249.7	61.4	26.3
Food manufacturing						
1961	6.2	747	290	237.1	92.2	11.6
1971	10.1	2,907	429	649.6	95.9	47.8
Beverages						
1961	6.3	1,145	949	294.2	243.9	12.4
1971	27.0	6,819	3,169	307.3	142.8	32.5
By number of workers, 1971:						
Food, beverages & tobacco						
Under 5 workers	2.4	913	58	374.8	24.0	15.8
5 to 9	7.4	1,829	136	247.5	18.4	15.1
10 to 19	12.3	3,674	205	299.0	16.7	14.5
20 to 49	22.9	13,119	261	572.5	11.4	15.7
50 to 99	36.2	16,149	483	445.6	13.3	17.5
100 to 199	62.9	22,849	395	363.5	6.3	16.8
200 to 499	182.6	45,233	518	247.7	2.9	14.8
500 & over	1,266.3	437,761	71,734	345.7	56.7	34.0

Source: Same as Appendix Table 4.

Rice Policies of Taiwan*

Hsing-yiu Chen,** Wen-fu Hsu,*** Yu-kang Mao

Rice is a commodity with unique economic and political significance for Taiwan's 16 million people. It is grown by almost 90 percent of the Province's 880,000 farm families, and since World War II, it has generated an important portion of Taiwan's foreign exchange earnings. In addition, rice has often been used in paying or calculating wages, rents, loans, and in settling other transactions. For example, rice served as legal tender for the bonds issued under the Land Reform Program to compensate landlords for land compulsorily purchased by the government for redistribution to tillers.

In 1973 rice acreage amounted to 778,000 hectares, or about 47 percent of the 1,645,000 hectares planted to crops in that year[1]. The total area of paddy land was 517,000 hectares, implying that two crops of rice were planted on about half of the paddy land. The importance of rice in agriculture can also be observed from the composition of the gross domestic product generated by agriculture. In 1974 rice accounted for about 50 percent of the total value of crops produced in Taiwan and for about 35 percent of agricultural output, including livestock. Because a considerable amount of locally-produced food grains and tuber crops are consumed as livestock feed, rice probably provides about 35 percent of the income of farm families.

I. PRODUCTION, CONSUMPTION, MARKETING, AND EXTERNAL TRADE IN RICE

1. Production

Taiwanese farmers prefer to grow rice if appropriate land is available. This attitude can be explained in large part by technical and economic relationships. Until mid-1973, the price of rice was lower than that of other crops such as fruits and vegetables. But the input-output relationships for growing rice tend to be more clear-cut and predictable to most farmers. Rice growing is much less affected than other crops by natural hazards, such as typhoons. Insects and diseases affecting rice are more easily controlled, and the market price also tends to be rather stable.

* Reprinted from Food Research Institute Studies, Vol. XIV, No. 4, 1975, Stanford University.
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1) Taiwan, Dept. of Agri. and Forestry, *Taiwan Agricultural Yearbook, 1975* (Taipei, 1975).

Hence, the anticipated net revenue from rice may be comparable to other high-priced but more risky crops.

Rice output in Taiwan increased in all but three years between 1950 and 1968. From 1960 to 1968, the annual growth rate of rice production was 3.4 percent, exceeding the average population growth rate of 3 percent per annum for the period. Between 1969 and 1972, however, rice output remained stable at levels somewhat below the peak of 2.5 million tons produced in 1968, until the high support price in 1973 helped boost rice production again.

Because the planted acreage of rice has changed little since 1960, rice production increases were achieved almost entirely by raising yields. From 1950 to 1972, the yield of brown rice increased at an average rate of 100 kilograms per hectare per year. Factors underlying this increase in yields include: development and distribution of better varieties; production and supply of chemical fertilizers and pesticides; extension of new farming practices; improvement of irrigation facilities and methods; and increased supplies of simple but efficient farm implements.

An analysis of the cost of paddy production is made every year on the basis of surveys conducted by the Food Bureau. The analysis shows that in 1972 production costs of the first and second crops were similar, ranging from N.T.$441 (U.S.$11.03) to NT$466 (U.S.$11.65 at N.T.$40=U.S.$1, prevailing in 1972) per 100 kilograms of paddy. The production cost per hectare was about N.T.$20,000 per crop of rice in the same year.

Intensive cultivation methods are characteristic of rice production in Taiwan. Labor used for growing one hectare of rice, for example, was 97 days for the first crop and 89 days for the second crop in 1950. The highest labor input experienced for the first crop was 109 days in 1965. Because of the labor shortage experienced in the rural areas in recent years, however, the amount of labor used in the production of rice has begun to decline.

As a result of both increased labor use and rising wage rates, the weight of labor cost in the total production cost of rice has increased steadily during the past two decades. For the production of first crop rice in 1950, for instance, an amount of N.T.$688 was used for one hectare of paddy. The total production cost was N.T.$2,295, indicating that wages alone accounted for roughly 30 percent of the total. Labor costs increased steadily, and in 1972 they reached N.T.$9,133 per hectare. The total production cost for the first rice crop was N.T.S19,867 in that year, of which labor accounted for about 46 percent.[2)]

(2) Hired labor accounted for 52 percent of the labor costs.

Nonfarm inputs in the production of rice have also increased remarkably in the past 20 years. In 1950 chemical fertilizers distributed by the government for rice production totaled 301 kilograms per hectare. This figure increased to a record level of 919 kilograms in 1964. Between 1964 and 1969, chemical fertilizers used for rice production maintained a level of around 900 kilograms per hectare, but since 1970 there has been a declining trend. Over the entire period, however, fertilizer costs have been second only to labor costs and have accounted for about 25-30 percent of the total costs of producing paddy.

2. Consumption

According to a recent survey, the average family expenditure on rice alone accounted for 85.7 percent of the expenditures on staple food, 24.1 percent of all foods, and 10.7 percent of all consumption expenditures[3]. If the price of rice had not been maintained at an artificially low level, the relative share of rice in family expenditures would have been even larger. The per capita energy intake in Taiwan, 2,733 calories per day in 1974[4], was one of the highest in Asia. Rice supplied 1,323 calories or 48 percent of this total.

Rice is consumed three times a day by the majority of families in Taiwan. A survey in 1972 indicated that average per capita consumption of rice was 131 kilograms of polished rice[5]. However, substantial differences exist among different groups in the population. The per capita consumption of rice is influenced by the degree of urbanization. Consumption per capita was 96 kilograms of polished rice for urban families, 137 kilograms for suburban families, and 151 kilograms for rural families.

If rice consumption is expressed in expenditure terms, however, the variation of rice expenditure among different groups of the population becomes narrow due to marketing margins. The rice consumption expenditure for the three groups of the population was N.T.$720 per person per year for the urban population, and N.T.$95 and N.T.$997 for the suburban and rural populations, respectively. These findings imply that the aggregate income elasticity of rice is negative and that the per capita consumption of rice can be expected to decrease when people can afford luxury foods such as meat, milk, and eggs.

3. Marketing

Following the rapid economic growth of Taiwan in recent years, rice produc-

3) Taiwan, Dept. of Budget, Accounting, and Statistics, *Report on the Survey of Family Income and Expenditure* (Taipei, 1972).
4) Joint Commission on Rural Reconstruction, *Taiwan Food Balance Sheet, 1974* (Taipei, 1975).
5) W. F. Hsu, "The Effect of Income on Family Food Consumption in Taiwan," *Memoirs of the College of Agriculture Vol. 13, No. 1,* National Taiwan University, June 1972.

Table 1. Off-farm Marketing and Government Collection of Rice*

Year	Total off-farm marketing (*thousand metric tons*)	Government collection (*thousand metric tons*)	Off-farm marketing to total production (*percent*)	Government collection to off-farm marketing (*percent*)
1950	701	388	49	55
1952	802	429	51	53
1954	848	554	50	73
1956	821	520	46	63
1958	882	545	47	62
1960	875	466	46	53
1962	1,067	596	51	56
1964	1,171	670	52	57
1966	1,263	636	53	50
1968	1,356	697	54	51
1970	1,330	499	59	38
1972	1,332	309	55	23
1973	1,278	259	57	20

* Off-farm marketing figures for 1950–68 are quoted from T. H. Lee, "Government Interference in the Rice Market in Taiwan," paper presented to the Rice Policy Conference in Manila, International Rice Research Institute, April 20, 1971, p. 5, and those for 1970–73 are estimates of the authors; figures of off-farm marketing include government collections.

tion has moved toward a more commercial basis. Table 1 indicates that 57 percent of total rice production was marketed off farms in 1973 as compared to 49 percent in 1950, even though average farm size became smaller.

Rice is marketed through two channels, free market and government; the government accounts for about 30 percent of the total. In the free-market channed, rice mills at local markets play a predominant role. In addition to processing paddy into brown rice and polished rice, most rice mills in Taiwan also perform wholesaling and retailing functions, Customarily, rice shipped to a distant market is in the form of brown rice because it can be stored longer than polished rice. In 1974 there was a total of 19,000 rice merchants, including shippers, wholesalers, retailers, and processors.

Rice storage is an important function in adjusting seasonal supply to non-seasonal demand. Customarily, farmers store their rice in on-farm warehouses or storage bins. The government rice is stored in farmers' association warehouses, and storage is consigned to private rice mills only if the warehousing capacity in the local farmers' associations falls short.

Most producers store their rice for more than six months, but few store it longer than a year. Government rice, however, is stored for a much longer period,

usually from 12 to 18 months[6]. Storage losses expressed as ratios to total storage costs (excluding value of the commodity) are about 18 percent in on-farm warehouses and 11 percent for government-stored rice.

The rice market appears to be the most competitive agricultural product market in Taiwan. Numerous buyers and sellers operate in the market, and the product is well-known and relatively homogeneous in quality. For these reasons, price differentiation among different localities is negligible. As shown in Table 2,

Table 2. Price Differentiation of Rice Among Four Cities in Taiwan*
(*N.T.$ per kilogram*)

	Taipei	Keelung	Taichung	Kaohsiung	Maximum price difference	Percent against lowest price
1972						
September	8.00	7.83	7.71	7.72	0.92	3.76
October	8.00	7.83	7.54	7.69	0.46	6.10
November	8.00	7.83	7.43	7.67	0.57	7.67
December	8.00	7.89	7.49	7.71	0.51	6.81
1973						
January	8.22	8.28	8.16	8.20	0.12	1.47
February	8.33	8.22	8.12	8.33	0.21	2.59
March	8.29	8.00	8.00	8.06	0.29	3.63
April	8.21	8.00	8.00	8.00	0.21	2.63
May	8.17	8.00	7.91	8.00	0.26	3.29
June	8.17	8.22	7.86	8.00	0.36	4.58
July	8.22	8.33	8.00	8.28	0.33	4.13
August	8.50	8.37	8.03	8.78	0.75	9.34
Average	8.18	8.07	7.85	8.04	0.33	4.20

* Data from Wen-fu Hsu, "A Study of Marketing of Selected Agricultural Products in Taiwan" (in Chinese), Department of Agricultural Economics, National Taiwan University, April 1974, p. 76.

recent differences in monthly prices among four major cities have been less than 5 percent. The marketing costs for rice are presented in Table 3. Under this cost structure, rice farmers receive nearly 85 percent of the retail price. Middle-men margins were only 9 percent, while other costs, including transportation and processing expenses, represented about 7 percent.

4. External Trade

Table 4 contains data on rice production and exports between 1953 and 1973. The largest quantity of rice exported during these 20 years was 263,000 tons in 1957, when foreign sales accounted for 14 percent of total production. Rice exports

6) M. Y. Chew, "A Study on Storage Cost of Rice in Taiwan," National Chung Hsing University, 1971.

Table 3. Costs of Marketing 100 Kilograms of Polished Rice*

Items	Amount (*N.T.$*)[a]	Percent of retail price
Farm value (140 kg. of paddy—equivalent to 100 kg. of polished rice)	601.41	84.57
Transportation	11.98	1.69
Packaging	2.33	0.33
Processing	11.27	1.59
Wholesale margin	24.03	3.38
Sub-total	49.61	6.98
Wholesale price	651.02	91.54
Transportation	3.39	0.48
Processing	15.00	2.11
Packaging	0.74	0.10
Retail margin	41.02	5.77
Sub-total	60.15	8.46
Retail price of polished rice (100 kg.)	711.17	100.00

* Data from Wen-fu Hsu, "A Study of Marketing of Selected Agricultural Products in Taiwan" (in Chinese), Department of Agricultural Economics, National Taiwan University, April 1974, p. 92.
[a] The conversion rate of N.T.$ to U.S.$ was 38 to 1 for 1974 and after.

Table 4. Production and Export of Brown Rice*

Year	Production (*metric tons*)	Export (*metric tons*)	Exports as a percentage of production
1953	1,641,557	89,525	5.45
1954	1,695,107	89,850	5.30
1955	1,614,953	167,133	10.35
1956	1,789,829	113,850	6.36
1957	1,839,009	262,931	14.30
1958	1,894,127	181,762	9.60
1959	1,865,316	93,725	5.03
1960	1,912,018	48,116	2.52
1961	2,016,276	93,373	4.63
1962	2,112,875	39,373	1.86
1963	2,109,037	186,407	8.84
1964	2,246,639	234,765	10.45
1965	2,348,041	238,661	10.16
1966	2,379,661	220,817	9.28
1967	2,413,790	96,040	3.98
1968	2,518,103	52,964	2.10
1969	2,321,633	51,428	2.22
1970	2,462,643	5,652	0.23
1971	2,313,802	83,817	3.62
1972	2,440,329	27,568	1.13
1973	2,254,730	80,964	3.59

* Data from Taiwan Provincial Food Bureau, *Taiwan Food Statistics Book* (Taipei, 1974 ed.), pp. 2 and 99.

since 1967 have decreased to around 50,000 tons, or about 2 percent of the annual production.

II. OBJECTIVES OF RICE POLICY, 1945-70

The four principal objectives of rice policies in Taiwan since World War II have been (1) to produce as much rice as possible from limited agricultural resources; (2) to control (procure) as much rice as possible for the government; (3) to export as much rice as possible to earn foreign exchange; and (4) to stabilize the market price of rice as a basis for economywise price stabilization.

A variety of economic and political concerns has given rise to this set of objectives. Food shortages were severe on the mainland during the Second World War. Because of this experience and the large population influx from the Chinese Mainland, there was a natural concern about producing sufficient food from domestic sources. Lessons were also learned from the hyper-inflation during and immediately after the war years on the mainland. The Chinese economy was predominantly rice-based, and a large part of business and daily life was directly or indirectly carried out in terms of rice. A sufficient supply of rice was therefore an indication of affluence and stability in the total economy. Foreign exchange was needed to finance the import of capital goods, raw materials, and modern technology from foreign countries. In the initial stages of the postwar economic rehabilitation and development, Taiwan did not have anything significant to export except rice and sugar.

In view of the role of rice as the traditional staple food of Taiwan, it is understandable that the government considered adequate supplies to be imperative. Since rice imports were not always dependable and there were continuing balance-of-payments problems, the government made extensive efforts to increase domestic rice production. The successful implementation of rice production programs was instrumental in the steady overall economic growth that Taiwan has experienced during recent years.

The role of rice as a wage good has been a particularly important influence on government policy. In many instances, rice was used to hedge against inflation, and often financial transactions were made in terms of, or in relation to, rice. Under these conditions, fluctuations in the price of rice were considered to have an adverse influence on the prices of other commodities and services. It was argued that a rise in rice prices would raise labor costs, thereby raising the cost of production in labor-intensive industries. Increases in the cost of producing industrial goods would in turn affect their competitive position in international markets, and the pace of industrialization would slow down. Consequently, stabilizing the general price level meant maintaining rice prices at relatively low levels.

In earlier periods, policy makers also wanted to limit money circulation by requiring that transactions be made in kind. They noted that if fertilizer were bought for cash, the farmers would have to sell their rice for cash. Many government officials believed that barter transactions would help eliminate the circulation of money and that the resulting pressure of money on prices would thus be avoided.

Most government officials also maintained that the scale of operation of the majority of farmers was too small to permit any appreciable marketable surplus of rice. The small-scale cultivators would therefore not benefit from higher rice prices. Policy makers felt that small farmers would benefit more from having inputs supplied at reasonable costs to help lower production costs. Furthermore, they felt that fertilizer would become an object of speculation by dealers, and, as a consequence, fertilizer prices would fluctuate more than under a government-controlled barter system.

During the first two decades of postwar agricultural rehabilitation, government policies were quite successful in achieving both greater rice production and greater control over rice marketing. The government increased the amount of rice under its control by supplying more bartered fertilizer and by increasing land-tax burdens. Under the slogan of "more food for the people and the military," government policies toward rice were not seriously challenged.

The Provincial Food Bureau (PFB) maintained a large cadre of workers to handle the government's daily business of rice collection, fertilizer distribution, storage management and rice processing and distribution. In 1974 the size of the PFB staff was about 3,000 full-time employees. Moreover, the field operations of the PFB are entrusted to the farmers' associations and to local rice mills on a fee basis; recent rates have been N.T.$70 per metric ton for the distribution of fertilizer and N.T.$8.50 per metric ton of paddy for the collection and storage of rice. Because the associations and mills have not been paid enough to recover all incidental costs, it is difficult to calculate precise marketing costs. Expenses of the PFB are met by the profits made from the barter of fertilizer for rice, stabilization sales, and exports of rice. Because the cost calculations of government-distributed rice are inaccurate, there is strong speculation that inefficiencies exist in the government's collection and distribution of rice.

Rice prices in Taiwan have been very stable except in 1953, 1960, and 1974, when they experienced sharp upsurges because of bad weather and short supplies. In addition, the price spread between producers' prices and consumers' prices has been narrow. The seasonal price fluctuations in normal years are also small in magnitude. To a large extent, this price stability resulted from active government

participation in rice marketing and strict application of government regulations in the rice market. Even with this relatively high degree of stability, however, many people have not been satisfied with the effectiveness of the government's rice program.

III. RECENT CHANGES IN RICE POLICIES

Taiwan's rapid growth in the 1960s resulted in challenges to many of the earlier rice policies. As industrialization increased rapidly, agriculture became a declining industry and incomes of farmers were reduced relative to those of non-farmers. With rising incomes, nonfarm consumers shifted their consumption patterns, and thus food items, other than rice, provided better income opportunities for farmers. This diversification within agriculture impeded further increases in rice production.

Because of the relative decline in farm income, the government was reluctant to increase the heavy burden on the rice-growing farmers through the land tax or through the barter of fertilizer for rice. It also became more difficult for the PFB to generate net profits from a barter ratio unfavorable to the farmers. In the 1950s the PFB made a yearly profit of N.T.$388 million (U.S.$24.87 million at an exchange rate of U.S.$1=N.T.$16), but given their relative fall in income, growers appeared no longer willing to bear such a heavy tax burden in the 1970s[7]. It became difficult to induce farmers to grow more rice when other goods, such as fruits, vegetables, and livestock, offered better profit opportunities. As a result, rice production has declined somewhat since reaching its record level in 1968.

Consumers have also found themselves in altered circumstances. Having more money to spend than before, they are becoming less responsive to rice prices because now only a small portion of their income is spent on rice. Consequently, the theory that price of rice influences living costs and wage levels is much less plausible than before. More and more, government employees are finding rice rations inconvenient and are demanding payment in money.

Since 1970 rice policies have shifted emphasis. The PFB's scope of activities has narrowed as production programs, including irrigation and demonstration projects, were dropped. The PFB stopped supplying feed and agricultural chemicals. Most importantly, the bartering system of fertilizer for rice was formally abolished in 1973. The government instead instituted a guaranteed price for rice to assure a reasonable income to rice growers. The minimum price of paddy rice was set at N.T.$5.20 per kilogram for the first rice crop of 1973 and the guaranteed price was increased to N.T.$6 for the second crop. The price was set at N.T.$10 for the first

7) a. W. C. Chu, "An Assessment of Fertilizer Barter System" (in Chinese), Nonyu, Taiwan, March 1962.
b. T. H. Lee, "Government Interference in the Rice Market in Taiwan," paper presented to the Rice Policy Conference in Manila, International Rice Research Institute, May 4-9, 1971.

and second rice crops of 1974 and N.T.$11.50 for the first and second rice crops of 1975, the highest prices farmers have ever received. A rice stabilization fund also was established in April 1974 with a total amount of N.T.$3 billion. This fund is evidence of the government's desire to participate indirectly in the rice market rather than to control the rice supply directly. While the land tax is still collected in kind, the rate was lowered. Compulsory purchase remains in effect, but the purchase price is now to be set no lower than the market price. Government policies are thus moving in a direction more favorable to rice farmers.

The shifts in rice policy objectives in Taiwan are illustrated in Table 5. Before 1970 the emphasis was on consumers' welfare, government revenue, and economic stability. Self-sufficiency was not considered a primary objective of rice policy because of the export potential for rice in the 1950s and 1960s. The foreign market for Ponlai varieties of rice largely disappeared in the late 1960s, however, because of increased rice production in Japan. The Chinese government continued to depress rice prices until 1972. As a consequence, farmers switched from rice production to other crops. For example, some farmers replaced the rice crop with bananas when banana production started to show handsome profits after the reorganization of the export system. This tendency continued in the South, where most of the export bananas are grown. It is estimated that 25,000 hectares of paddy field were converted to banana production during the period from 1963 to 1970.

Table 5. Changes of Weight of Rice Policy Objectives in Taiwan Before and After 1970*

Objectives	Weight before 1970	Weight after 1970
Farmers' income	—	0.3
Consumers' welfare	0.3	0.3
Government revenue	0.3	—
Foreign exchange	0.1	—
Self-sufficiency	—	0.2
Economic stability	0.3	0.2
Total	1.0	1.0

* Authors' estimates.

In recent years, as world food shortages have become increasingly serious, the government has made self-sufficiency in rice a national policy. This policy is not likely to be changed in the coming years if the world food supply does not show significant improvement. To increase rice production and improve farmers' incomes, the government has changed its rice price policy by providing incentive

prices to rice growers. It is expected that this policy will halt the decline of rice production and narrow the disparity between the incomes of farmers and those of nonfarmers.

IV. GOVERNMENT POLICIES FOR RICE PROCUREMENT AND DISTRIBUTION

Compulsory collection and rationing of rice were enforced in Taiwan by the Japanese government during World War II. In that period, the surplus rice was purchased compulsorily and rationed at official prices to the nonfarm population. After restoration of the island province, this policy was abandoned temporarily by the Chinese government. However, new measures were introduced to cope with the problems of food shortage caused mainly by the large influx of people from the mainland.

The total rice collection by the government expressed in terms of unpolished brown rice was about 400,000 metric tons a year in 1950. It increased to about 500,000 metric tons from 1950 to 1960, to about 550,000 metric tons between 1961 and 1965, and reached an all-time high of about 700,000 metric tons in 1968. Total rice collection by the government then declined to about 500,000 metric tons per year thereafter and further dropped to 309,000 and 259,000 metric tons in 1972 and 1973, respectively. The major means for collecting rice have been the paddy land taxes in kind, compulsory purchases of paddy from the paddy landowners, rent on government-owned farmland, proceeds in kind from the sale of public land, barter of fertilizer for rice, sales proceeds collected from ex-tenants who received land under the land reform program, and repayment of rice production loans.

1. Land Taxes

The paddy land tax and the surtax in kind on the owners of paddy land were inherited from schemes adopted in mainland China. For rural lands other than paddy fields, however, related taxes are collected in cash. In 1974 the amount of rice to be paid by paddy landowners was calculated as follows: paddy land tax in kind equals tax unit *Yen* (Y) times 22 kilograms (paddy rice) times paddy land area; and compulsory purchase of rice equals tax unit (Y) times 35 kilograms (paddy rice) times paddy land area.

The land-tax unit is determined on the basis of the productivity of the land. The cultivated land, both paddy and upland, has been classified into 26 grades. For each grade a tax unit ranging between Y1.2 and Y49.0 is assigned. Land-tax

collections have been adjusted seven times since 1945 by changing the amount of paddy to be collected per tax unit without changing the tax unit for a specific grade of land. For instance, the amount was 8.85 kilograms in 1946, 11.505 kilograms in 1947, 14.16 kilograms in 1950, 19.37 kilograms in 1962, 27.0 kilograms in 1969, and 22.0 kilograms in 1974. In 1973 a total of 120,658 metric tons of brown rice was collected from a total paddy land area of 544,505 hectares. On average, approximately 281 kilograms of paddy per hectare were collected under this scheme.

2. Compulsory Purchase of Paddy

The compulsory purchase of paddy from landowners at official prices constitutes another source of government-produced rice. Any parcel of paddy land is subject to payment of paddy land tax plus compulsory purchase of rice. Collections, made on top of the paddy land tax, are calculated on the basis of the tax unit which depends upon the productivity of land. The amount to be purchased has been adjusted several times since 1950. In 1973 the figure was 12 kilograms per tax unit, but in 1974 the assessment was raised to 35 kilograms to offset the decrease in government-collected rice after the abolition of the system of bartering fertilizer for rice.

If the price paid by the government equals to the market price of paddy, the compulsory purchase of rice is tantamount to a business transaction between the government and the farmer. The government, however, has typically paid only 70-80 percent of the prevailing market price. The difference between the official and market prices thus constitutes an additional, but hidden, tax on the paddy landowners. However, since 1973 the government has raised the purchase price of rice to the market price level in order to increase farm incomes. In 1973 the compulsory purchase of paddy by the government amounted to 57,000 metric tons of brown rice, or roughly half of the amount collected through land taxes.

3. The System of Bartering Fertilizer for Rice

In order to control as much rice as possible, the government devised a barter system for fertilizer and rice in 1948. Under this system, chemical fertilizers were distributed to the rice growers by the government in exchange for paddy. Spot barter was made for 40 percent of the fertilizer, while the remaining 60 percent was loaned to the rice growers to be repaid after harvest. Since all fertilizers, both domestic and imported, were controlled by the government, farmers in need of chemical fertilizer (except for sugarcane growers whose fertilizer was distributed by the Taiwan Sugar Corporation) traded paddy to the government. The exchange

ratio of rice for fertilizer was usually unfavorable to rice farmers. The amount of rice required for one kilogram of ammonium sulphate was 1.20 kilograms for the first crop of 1950. Although the exchange ratio has since been reduced several times, reaching 0.53 kilograms in 1972, this arrangement never won the full support of most rice growers. Rice collected by the government through this system constituted the bulk of government-procured rice until the system was abolished in 1973.

Fertilizers were not the only commodity that the government offered to the farmers in exchange for rice. The PFB also bartered other production materials, including soybean cake and consumer goods such as cotton cloth. Unlike the monopolistic position in supplying chemical fertilizer, however, the government had to compete with commercial channels in supplying these other materials. The other barter programs failed, partly because of the unrealistic barter ratios established by the PFB and partly because of the cumbersome nature of the programs.

4. Other Methods

In the center of a postwar land reform program, the government compulsorily purchased land from landowners and distributed it to tenant cultivators. The land value was to be repaid by the tenants in semiannual installments over 10 years. The payment of the land value was to be made in paddy if the land was paddy land. Rice collected in this way amounted to about 50,000 metric tons in the peak year of 1959 and has decreased since then.

The government also acquired a substantial amount of cultivated land that was previously owned by Japanese nationals during the Japanese occupation. This public land was leased to farmers for cultivation, and a part of it was sold to tillers. Both land sales and land rent were collected in kind. In the peak years of 1964 and 1965, rice collected by this means amounted to 38,000 metric tons per year.

In addition, the PFB has provided rice production loans to needy rice growers in an effort to encourage rice production. The rice production loan, bearing an interest rate of 3 percent per crop, is to be repaid in paddy. In calculating the amount of rice to be repaid, the PFB uses the market price of rice prevailing one month after harvest. The cash production loan is then converted into paddy at the lowest price during the season. Through this procedure, the borrowing farmers are required to repay the principal with interest rates higher than the nominal rates. For this reason, rice production loans have never been popular among rice farmers, and program achievements always have been far below the established targets.

The share of the government's rice collection by all of these programs in the

total amount of rice marketed-off-farm averaged between 50 and 60 percent during 1950-70. By 1970, however, this share was only 38 percent, and it declined to 20 percent in 1973.

5. Distribution of Government Rice

The collection of government rice was by no means considered an end in itself. The disposal of government rice has been made through several channels including rations to armed forces, military dependents, civil servants, public school teachers, and mine workers. In addition, the government undertakes market stabilization sales and exports.

Taiwan maintains a large armed force. About 100,000 to 120,000 metric tons per annum of government rice are used to supply military personnel. In addition, low pay to the military is compensated partially by rations of rice and other necessities. These free rations are provided to officers for use by their families but not to draftees. The rice used for this purpose is rather limited, about 40,000 to 50,000 metric tons per year.

As a part of government employees' and teachers' salaries, the government provides free rations of about 100,000 to 120,000 metric tons of rice per year. Since 1970, however, rice distribution under this category has declined significantly because many eligible persons have chosen to receive a money equivalent instead of rice. Many people have criticized direct distribution of rice because of the administrative difficulties involved and because the rice offered was of inferior quality.

In order to stabilize the domestic market price of rice, the PFB has occasionally made sales from its stock of rice. Stabilization sales are usually conducted in periods of rising prices. The government's price is usually about 5 percent lower than the prevailing price so that further rises in the market price may be checked. However, stabilization has not always been possible because the PFB has sometimes been unable to release an unlimited amount of rice at a fixed price into the market. Amounts of government rice released in this way have fluctuated widely during the past 20 years, ranging between 244,000 metric tons in 1960 and 29,000 metric tons in 1969.

In the early stages of postwar economic development in Taiwan, the export of rice played an important role in earning foreign exchange. Rice exports were monopolized by the government; no commercial establishment was permitted to handle exports. Rice for export was supplied from government stocks. In 1965 rice exports reached a record of about 300,000 metric tons, but exports have declined significantly since 1966 in large part because Japan became a rice-surplus country.

A considerable amount of logistic support is required for the collection, storage, processing, and control of government rice. The PFB does not have the local facilities to handle these operations. Field operations for the distribution of fertilizers and for the collection, storage, and processing of rice are entrusted to local farmers' associations and merchant rice mills. The merchant rice mills are authorized only to collect rice turned in to the government for land taxes and compulsory purchases. All other local rice activities are entrusted to farmers' associations. These groups are paid a limited handling fee for handling government rice.

To facilitate the storage of paddy and of chemical fertilizers, the township farmers' associations have constructed many fertilizer and rice warehouses. Both the the PFB and the Joint Commission on Rural Reconstruction (JCRR) have provided financial assistance in the form of grants or loans for these storage facilities. Of the existing 850,000 metric tons of warehouse capacity, about half was constructed with PFB and/or JCRR assistance.

The recovery ratio in the processing of paddy into brown rice is a crucial factor in making more rice available to final consumers. To help renovate the rice hulling facilities of the farmers' associations, JCRR has assisted in the reconstruction of mills. As a result, the recovery ratio of brown rice from Ponlai rice has increased from about 76 percent in the immediate postwar period to about 80 percent in recent years.

The government intervenes in the market when prices deviate from desired levels. When the market price of rice rises substantially, the government food authorities release stocks at lower prices until the market price is reduced to the desired level. The stabilization level is arbitrarily set by the PFB though it is usually 15 to 20 percent higher than costs of production.

The "official price" of rice is applicable to the following categories: payments for rice compulsorily purchased from owners of paddy land; conversion of land tax in kind into cash for upland and single-cropping paddy land yielding only one crop of rice annually; and settlement of accounts between food authorities and other government agencies regarding rice rations. The official price of rice is announced by the PFB every season. During the two decades before 1973, the official price of rice was usually set 20 to 30 percent lower than the market price.

The year-to-year changes in rice prices during the past 20 years are presented in Table 6. Several conclusions can be drawn from these data. First, prices at the farm, wholesale, and retail levels are close. Second, except in 1973 and 1974, the year-to-year changes in the price of rice have been gradual, showing the effective-

ness of government control over rice prices in most years. Third, the government has maintained a relatively low price for rice. This policy has been based on the belief that rice is a necessity and that its cost should not impose hardships on the general populace.

Table 6. Prices of Rice at Different Market Levels*[a]

Year	Farm price of paddy	Wholesale price of polished rice (*N.T.$/kilogram*)	Retail price of polished rice
1954	1.89	2.27	2.93
1955	2.10	2.93	3.15
1956	2.18	3.18	3.42
1957	2.34	3.36	3.63
1958	2.46	3.49	3.75
1959	3.09	3.72	3.97
1960	4.19	5.29	5.50
1961	3.93	5.81	5.98
1962	3.79	5.47	5.90
1963	4.00	5.61	5.91
1964	4.09	5.80	5.93
1965	4.13	5.85	5.97
1966	4.15	5.93	6.02
1967	4.41	6.23	6.32
1968	4.63	4.49	6.70
1969	4.53	6.47	6.89
1970	4.80	7.06	7.23
1971	4.65	6.72	7.34
1972	4.93	7.04	7.81
1973	5.69	8.17	9.63
1974 (March)	11.06	16.11	20.09

* Data from Taiwan Provincial Food Bureau, *Taiwan Food Statistics Book* (Taipei, 1974 ed.).
[a] The conversion rate of N.T.$ to U.S.$ is 38 to 1 in 1975.

Statistics provided by the PFB reveal that between 1955 and 1969 the rice price index was consistently 22 to 36 percent lower than the general price index[8] Since nearly all farmers in Taiwan are engaged in rice production and the entire populace consumes large amounts of rice, the policy to maintain relatively low rice prices has had an important impact on income distribution by enlarging the discrepancy between farm and nonfarm incomes. In addition, depressed prices have reduced incentives for farmers to make further investments and thereby to enhance agricultural productivity. While the low price policy for rice has had some unfavorable results, it nevertheless contributed greatly to social stability and to the sustained growth of the Taiwan economy.

8) Taiwan Provinical Food Bureau, "The Review of the Current Situation of Food Policy Execution" (in Chinese), Taipei, Oct. 1970.

V. SUMMARY

Because of the importance of rice in both production and consumption, rice policy in Taiwan directly influences the stability of the economy and the welfare of the people. For more than two decades following the Second World War, Taiwan's rice policy generally favored consumers at the expense of producers. Since 1970, however, the policy orientation has been reversed in an effort to stimulate increases in production.

In view of the role of rice as a wage good, the government initially aimed to keep the price of rice at relatively low levels. Rising rice prices would very likely have led to increases in industrial wage rates, thereby undercutting the competitiveness of Taiwan's nascent manufacturing firms in the domestic market and abroad.

Although it kept rice prices low, the government did not ignore the producers of rice. It made efforts to stabilize or reduce the prices of purchased inputs, including fertilizers, chemicals, farm implements, and irrigation facilities. To some extent, these measures were effective, and rice production steadily increased until 1968 when it peaked at 2,520,000 metric tons. At the some time, foreign exchange earnings from the export of rice played a significant role in financing vital imports for economic development.

After 1968, total rice production began gradually to fall. Largely as a result of government pricing policies, farmers switched to more profitable crops. Other rice farmers increasingly took off-farm jobs, the availability of which was one of the by-products of the substantial postwar growth of the Chinese economy. This situation forced the government to reconsider its rice policy.

Beginning in 1970, the government introduced high, guaranteed prices for rice and abolished earlier policies considered detrimental to the interests of rice farmers, most notably the system of bartering fertilizer for rice. These new policies have provided substantial incentives to rice producers, and preliminary estimates of the rice crop in 1975 indicate a return to the peak levels produced in 1968.

Agricultural Incentives and Their Implications for Employment in Taiwan*

Hsi-huang Chen

I. INTRODUCTION

A phenomenon of economic significance in the process of agricultural development is that subsistence farming gradually gives way to commercialized agriculture. Under the traditional farming system, farming considerations are intermixed with family considerations and decisions regarding family consumption tend to influence directly those concerning investment in farming. In general, the farmer produces more than what his family chooses to consume and sells the surplus in the market in order to purchase nonfarm goods and services. Thus traditional agriculture tends to be characterized by a low level of capital investment and of productivity. It is usually dominated by an attitude which emphasizes the maintenance of the present condition rather than its improvement.

As agricultural development goes on, the farm and nonfarm commodity markets become increasingly interdependent. Farmers turn out agricultural products not only for their own consumption but mostly for the market. Because of the close relationship between agricultural production and food processing, the more the agricultural sector advances, the greater its dependence upon the development and modernization of the manufacturing industry. More important, a well-developed food industry promotes not only the export but also the import of agricultural products. These are the so-called "import substitution" and "export promotion" which are induced on the basis of the comparative advantages of the countries concerned.

Since World War II, Taiwan has been very successful in promoting its agricultural development. Three strategies for agricultural development have been adopted over the past 30 years. In the early stage of its agricultural development, being faced with a food shortage problem, emphasized increase in food production in order to meet domestic needs. This policy target was realized with the aid of technical innovation which made it possible to increase yield. The means employed in this stage was technological efficiency. Secondly, after agricultural production was able

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to provide more than enough food for domestic needs, cash crops started to be grown along with the food crops in order to earn more income for the agricultural sector. These crops include mushrooms, asparagus, pineapples, etc. The means adopted in this period was price efficiency. Finally, after technical innovation and cash crops growing, the developmental strategy was to search for foreign markets for agricultural exports, which in turn would earn foreign exchange for the economy. The means employed in this last stage was marketing efficiency (location efficiency).

Actually, growth in our agricultural output has been achieved mainly through technical innovations that have raised the productivity of the relatively fixed inputs of land. Labor and capital, in combination with land, are two major factors of agricultural production which mutually interact in substitution for each other in process of agricultural development. In the early stages of development, abundant labor served as a cheap source of growth. Farming was usually performed by labor-using and land-saving technology. At this time, unpopular methods were emphasized to accumulate capital, often at the expense of the farmer's living standard. However, as the nation progressed in pursuit of development, new efficient technologies were gradually introduced, and government policies on prices, inputs, and credits provided solid economic incentives to farmers. The combination of these factors resulted in increased income for the farmers in general and raised the possibility of relying more heavily on means for more capital investment in substitution for labor. The farming type as a result changed from labor-using and land-saving.

Problems of labor transference arose as a result of the introduction of more modern farming instruments and technologies and increased wage rates. Several questions, however, need to be answered concerning crop production and change in labor employed for agricultural development. For example, the decline of farm labor in absolute number made it impossible to maintain the labor-intensive farming system; labor-intensive farming is no longer efficient in Taiwan. This leads us to question whether we are able to apply more capital in substitution for labor for maintaining high land productivity and whether some crops will be adversely affected by this change by virtue of different economic incentives to the farmers. Are there any new incentives—price or others—that can be applied to maintain the production of individual crops? Or, would it be possible for this country which has modernized the farm sector with high agricultural growth rates to offer farmers substantial economic incentives to institutionalize their production and thus maintain a steadily increasing trend for the production of most of its crops?

Unfortunately, there are relatively few empirical studies that are relevant to

these questions. Historical examinations of agricultural incentives and their relation to employment have not been analyzed systematically. The recent rapid agricultural growth in Taiwan has increased the variety of farm jobs and changed their compositions. The factors responsible for such variations in farm jobs as well as their directions and magnitudes need systematic investigation with a view to aiding production planning for each crop.

This study is aimed at measuring the comparative advantages of the production of five selected crops and investigating how specific government policies have influenced the production and trade of each crop. The structure of incentives and the capital-labor ratio in agricultural production will be compared for the purpose of analyzing the components of farm job changes due to the agricultural incentive system.

II. THREE INDICATORS FOR MEASURING THE COMPARATIVE ADVANTAGES OF FIVE SELECTED CROPS

The comparative advantage is not a new economic concept but has been applied for a long time to measure the practicable possibilities on international trade. The classical school leader Adam Smith (1723-1790 A.D.) stated that the value of goods was produced by labor and the production cost was in fact the labor input. Regional cooperation (or international cooperation) with specialized production therefore could raise labor efficiency, which in turn would create benefit for the cooperating regions (or countries). Adam Smith's explanation here was based on the absolute advantages of increased labor productivity through specialized production. Later, David Ricardo (1772-1823) modified Adam Smith's principle of regional cooperation by applying the concept of comparative advantage. Although Ricardo's theory was an improvement upon Smith's, both were limited by their conceptual emphasis upon labor production value under the free economic system. This principle could not be accepted by later economists, particularly after the Industrial Revolution, because labor, capital, and land were the three elements of production and none of them could be neglected. At present, cost measurement is quite different from that of the classical school. Today, most economists agree that not all production elements are homogeneous and each of them can apply alternative employment. As one resource is used for one kind of production, then it will expense that resource for other uses. This expense is the so-called "opportunity cost". Now this concept is widely accepted by economists and is applied to comparative advantage analysis.

Recently, economists concerned with future resource allocation have applied

themselves to measure the advantage of trade in terms of foreign exchange earnings. Pearson, Akrasanee, and Nelson constructed three measures for this purpose.[1] They are net social profitability (NSP), domestic resource costs (DRC) of foreign-exchange earned or saved, and the effective rate of protection (ERP) on value added. All the three measures are theoretically sound but different in analytical concepts and conditions. The net social profitability measure contains the adjustment of economic rent and shadow price and external effect on the local economy. The domestic resource costs measure the social cost of earning or saving a net marginal unit of foreign exchange. And the effective rate of protection measures the percentage increase, resulting from protection, in the domestic value added over the value added in a free trade situation. As Pearson said, NSP, DRC, and ERP have been applied or suggested for application in two uses—the *ex post* measurement of the cost of trade distorting policies and the *ex ante* evaluation of resource allocation.[2]

However, the three measures for comparative advantages have their own basic hypotheses for the analysis of each product. Those hypotheses have direct bearing on the results of actual analysis. Moreover, for analysis of comparative advantage the data selected either suitable for this analysis or not, will have great influence on the effectiveness of the conclusions reached. Generally speaking, the methods for measuring comparative advantages usually are theoretically sound but empirically weak owing to a lack of complete data for analysis. Detailed explanation of the sources and compilation of data is therefore very necessary to test the truth of the results.

The similarity of the basic hypotheses of the three measures is explained as follows:

1. Products Selected for Comparative Advantage Analysis Must Be Tradable.

Products are "tradable" when they have a high commercialization level in the world market which makes comparative advantage analysis possible. Theoretically speaking, if a commodity has a comparative advantage in production, we can promote its production and sell it on the world market in order to earn foreign exchange or save domestic resources costs. However, the premise for this production is that the product must have a high commercialization level in the world market; otherwise, the product can not be sold in the world market. Thus "tradable" is the first premise for comparative advantage analysis.

1) Scott R. Pearson, Narongchai Akrasanee, and Gerald C. Nelson, "Comparative Advantage in Rice Production: A Methodological Introduction", Food Research Institute Studies, XV, 2, 1976, Stanford University.
2) Scott R. Pearson, "Net Social Profitability, Domestic Resource Costs, and Effective Rate of Protection", Food Research Institute, Stanford University, mimeograph.

2. The Foreign Price Elasticity of Demand (or Supply) Must Be Unlimited

As to price elasticity for import or export, some products are suitable for measuring the comparative advantage of trade but not of others. The volume of any product of Taiwan, either for consumption or for production, amounts to so small a percentage of the world's total tradable volume of the same product, that with respect to price change Taiwan's increase in import or export for that product can be regarded as unlimited. Then, measuring the comparative advantage for trade of that product from the view point of Taiwan is meaningful. Generally speaking, increase in the total exports or imports would not significantly affect the price change in the world market and the trade capacity of the world market would be unlimited to Taiwan. Thus it can increase at will the import or export of those goods which have a comparative advantage according to favorable price changes in the world market.

3. A Fixed Input-Output Relationship

This assumption is based upon two hypotheses: (1) There is a fixed production function type, and (2) there is no technical innovation. Both of these two conditions are applicable only within a short period. In the long run, because of change in factor inputs, the productivity of scarce resources will be limited by the law of diminishing return, and the input-output coefficient would be changed. On the other hand, the level of technology can not maintain constant growth in the long term in a dynamic economic society. Since the basic assumptions of comparative advantage are incremental costs of production, determined by a given technology and an assumed set of relative factor prices which are constant, subject to sensitivity analysis to reflect changed assumptions, and thus measuring comparative advantage is not good for long-term analysis but is for short-term analysis only. However, for the purpose of making time series comparison, to measure comparative advantages in different periods in order to make a comparison is still something useful for the purpose.

Five crops—corn, soybeans, bananas, sugarcane and rice were selected under this study for comparative advantage analysis. Corn and soybeans account for the bulk of Taiwan's agricultural imports, bananas and sugar are main agricultural exports, and rice is the main food crop produced for self-sufficiency but still with a high level of commercialization in the world market.

Taiwan's corn and soybeans imports in 1975, for example, amounted to 2.83% and 5.02%, respectively, of the total volume traded in the world market. The import requirements for these two crops in this country are small compared with

the world market, and thus the world supply can be regarded as unlimited to this country. Corn and soybeans imports in 1975 made up 90.98% and 93.04%, respectively, of the total domestic consumption. Their proportions are very significant. To measure the comparative advantages of these two crops is heavy with policy implication.

In 1975, bananas and sugar exports occupied only 1.64% and 2.00%, respectively, of the world market. The percentages are so small that the world market capacity for Taiwan exports is also unlimited. On the other hand, bananas and sugar exports, also in 1975, accounted for 54.57% and 55.08%, respectively, of the outputs. Exports of these two crops have great influence on the domestic resources allocation for production. Similarly, measuring the comparative advantages of these two crops will be of use in resources allocation for their production.

Rice is a commodity with unique economic and political significance for Taiwan's 17 million residents. There are four principal objectives of rice policy in Taiwan since World War II: (1) to produce as much rice as possible with limited agricultural resources; (2) to secure as much rice as possible in the hands of the government; (3) to export as much rice as possible to earn foreign exchange; and (4) to assure stable market prices as a basis for economywide price stabilization.[3] To measure the comparative advantage of rice will help in the evaluation of the production efficiency of government policies and institutional incentives.

The proportion in the world trade and the level of commercialization for the five selected crops of Taiwan are listed in Table 1.

Table 1. Commercialization and Share of Taiwan Trade in World Market of Five Selected Crops

Unit: M.T. %

Agricultural Product	World Trade (1)	Domestic Consumption or Production (2)	Import or Export (3)	(3)/(1)×100	(3)/(2)×100
Soybean	16,473,000	889,047(c)	827,127(m)	5.02	93.04
Corn	49,183,000	1,529,325(c)	1,391,445(m)	2.83	90.98
Rice	8,805,000	2,494,183(p)	11(x)	...	...
Sugar	20,315,000	738,863(p)	407,000(x)	2.00	55.08
Banana	6,551,000	196,585(p)	107,283(x)	1.64	54.57

Sources: Trade Yearbook, FAO, UN; Taiwan Agricultural Yearbook; and Industry of Free China.
Foot Note: (c) Consumption
(p) Production
(m) Import
(x) Export

3) H. Y. Chen, W. F. Hsu and Y. K. Mao, "Rice Policies of Taiwan", Food Research Institute Studies, Vol. XIV, No. 4, 1975, Stanford University.

III. GOVERNMENT INCENTIVES FOR INCREASED PRODUCTION OF FIVE SELECTED CROPS

As indicated in the previous section, the five agricultural products selected for this study are rice, sugar, bananas, corn and soybeans. Rice as the staple food for Chinese is produced with a view to achieving self-sufficiency. Sugar and bananas, two long-time export items of Taiwan, have earned a great deal of foreign exchange to nourish the economy. As two important agricultural commodities on Taiwan's shopping list, corn and soybeans are mainly used as feed for livestock and poultry raising.[4)]

The government rice policy aims to fully satisfy demand for rice with domestic production. It requires that optimum incentives and support should be provided in order that rice yield may always surpass population growth. With this in view, the government has over the years adopted the following guidelines to boost rice production responding to increasing demand:[4)]

a. To reduce the cost of production by setting reasonable ceilings upon the prices of fertilizer, pesticide and farm machinery in order to keep farm prices relatively stable and leave an equitable margin of profit for the the farmer.

b. To strengthen farmers' organizations and their services.

c. To improve the agricultural financing system and provide an adequate supply of long-term loans.

Pursuant to these principles, various action programs have been designed by the government. Fertilizer prices were cut down in March 1970 to US$116 from US$135 per ton of urea and to US$72 from US$82 per ton of ammonium sulphate. As these two fertilzers are widely used, this price reduction had produced very considerable favorable effect on rice production. In February 1971, the price of urea was further lowered to US$100 per ton and that of ammonium sulphate to US$65 per ton.

In 1974, for the purpose of stabilizing rice prices and increasing farmers' income, the government set up a stabilization fund to provide guaranteed prices for rice. The minimum prices were fixed at approximately the cost of production plus a 20 percent profit. The minimum paddy price was set at NT$5.20 per kilogram for the first crop of 1973 and it was raised to NT$6 for the second crop. The price was further raised to NT$10 for both the first and second crops of 1974. Since 1975 the government purchase price has remained at NT$11.50 for both rice

4) See T. H. Shen, "Turning Point in Taiwan's Agricultural Development Policy", Mai Ya Publications, Inc., 1972.

crops, the highest the farmers have ever received. This guaranteed-price policy gives rice farmers a very strong incentive, and record production was achieved in 1976.

For sugar and bananas, government incentives for production has set up relative to world market demand. The annual sugar production averages about 850,000 m.t., of which about 700,000 m.t. is exported and the balance is retained for domestic consumption. Sugar exports are handled by the Taiwan Sugar Corporation (TSC). While the domestic sugar market is open to cane farmers and sugar dealers in free competition, TSC may intervene in domestic sugar marketing to protect the interests of both producer and consumer by adjusting the quantity of sugar to be traded in the local market. Generally, TSC tries to maintain the domestic sugar price at a high level as an incentive to encourage farmers to plant more sugarcane. Sugar for domestic marketing comes from two sources: contract cane farmers and TSC. According to the contract, the farmers' share of sugar may be resold to TSC for export at a certain percentage or sold to local sugar dealers for domestic consumption. Taiwan joined the International Sugar Agreement in 1954, obtaining an annual export quota of 650,000-750,000 m.t.

Government incentives for banana production are not postive enough. Generally speaking, an increase in price received from export would stimulate both banana production and export, because it is rather easy (1) for farmers to expand banana acreage and (2) to export bananas originally reserved for domestic consumption. But the actual situation is not so because (1) the government will enforce the retirement of banana plantings on steep slopes for the sake of soil conservation and (2) bananas are currently exported only to Japan which maintains a strict banana import quota. The problem in banana export is not one of price, but of market. As efforts have been made in recent years by the government to reduce banana acreage and production, it is unlikely that an increase in foreign market price will increase the total production. It is possible that a price increase in the foreign market will drive up the price of bananas in the producing areas and the exporters' profits, but it can hardly affect the elasticity of banana export as it is limited by the market and import quota of importing countries.

With respect to corn and soybeans, the government has no intention of fully satisfying the demand with domestic production. However, the farmers are still encourage to produce corn and soybeans in order (1) to improve the land utilization rate and (2) to produce as much corn and soybeans as possible in order to reduce dependence upon foreign supplies of the domestic animal industry. At present, Taiwan still has some idle land which can be exploited for growing corn and soybeans. As estimated, there is about 250 thousand hectares of rotational rice

fields and winter rice fields which are available for corn and soybean production. However, as the c.i.f. prices of imported corn and soybeans are lower than production costs of these two crops, the market prices do not constitute any incentive to increase corn and soybean production.

To boost corn and soybean production, the government has offered guaranteed prices for them to assure a reasonable income to the growers. In 1972, "Taiwan Grains and Feeds Development Foundation" was established with an initial amount of NT$1 million and an additional tax of NT$40 has been levied upon each ton of imported grans for contribution to the fund. The fund has been used to corn and soybeans at guaranteed price. The guaranteed prices were set at NT$6.5 and NT$11.5 per kilogram in 1976 for corn and soybeans, respectively, and they were raised to NT$7 and NT$12 per kilogram in 1977. The guaranteed prices are equal to the production costs plus a 20% profit. The price support guaranteeing reasonable profits gives the farmers a strong incentive to produce these two crops.

In recent years, the Chinese government has emphasized the necessity of reducing the cost of production and boosting farmers' income. The general agricultural policy adopted by the government has as its chief goal holding low the prices of farm requisites and guaranteeing reasonable prices for farm products. Under this policy, farmers are given a real incentive to increased crop production.

IV. COMPARATIVE ADVANTAGES OF FIVE SELECTED AGRICULTURAL PRODUCTS

As presented above, within the framework of government guidance and support, farmers are greatly influenced by institutional incentives although decision-making is still mostly theirs. To appraise the system of incentives and to evaluate the comparatives advantages of the five selected crops, NSP, DRC, ERP and related crops, NSP, DRC, ERP and related parameters in 1970, 1972, 1974 and 1976 are estimated as follows;

Rice

The costs and rates of return for the first and second rice crops are presented in Table 2 and Table 3 respectively.

For both crops, calculations are based on the Ponlai rice, which is most popular among the farmers in Taiwan. The DRC coefficient for both the first and the second crop was less than one in 1970 and 1974, but greater than one in 1972 and 1976. By definition, if an activity is socially profitable, then its DRC coefficient is less than one; when it is not socially profitable, its DRC coefficient is greater than one. Generally

Table 2. Costs and Return Data and Indicators For Taiwan (NT$ per kg. or as indicated)

(Ponlai Rice, 1st Crop)

Index: 1970=100

	1970		1972		1974		1976	
	Amt.	Index	Amt.	Index	Amt.	Index	Amt.	Index
(1) Gross output at actual market prices	7.059	100.00	7.036	99.67	14.668	207.79	15.656	221.79
(2) Tradable inputs, at actual market prices	1.474	100.00	0.955	64.79	2.331	158.14	3.026	205.29
(3) Value added, in actual prices, (1)−(2)	5.585	100.00	6.081	108.88	12.337	220.90	12.630	226.14
(4) Factor costs, other than capital, at actual market prices	3.527	100.00	4.540	128.72	8.339	236.43	8.515	241.42
(5) Indirect taxes	0.136	100.00	0.124	91.18	0.329	241.91	0.334	245.59
(6) Private profitability, (3)−(4)−(5)	1.922	100.00	1.417	73.73	3.669	190.89	3.781	196.72
(7) Gross output, at world market prices	5.434	100.00	5.624	103.50	20.026	368.53	11.552	212.59
(8) Tradable inputs, at world market prices	1.074	100.00	0.705	65.64	2.304	214.53	2.340	217.88
(9) Value added in world market prices, (7)−(8)	4.360	100.00	4.919	112.82	17.722	406.47	9.212	211.28
(10) Domestic resource costs other than capital, at opportunity costs.	3.527	100.00	4.540	128.72	8.339	236.43	8.515	241.42
(11) Social profitability, (9)−(10)	0.833	100.00	0.379	45.50	9.383	1,126.41	0.697	83.67
(12) Domestic capital costs, at opportunity costs	0.768	100.00	1.036	134.90	1.414	184.11	1.746	227.34
(13) Net social profitability, at official exchange rate, (11)−(12)	0.065	100.00	− 0.657	−1,010.77	7.969	12,260.00	− 1.049	−1,613.85
(14) Ratio of shadow price of foreign exchange (SPFX) to official exchange rate (OER)	1.020	100.00	1.052	103.14	1.035	101.47	1.057	103.63
(15) Net social profitability, at shadow prices of foreign exchange, (9)×(14)− [(10)+(12)]	0.152	100.00	− 0.401	− 263.82	8.589	5,650.66	− 0.524	− 344.74
(16) Nominal protective coefficient on output (NPCO), (1)÷(7)	1.299	100.00	1.251	96.30	0.732	56.35	1.355	104.31
(17) Nominal protective coefficient on tradable input (NPCI), (2)÷(8)	1.373	100.00	1.354	98.62	1.011	73.63	1.293	94.17
(18) Effective protective coefficient on value added (EPC), (3)÷(9)	1.281	100.00	1.236	96.49	0.696	54.33	1.371	107.03
(19) Domestic resource cost coefficient (DRC Coef.),[(10)+(12)]÷(9)	0.985	100.00	1.134	115.13	0.550	55.84	1.114	113.10
(20) Ratio of DRC to SPFX/OER, (19)÷(14)	0.966	100.00	1.077	111.49	0.532	55.07	1.054	109.11
(21) Yield (kilagrams of raw products per hectare)	3,176.550	100.00	3,104.830	97.74	3,161.380	99.52	3,353.100	105.56

Table 3. Costs and Return Data and Indicators For Taiwan (NT$ per kg. or as indicated)

(Ponlai Rice, 2nd Crop)

Index: 1971=100

	1970		1972		1974		1976	
	Amt.	Index	Amt.	Index	Amt.	Index	Amt.	Index
(1) Gross output at actual market prices	7.059	100.00	7.036	99.67	14.668	207.79	15.656	221.79
(2) Tradable inputs, at actual market prices	1.396	100.00	1.155	82.74	3.795	271.85	3.079	220.56
(3) Value added, in actual prices, (1)−(2)	5.663	100.00	5.881	103.85	10.873	192.00	12.577	222.09
(4) Factor costs, other than capital, at actual market prices	3.642	100.00	4.663	128.03	10.828	297.31	9.336	256.34
(5) Indirect taxes	0.138	100.00	0.154	111.59	0.507	367.39	0.368	266.67
(6) Private profitability, (3)−(4)−(5)	1.884	100.00	1.064	56.48	− 0.463	− 24.58	2.893	152.49
(7) Gross output, at world market prices	5.434	100.00	5.624	103.50	20.026	368.53	11.552	212.59
(8) Tradable inputs, at world market prices	0.995	100.00	0.832	83.62	3.234	325.03	2.375	238.69
(9) Value added in world market prices, (7)−(8)	4.439	100.00	4.792	107.95	16.792	378.28	9.177	206.74
(10) Domestic resource costs other than capital, at opportunity costs	3.642	100.00	4.663	128.03	10.828	297.31	9.336	256.34
(11) Social profitability, (9)−(10)	0.797	100.00	0.129	16.19	5.964	748.31	− 0.159	− 19.95
(12) Domestic capital costs, at opportunity costs	0.714	100.00	1.053	147.48	1.877	262.89	1.536	215.13
(13) Net social profitability at official exchange rate, (11)−(12)	0.083	100.00	− 0.924	−1,113.25	4.087	4,924.10	− 1.695	−2,042.17
(14) Ratio of shadow price of foreign exchange (SPFX) to official exchange rate (OER)	1.020	100.00	1.052	103.14	1.035	101.47	1.057	103.63
(15) Net Social profitability, at shadow prices of foreign exchange, (9)×(14)− [(10)+(12)]	0.172	100.00	− 0.675	− 392.44	4.675	2,718.02	− 1.172	− 681.40
(16) Nominal protective coefficient on output (NPCO), (1)÷(7)	1.299	100.00	1.251	96.30	0.732	56.35	1.355	114.31
(17) Nominal protective coefficient on tradable input (NPCI), (2)÷(8)	1.403	100.00	1.389	99.00	1.173	83.61	1.296	92.37
(18) Effective protective coefficient on value added (EPC), (3)÷(9)	1.276	100.00	1.227	96.16	0.648	50.78	1.371	107.45
(19) Domestic resource cost coefficient (DRC Coef.), [(10)+(12)]÷(9)	0.981	100.00	1.193	121.61	0.757	77.17	1.185	120.80
(20) Ratio of DRC to SPFX/OER, (19)÷(14)	0.962	100.00	1.134	117.88	0.731	75.99	1.121	116.53
(21) Yield (kilograms of raw products per hectare)	3,157.240	100.00	3,024.830	95.81	2,326.210	73.68	3,094.480	98.01

speaking, with the keen competition in today's economic society, rice production would not be so desirable so far as resources use is concerned. As economic development goes on, the DRC coefficients can be expected to grow. However, the DRC coefficients are lowest for both rice crops in 1974, which therefore had the highest comparative advantage as compared with either the previous year or the following one. This resulted mainly from the energy and food crisis in 1973-74 which increased the world market price from US$227 per ton in 1973 to US$373 in 1974. After the food crisis, the price in the world market dropped to US$255 per ton in 1976 and the DRC coefficient rose to 1.114 and 1.185 for the first and second crops, respectively, which showed that with decreased world market prices domestic rice production became a comparative disadvantage in 1976.

Comparative advantage in rice production, as indicated by the DRC coefficient, had a positive advantage in 1970 and 1974, but had a negative advantage in 1972 and 1976. When judged by NSP at shadow prices of foreign exchange, the situation was similar. However, the Taiwanese farmer does not necessarily conform to criteria for social efficiency. As indicated in the tables, with government price incentives, the private profitability showed only positive advantage. Thus even with negative NSP coefficient in 1972 and 1976, the farmers still continued their rice farming because of private profitability. And the ERP coefficient (measured by EPC minus one) have a positive advantage in 1972 and 1976, which indicated that even when the production efficiency is lower domestically than in foreign countries, rice still can be produced by Taiwanese farmers under government protection.

Actually, rice production in Taiwan has been actively supported by government policy and many public investment programs. Profits that have accrued to the farmers and society in recent years have proved the fruitfulness of the efforts made to increase rice yield.

Sugar and Bananas

Costs and return data for sugar and bananas are presented in Table 4 and Table 5 respectively.

These two products, both traditional agricultural exports, have low levels of costs and the DRC coefficient ranges from 0.335 to 0.735 for sugar and from 0.342 to 0.561 for bananas. All DRC coefficients are below 1 which indicates that sugar and bananas have the comparative advantage for production in the years concerned.

Sugar and bananas are subject to relatively high negative effective rates of protection primarily because of the contract for the government to purchase from

Table 4. Costs and Return Data and Indicators For Taiwan (NT$ per kg. or as indicated)

(Sugarcane) Index: 1970=100

	1970		1972		1974		1976	
	Amt.	Index	Amt.	Index	Amt.	Index	Amt.	Index
(1) Gross output at actual market prices	6.446	100.00	6.909	107.18	7.866	122.03	8.186	126.99
(2) Tradable inputs, at actual market prices	0.830	100.00	0.655	78.92	1.354	163.13	1.821	219.40
(3) Value added, in actual prices, (1)−(2)	5.616	100.00	6.254	111.36	6.512	115.95	6.365	113.34
(4) Factor costs, other than capital, at actual market prices	1.982	100.00	2.595	130.93	4.722	238.24	4.176	210.70
(5) Indirect taxes	0.049	100.00	0.025	51.02	0.077	157.14	0.126	257.14
(6) Private profitability, (3)−(4)−(5)	3.584	100.00	3.633	101.37	1.714	47.82	2.063	57.56
(7) Gross output, at world market prices	4.432	100.00	6.854	154.65	20.664	466.25	9.750	219.99
(8) Tradable inputs, at market prices	0.671	100.00	0.594	88.52	2.005	298.81	1.754	261.40
(9) Value added in world market prices, (7)−(8)	3.761	100.00	6.260	166.45	18.659	496.12	7.996	212.60
(10) Domestic resource costs other than capital, at opportunity costs	1.982	100.00	2.595	130.93	4.722	238.24	4.176	210.70
(11) Social profitability, (9)−(10)	1.779	100.00	3.664	205.96	13.937	783.42	3.820	214.73
(12) Domestic capital costs, at opportunity costs	0.784	100.00	0.925	117.98	1.520	193.88	1.370	174.74
(13) Net social profitability, at official exchange rate, (11)−(12)	0.995	100.00	2.739	275.28	12.417	1,247.94	2.450	246.23
(14) Ratio of shadow price of foreign exchange (SPFX) to official exchange rate (OER)	1.020	100.00	1.052	103.14	1.035	101.47	1.057	103.63
(15) Net social profitability, at shadow price of foreign exchange, (9)×(14)−[(10)+(12)]	1.070	100.00	3.065	286.45	13.070	1,221.50	2.906	271.59
(16) Nominal protective coefficient on output (NPCO), (1)÷(7)	1.454	100.00	1.008	69.33	0.381	26.20	0.840	57.77
(17) Nominal protective coefficient on tradable input (NPCI), (2)÷(8)	1.238	100.00	1.103	89.10	0.675	54.52	1.038	83.84
(18) Effective protective coefficient on value added (EPC), (3)÷(9)	1.493	100.00	0.999	66.91	0.349	23.38	0.796	53.32
(19) Domestic resource cost coefficient (DRC Coef.), [(10)+(12)]÷(9)	0.735	100.00	0.562	76.46	0.335	45.58	0.694	94.42
(20) Ratio of DRC to SPFX/OER, (19)÷(14)	0.721	100.00	0.535	74.20	0.323	44.80	0.656	90.98
(21) Yield (Kilograms of raw sugar* per hectare)	10,463.200	100.00	10,828.000	103.49	10,486.600	100.22	12,141.800	116.04

* conversion ratio
sugarcane: raw sugar=10:1

Table 5. Costs and Return Data and Indicators For Taiwan (NT$ per kg. or as indicated)

(Banana)

Index: 1970=100

	1970		1972		1974		1976	
	Amt.	Index	Amt.	Index	Amt.	Index	Amt.	Index
(1) Gross output at actual market prices	3.184	100.00	2.944	92.46	4.436	139.32	8.429	264.73
(2) Tradable inputs, at actual market prices	0.413	100.00	0.164	39.71	0.324	78.45	0.506	122.52
(3) Value added, in actual prices, (1)−(2)	2.771	100.00	2.780	100.32	4.112	148.39	7.923	285.93
(4) Factor costs, other than capital, at actual market prices	1.293	100.00	1.120	86.62	1.465	113.30	2.367	183.06
(5) Indirect taxes	0.038	100.00	0.022	57.89	0.047	123.68	0.047	123.68
(6) Private profitability, (3)−(4)−(5)	1.440	100.00	1.638	113.75	2.601	180.63	5.509	382.57
(7) Gross output at world market prices	5.862	100.00	5.261	89.75	5.182	88.40	6.412	109.38
(8) Tradable inputs, at world market prices	0.278	100.00	0.118	42.45	0.331	119.06	0.407	146.40
(9) Value added in world market prices, (7)−(8)	5.584	100.00	5.143	92.10	4.851	86.87	6.005	107.54
(10) Domestic resource costs other than capital, at opportunity costs	1.293	100.00	1.120	86.62	1.465	113.30	2.367	183.06
(11) Social profitability, (9)−(10)	4.290	100.00	4.023	93.78	3.387	78.95	3.637	84.78
(12) Domestic capital costs, at opportunity costs	0.700	100.00	0.638	91.14	0.533	76.14	1.002	143.14
(13) Net social profitability at official exchange rate, (11)−(12)	3.591	100.00	3.384	94.24	2.853	79.45	2.635	73.38
(14) Ratio of shadow price of foreign exchange (SPFX) to official exchange rate (OER)	1.020	100.00	1.052	103.14	1.035	101.47	1.057	103.63
(15) Net social profitability, at shadow price of foreign exchange, (9)×(14)−[(10)+(12)]	3.702	100.00	3.650	98.65	3.023	81.66	2.977	80.42
(16) Nominal protective coefficient on output (NPCO), (1)÷(7)	0.543	100.00	0.560	103.13	0.856	157.64	1.315	242.17
(17) Nominal protective coefficient on tradable input (NPCI), (2)÷(8)	1.484	100.00	1.390	93.67	0.979	65.97	1.241	83.63
(18) Effective protective coefficient on value added (EPC), (3)÷(9)	0.496	100.00	0.541	109.07	0.848	170.97	1.320	266.13
(19) Domestic resource cost coefficient (DRC Coef.), [(10)+(12)]÷(9)	0.357	100.00	0.342	95.80	0.412	115.41	0.561	157.14
(20) Ratio of DRC to SPFX/OER, (19)÷(14)	0.350	100.00	0.325	92.86	0.398	113.71	0.531	151.71
(21) Yield (Kilograms of raw products per hectare)	25,473.000	100.00	31,680.000	124.37	36,809.000	144.50	28,774.000	112.96

cane farmers the needed raw materials at a low price in order to reduce sugar production costs. This has greatly boosted Taiwan's position in the world sugar market. Taiwan also reduced banana acreage and yield in order to expand the production of other main food crops. Although in the world markets fluctuations in the prices of sugar and bananas are frequent, farmers are still attracted by prices in the world market. Sometimes, the farmers benefit immensely from very high prices in the world market which result in increased contract prices.

In recent years, however, sugar and bananas exports are subjected to strict quotas imposed by importing countries and enjoy no preferential treatment. This has generated serious problems in foreign trade. Production must be geared to world market demand. Too much production usually results in lowered domestic prices. Thus high world market prices may not give farmers a comparative advantage for the production of these two crops. As we see from the tables, the nominal protective coefficient on output (NPCO) are less than 1 in most years. Because of this the negative protection can be understood.

Corn and Soybeans

Costs and return data for corn and soybeans are presented in Table 6 and Table 7 respectively.

As mentioned in the previous section, the government has no intention of fully satisfying the domestic demand for corn and soybeans with local production. On the policy level, recommendations as to how much should be produced locally and their impact on production should take into consideration efficiency criteria and aim to acheive reduced dependency on foreign sources of corn and soybeans supplies, which can not be considered entirely from the economic point of view. Indicators of comparative advantage may be of reference value only but can not serve as the main factors in policy decision-making.

Tables 6 and 7 reveal that the comparative advantage in corn and soybean production, as measured by the DRC coefficient, was good in 1970 for corn and good in 1972 for soybeans only. The other years covered by this study witnessed only comparative disadvantages for the production of both corn and soybeans. As can be seen from the time series data, the comparative disadvantages for corn and soybeans have worsened in recent years. However, the supply response of the grain farmer does not necessarily conform to criteria for measuring social efficiency with DRC coefficients. With government-guaranteed prices, as indicated in Tables 6 and 7, private profitability has all positive advantage every year for corn and soybean production. The production profit has ranged from NT$0.710 to NT$1.095 per

Table 6. Costs and Return Data and Indicators For Taiwan (NT$ per Kg. or as Indicated)

(Cron, Winter Crop)

Index: 1970=100

	1970		1972		1974 (Spring plant)		1976	
	Amt.	Index	Amt.	Index	Amt.	Index	Amt.	Index
(1) Gross output at actual market prices	3.471	100.00	3.640	104.87	7.091	204.29	6.220	179.20
(2) Tradable inputs, at actual market prices	0.675	100.00	0.350	51.85	1.016	150.52	1.131	167.56
(3) Value added, in actual prices, (1)−(2)	2.796	100.00	3.290	117.67	6.075	217.27	5.089	182.01
(4) Factor costs, other than capital, at actual market prices	1.644	100.00	2.412	146.72	5.101	310.28	4.252	258.64
(5) Indirect taxes	0.057	100.00	0.027	47.37	0.143	250.88	0.128	224.56
(6) Private profitability, (3)−(4)−(5)	1.095	100.00	0.850	77.63	0.830	75.80	0.710	64.84
(7) Gross output, at world market prices	2.774	100.00	2.780	100.22	5.842	210.60	5.056	182.26
(8) Tradable inputs, at world market prices	0.459	100.00	0.298	64.92	1.046	227.89	0.948	206.54
(9) Value added in world market prices, (7)−(8)	2.315	100.00	2.482	107.21	4.796	207.17	4.108	177.45
(10) Domestic resource costs other than capital, at opportunity costs	1.644	100.00	2.412	146.72	5.101	310.28	4.252	258.64
(11) Social profitability, (9)−(10)	0.671	100.00	0.070	10.43	− 0.306	− 45.60	− 0.144	− 21.46
(12) Domestic capital costs, at opportunity costs	0.409	100.00	0.645	157.70	1.630	398.53	1.185	289.73
(13) Net social profitability, at official exchange rate, (11)−(12)	0.262	100.00	− 0.575	− 219.47	− 1.935	− 738.55	− 1.329	− 507.25
(14) Ratio of shadow price of foreign exchange (SPFX) to official exchange rate (OER)	1.020	100.00	1.052	103.14	1.035	101.47	1.057	103.63
(15) Net social profitability, at shadow price of foreign exchange, (9)×(14)−[(10)+(12)]	0.309	100.00	− 0.446	− 144.34	− 1.767	− 571.84	− 1.095	− 354.37
(16) Nominal protective coefficient on output (NPCO), (1)÷(7)	1.251	100.00	1.309	104.64	1.214	97.04	1.230	98.32
(17) Nominal protective coefficient on tradable input (NPCI), (2)÷(8)	1.471	100.00	1.176	102.53	0.971	84.66	1.192	103.92
(18) Effective protective coefficient on value added (EPC), (3)÷(9)	1.208	100.00	1.325	109.69	1.267	104.88	1.239	102.57
(19) Domestic resource costs coefficient (DRC Coef.), [(10)+(12)]÷(9)	0.887	100.00	1.232	138.90	1.403	158.17	1.324	149.27
(20) Ratio of DRC to SPFX/OER, (19)÷(14)	0.869	100.00	1.171	134.75	1.356	156.04	1.252	144.07
(21) Yield (Kilograms of raw products per hectare)	5,017.000	100.00	2,450.000	48.83	3,289.000	65.56	4,293.000	85.57

Table 7. Costs and Return Data and Indicators For Taiwan (NT$ per kg. or as indicated)

(Soybean, Winter Erop)

Index: 1970=100

	1970		1972		1974		1976	
	Amt.	Indcx	Amt.	Index	Amt.	Index	Amt.	Index
(1) Gross output at actual market prices	6.434	100.00	7.179	111.58	13.334	207.24	12.125	188.45
(2) Tradable inputs, at actual market prices	1.449	100.00	1.287	88.82	3.492	240.99	2.925	201.86
(3) Value added, in actual prices, (1)−(2)	4.985	100.00	5.892	118.19	9.842	197.43	9.200	184.55
(4) Factor costs, other than capital, at actual market prices	3.159	100.00	3.048	96.49	7.221	228.58	7.112	225.13
(5) Indirect taxes	0.097	100.00	0.131	135.05	0.325	335.05	0.336	346.39
(6) Private profitability, (3)−(4)−(5).	1.729	100.00	2.714	156.97	2.296	132.79	1.752	101.33
(7) Gross output, at world market prices	4.786	100.00	5.428	113.41	11.105	232.03	8.507	177.75
(8) Tradable inputs, at world market prices	0.961	100.00	0.815	84.81	2.764	287.62	2.009	209.05
(9) Value added in world market prices, (7)−(8)	3.825	100.00	4.613	120.60	8.341	218.07	6.498	169.88
(10) Domestic resources other than capital, at opportunity costs	3.159	100.00	3.048	96.49	7.221	228.58	7.112	225.13
(11) Social profitability, (9)−(10)	0.666	100.00	1.565	234.98	1.120	168.17	− 0.614	− 92.19
(12) Domestic capital costs, at opportunity costs	0.695	100·00	0.865	124.46	1.492	214.68	1.563	224.89
(13) Net social profitability, at official exchange rate, (11)−(12)	− 0.028	100.00	0.700	−2,500.00	− 0.372	1,328.57	− 2.177	7,775.00
(14) Ratio of shadow price of foreign exchange (SPFX) to official exchange rate (OER)	1.020	100.00	1.052	103.14	1.035	101.47	1.057	103.63
(15) Net social profitability, at shadow price of foreign exchange, (9)×(14)−[(10)+(12)]	0.048	100.00	0.940	1,958.33	− 0.080	− 166.67	− 1.807	−3,764.58
(16) Nominal protectve coefficient on output (NPCO), (1)÷(7)	1.344	100.00	1.323	98.44	1.201	89.36	1.425	106.03
(17) Nominal protective coefficient on tradable input, (NPCI) (2)÷(8)	1.507	100.00	1.579	104.78	1.263	83.81	1.456	96.62
(18) Effective protective coefficient on value added (EPC), (3)÷(9)	1.303	100.00	1.277	98.00	1.180	90.56	1.416	108.67
(19) Domestic resource cost coefficient (DRC Coef.), [(10)+(12)]÷(9)	1.007	100.00	0.848	84.21	1.045	103.77	1.335	132.57
(20) Ratio of DRC to SPFX/OER, (19)÷(14)	0.988	100.00	0.806	88.77	1.009	111.12	1.263	139.10
(21) Yield (Kilograms of raw products per hectare)	1,771.000	100.00	2,475.000	139.75	1,705.000	96.27	2,130.000	120.27

kilogram for corn and from NT$1.729 to NT$2.714 per kilogram for soybeans in recent years. As shown in ERP coefficients, all coefficients have the positive protection rate which explains government protection for domestic production in the form of an additional tax of NT$40 per ton on imported grains. The government policy of guaranteed prices and protection may do harm to resources allotment but will give farmers an additional incentive to continue producing corn and soybeans in order to realize the policy target of reducing dependence upon foreign supplies.

To sum up, as seen in Table 8, the domestic resource cost (DRC) coefficient was 0.397 for bananas, 0.656 for sugarcane, 1.054 for Ponlai rice first crop, 1.263 for soybeans, and 1.252 for corn in 1976.

It is clear that banana and sugarcane production is relatively advantageous because their DRC coefficients are below 1. Economically speaking, these two crops have a fairly low cost in terms of domestic resource cost of earning foreign exchange; they still play a very important role in agricultural exports. On the contrary, rice, soybeans and corn are clearly somewhat uneconomical because their DRC coefficients are all above 1. Particularly, the DRC coefficient of corn production appears so high that its domestic production is not profitable. The above findings serve to illustrate why the Chinese government on Taiwan has offered the farmers strong incentives in regard to both inputs and outputs to maintain rice, soybean, and corn production at desired levels.

For a comparison between NSP, DRC, and ERP each year, detailed information is presented in Table 8.

V. SENSITIVITY ANALYSIS FOR FIVE SELECTED CROPS

The estimates of the DRC elasticities in 1976 are presented in Table 9.

The DRC elasticities indicate the percentage changes in the DRC coefficients for a one percent change in each item of the relevant parameter. For example, if the DRC elasticity with respect to labor is 0.660, this result implies that a one percent increase in labor input will result in a 0.660 percent increase in DRC coefficient. Examination of these elasticities reveals the importance of each cost item relative to the maintenance of continued comparative advantage.

The cost of labor is one of the most significant cost parameters of the selected crops. The elasticities of the DRC coefficient with respect to labor range from 0.603 to 0.662 for the five selected crops, which indicate the most sensitive effect on the DRC coefficient among all cost items. Thus technological change with increase in labor productivity (or decrease in labor cost) would affect the comparative advantage of crop production.

Table 8. Indicators of Comparative Advantage

Crops	Year	NSP (SPFX)	Comparative advantage or disadvantage	DRC Coefficient (SPFX)	Comparative advantage or disadvantage	EPC = (ERP+1)	ERP
Soybean	1970	0.048	V	0.988	V	1.303	0.303
	1972	0.940	V	0.806	V	1.277	0.277
	1974	− 0.080	X	1.009	X	1.180	0.180
	1976	− 1.807	X	1.263	X	1.416	0.416
Corn	1970	0.309	V	0.869	V	1.208	0.208
	1972	− 0.446	X	1.171	X	1.325	0.325
	1974	− 1.767	X	1.356	X	1.267	0.267
	1976	− 1.095	X	1.252	X	1.239	0.239
Sugarcane	1970	1.070	V	0.721	V	1.493	0.493
	1972	3.065	V	0.535	V	0.999	−0.001
	1974	13.070	V	0.323	V	0.349	−0.651
	1976	2.006	V	0.656	V	0.796	−0.204
Banana	1970	3.702	V	0.350	V	0.496	−0.504
	1972	3.652	V	0.325	V	0.541	−0.459
	1974	3.023	V	0.398	V	0.848	−0.152
	1976	5.110	V	0.397	V	0.736	−0.264
Rice (1st crop)	1970	0.152	V	0.966	V	1.281	0.281
	1972	− 0.401	X	1.077	X	1.236	0.236
	1974	8.589	V	0.532	V	0.696	−0.304
	1976	− 0.524	X	1.054	X	1.371	0.371

NSP : Net Social Profitability
DRC Coefficient: Domestic Resources Costs Coefficient
EPC : Effective Protective Coefficient
ERP : Effective Rate of Protection (EPC=ERP+1)
SPFX : Shadow Price of Foreign Exchange Rate
V : Comparative advantage
X : Comparative disadvantage

The DRC elasticities with respect to land are similar for all the five selected crops. They range from 0.120 to 0.198. This result expresses the same level of land in the determination of comparative advantage. However, sensitivities to changes in capital vary from crop to crop and range from the most sensitive 0.314 of bananas to 0.170 of rice. Since banana production tends to be more capital-intensive than the other crops, bananas have the highest DRC elasticity. The DRC elasticities with respect to fertilizer appear less sensitive and affect comparative advantage less. Corn and rice have a higher sensitivity to changes in fertilizer application, because these two crops require more fertilizer than other crops.

Table 9. Elasticity of DRC Coefficient with Respect to Selected Crops and Selected Items in 1976

	DRC Coef. (at SPFX)	Labor (cost)	Land (rent)	Capital (cost)	Fertilizer (import price)	Yield (unit yield)	World market price
Rice (1st crop)	1.054	0.632	0.198	0.170	0.102	— 1.238	— 1.238
Sugarcane	0.656	0.603	0.150	0.247	0.043	— 1.205	— 1.205
Banana	0.397	0.614	0.129	0.314	0.033	— 1.040	— 1.040
Corn	1.252	0.662	0.120	0.218	0.134	— 1.216	— 1.216
Soybean	1.263	0.660	0.159	0.180	0.097	— 1.292	— 1.292

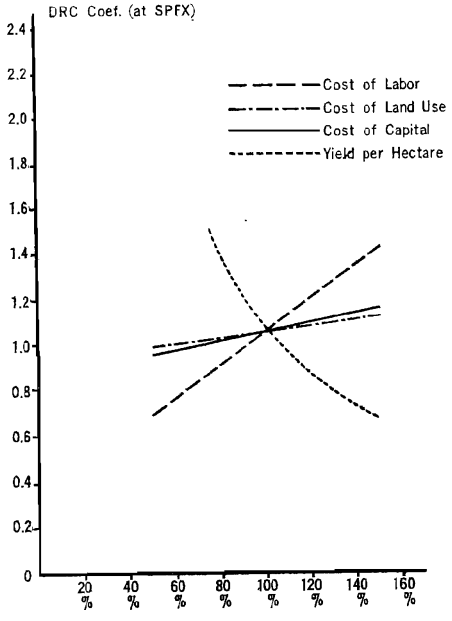
These elasticities are defined as $\frac{\triangle \text{DRC coefficient}}{\text{DRC coefficient}} \Big/ \frac{\triangle \text{i item}}{\text{i item}}$ and indicate the percentage change of the DRC cefficients for a one percent change in each item of the relevant parameter.

As can be seen from figures representing the relationship between input costs and DRC coefficients, the curves of input costs such as labor, land, capital and fertilizer have a positive slope which indicates that increase in input costs would result in increase in the DRC coefficient. Increase in production costs would therefore affect comparative advantage which in turn would affect exports or imports. The curve of yield per hectare has a negative slope, which indicates that increase in production per unit area would help reduce the DRC coefficient. All these four curves can be accepted logically.

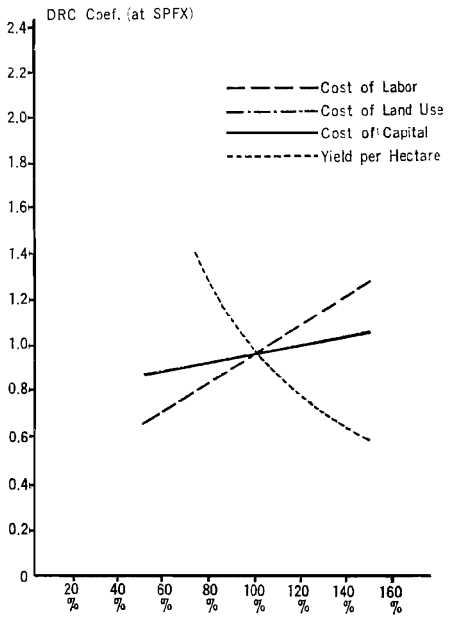
Take cost items for comparison. The curve of labor input has the highest slope among the cost items which shows the greatest sensitivity to labor input. The very significant sensitivities of labor inputs are similar for all selected crops except bananas, whose production is more capital-intensive than labor-intensive.

Since the energy and food crisis of 1973-74 affected to a great degree of Taiwan's agricultural production, data on agricultural production in 1970, 1972, 1974 and 1976 were studied for comparative analysis. As shown in figures, the slopes of the input cost curves did not show significant change in the wake of the crisis. However, there is a significant difference in the DRC coefficient. Rice, sugar and bananas have a lower DRC coefficient after the crisis. On the contrary, corn and soybeans have a higher DRC coefficient in the post-crisis period. It is clear that the energy and food crisis increased the DRC coefficient for imported goods but decreased it for exported goods. This made it more difficult for the government to maintain domestic production of corn and soybeans in competition with imported corn and soybeans, but the farmers were encouraged to expand rice, sugarcane, and banana production for export.

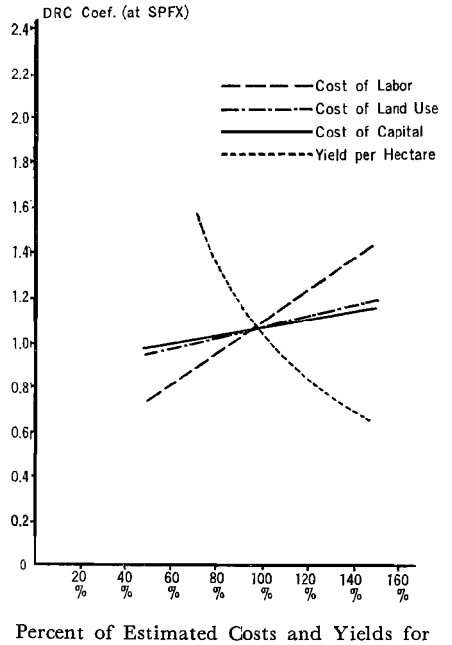
On the other hand, as shown in the attached figures, the curves represented the correlation between the world market price and the DRC coefficient. Under the



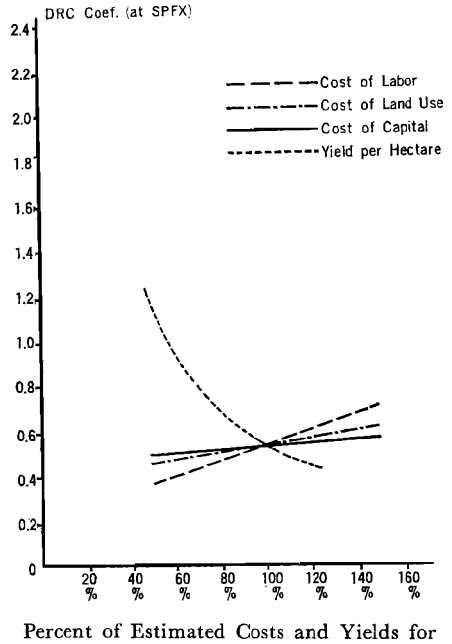
Percent of Estimated Costs and Yields for Ponlai Rice, 1st Crop, 1972



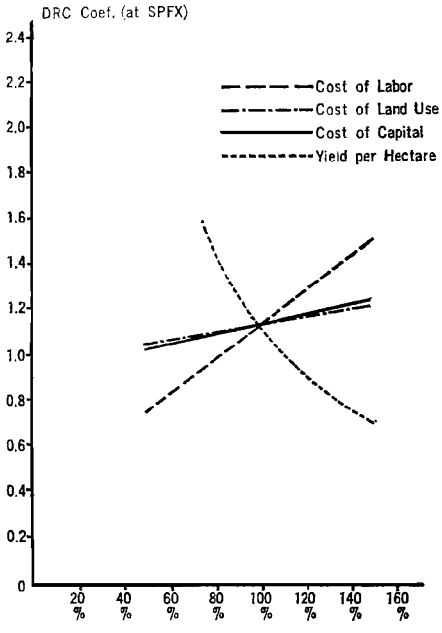
Percent of Estimated Costs and Yields for Ponlai Rice, 1st Crop, 1970



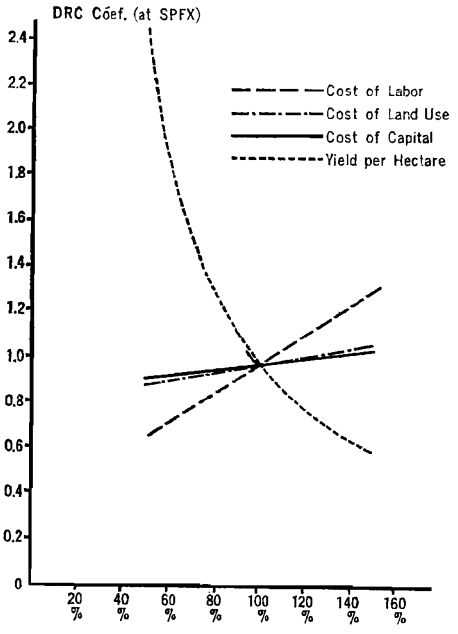
Percent of Estimated Costs and Yields for Ponlai Rice, 1st Crop, 1976



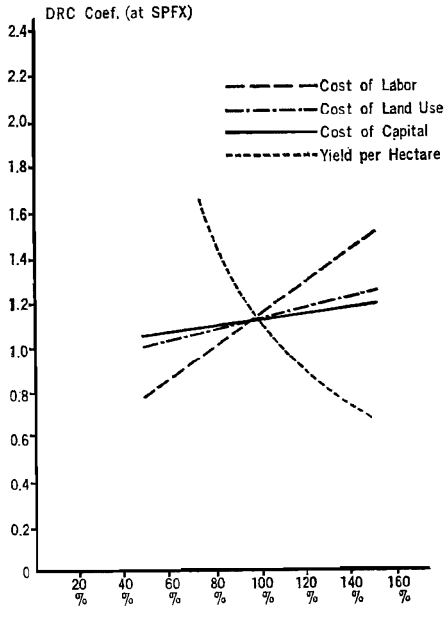
Percent of Estimated Costs and Yields for Ponlai Rice, 1st Crop, 1974



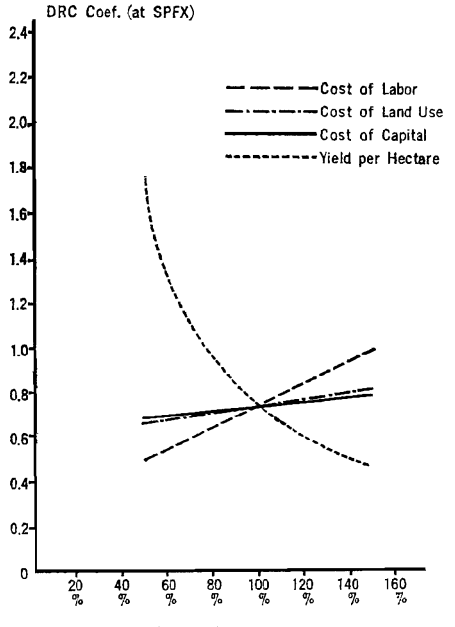
Percent of Estimated Costs and Yields for Ponlai Rice, 2nd Crop, 1972



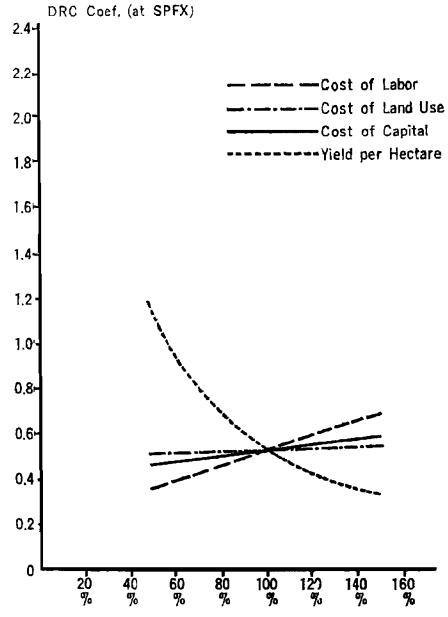
Percent of Estimated Costs and Yields for Ponlai Rice, 2nd Crop, 1970



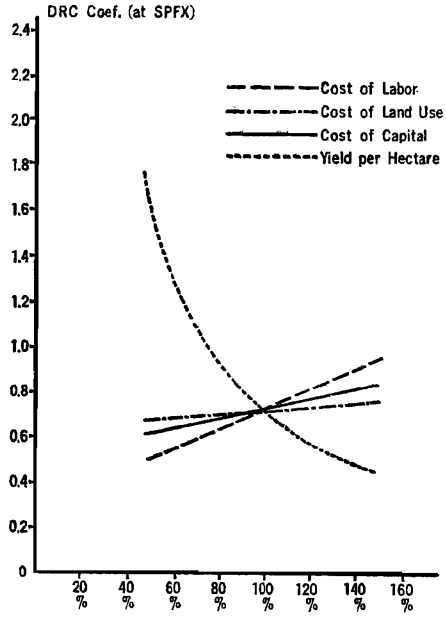
Percent of Estimated Costs and Yields for Ponlai Rice, 2nd Crop, 1976



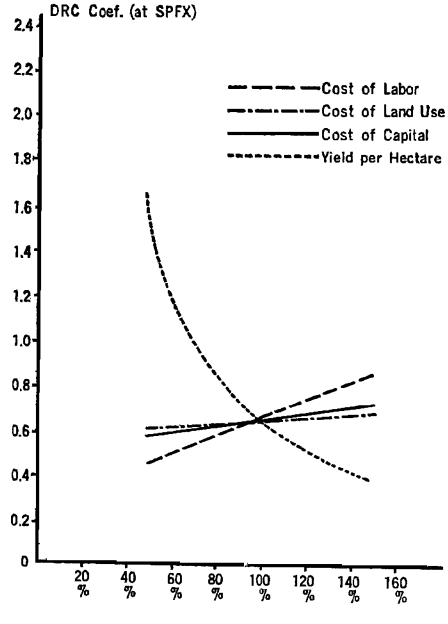
Percent of Estimated Costs and Yields for Ponlai Rice, 2nd Crop, 1974



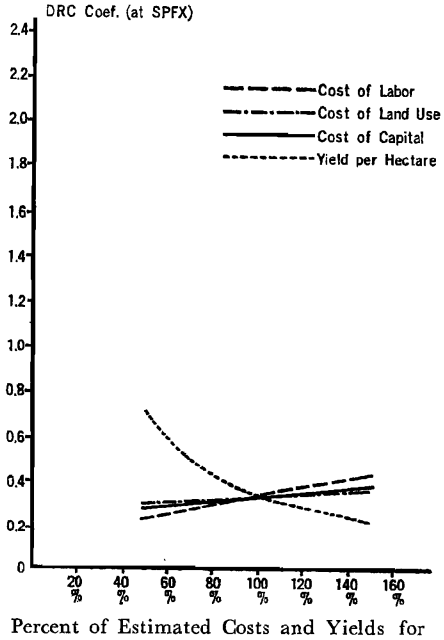
Percent of Estimated Costs and Yields for Sugarcane, 1972



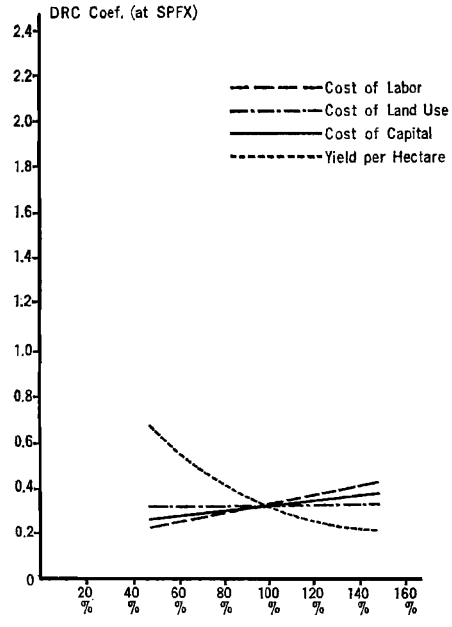
Percent of Estimated Costs and Yields for Sugarcane, 1970



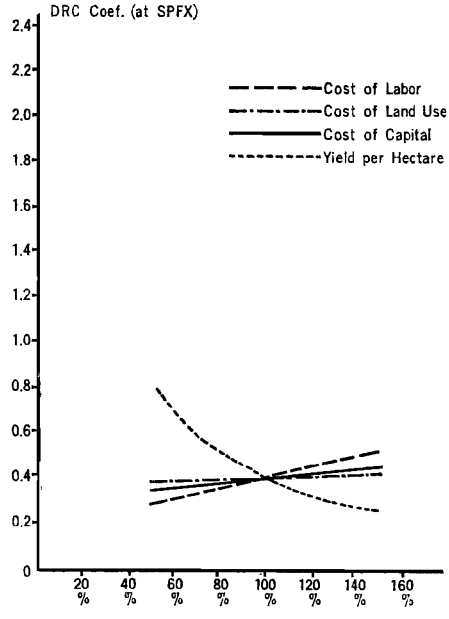
Percent of Estimated Costs and Yields for Sugarcane, 1976



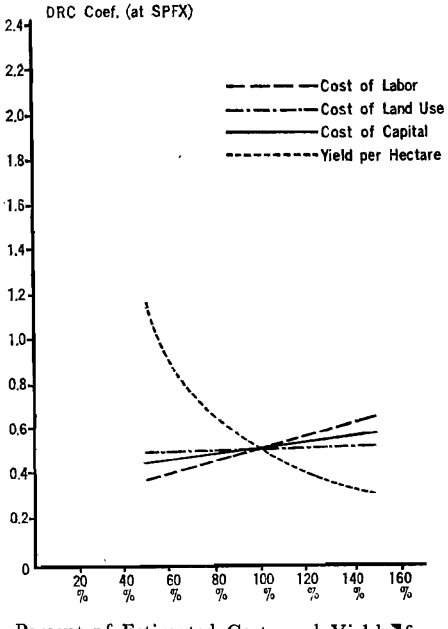
Percent of Estimated Costs and Yields for Sugarcane, 1974



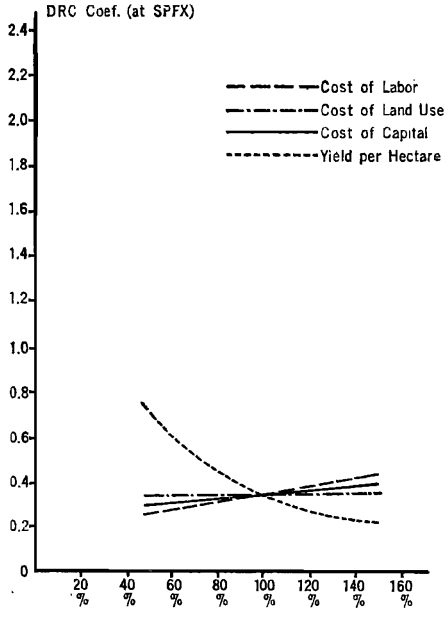
Percent of Estimated Costs and Yields for Banana, 1972



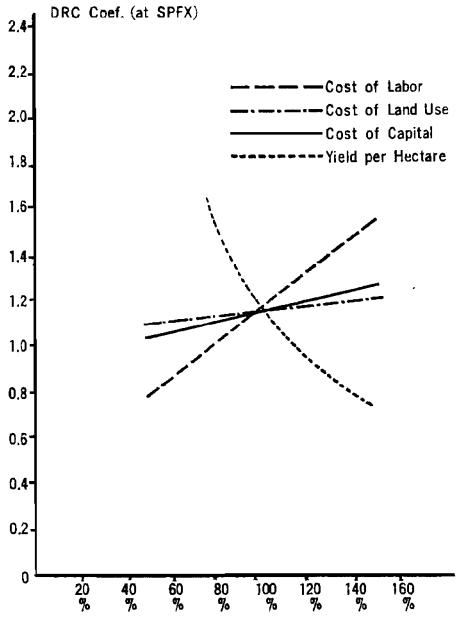
Percent of Estimated Costs and Yields for Banana, 1970



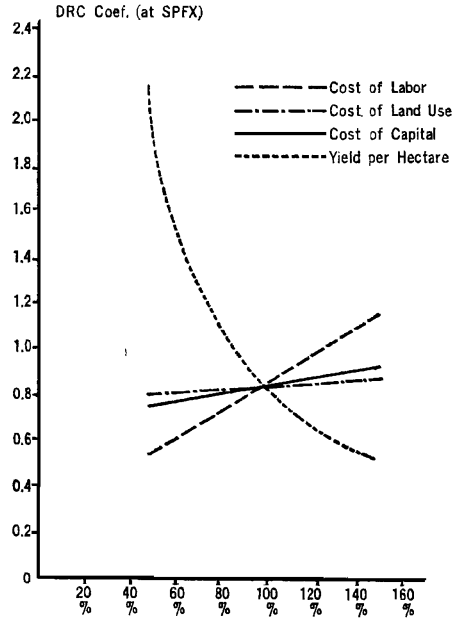
Percent of Estimated Costs and Yields for Banana, 1976



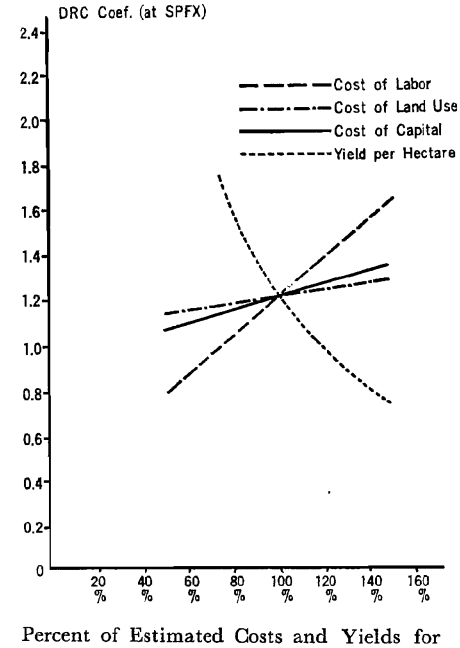
Percent of Estimated Costs and Yields for Banana, 1974



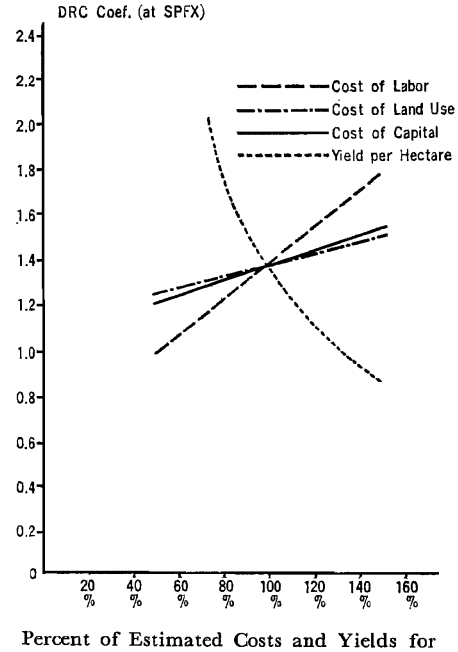
Percent of Estimated Costs and Yields for Corn, Winter Corp, 1972



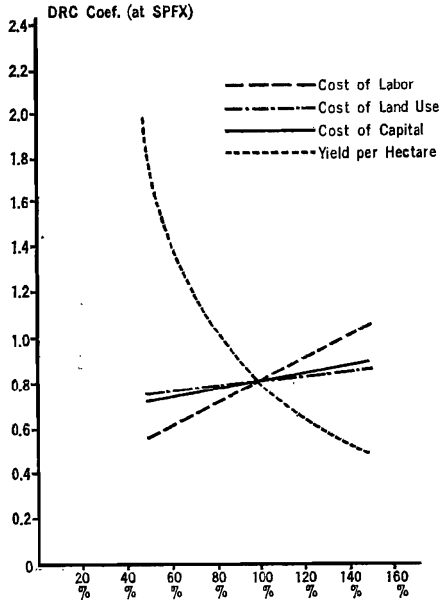
Percent of Estimated Costs and Yields for Corn, Winter Crop, 1970



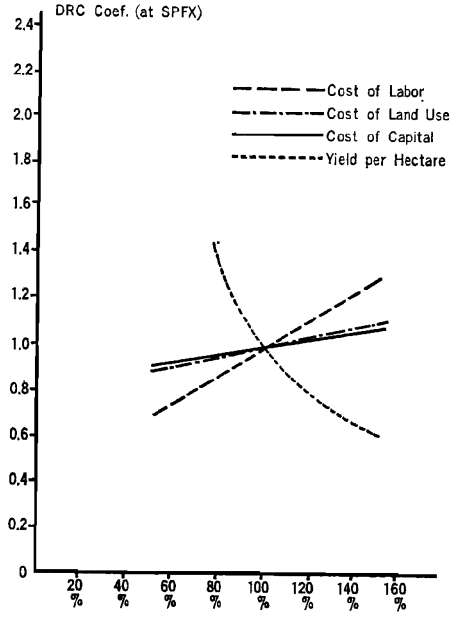
Percent of Estimated Costs and Yields for Corn, Winter Crop, 1976



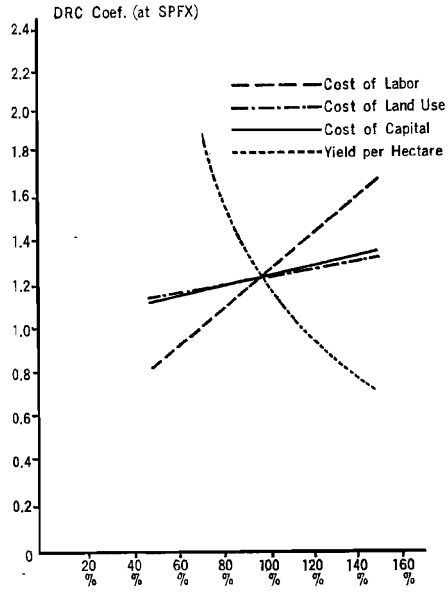
Percent of Estimated Costs and Yields for Corn, Spring Crop, 1974



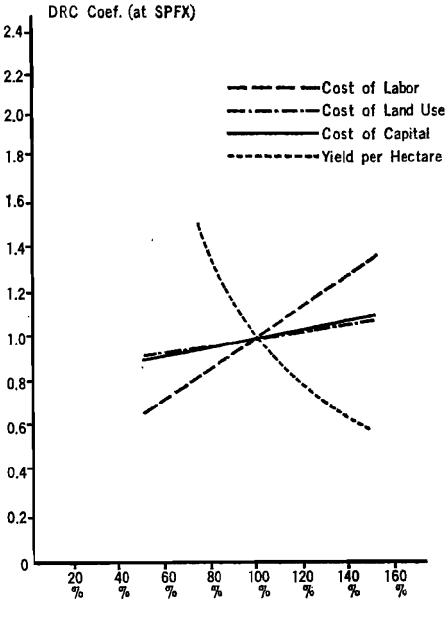
Percent of Estimated Costs and Yields for Soybean, Winter Corp, 1972



Percent of Estimated Costs and Yields for Soybean, Winter Crop, 1970



Percent of Estimated Costs and Yields for Soybean, Winter Crop, 1976



Percent of Estimated Costs and Yields for Soybean, Winter Corp, 1974

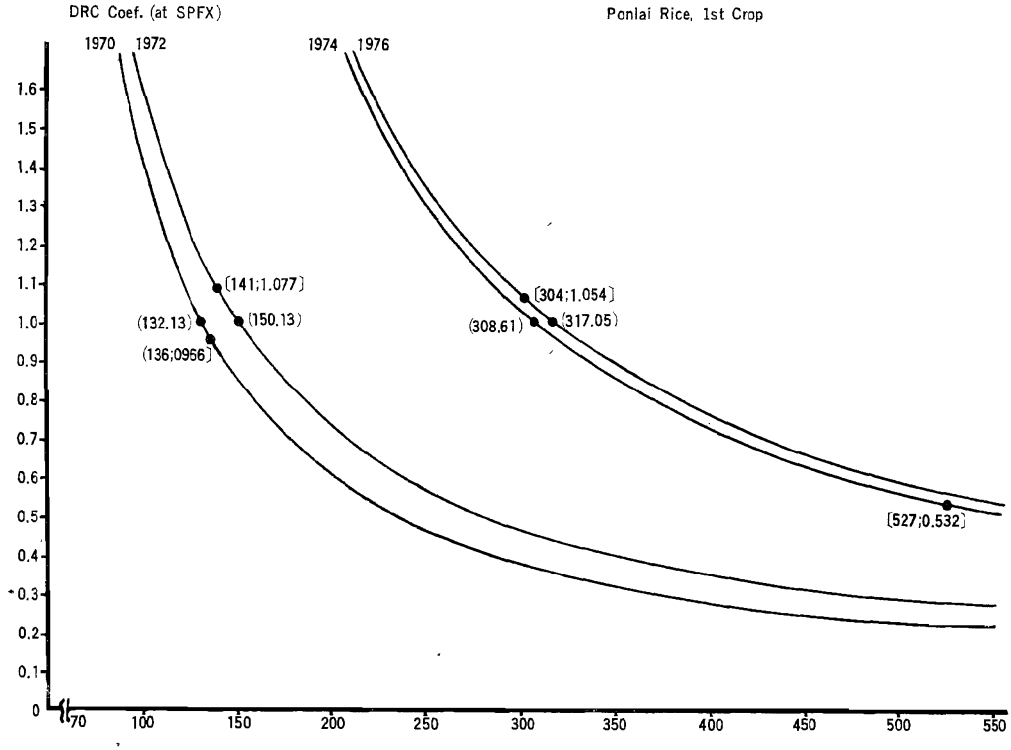
impact of the energy and food crisis, the curves of rice, sugarcane, corn, and soybeans showed a great move from right to left during the 1970-72 and 1974-76 periods. These significant changes show that the comparative advantage of these four crops has been worse off since the crisis. For these four crops, prices on the world market in 1974 and 1976 were almost double those in 1970 and 1972. Only bananas did not experience a great alteration between the 1970-72 and 1974-76 periods. However, the world market prices of rice and sugar have increased more than enough to cover increase in domestic resource cost after the crisis so that rice and sugar exports had become more profitable than before the crisis. But the competitiveness of corn and soybeans had declined following the energy crisis because the rising world market prices could not cover the increase of domestic resource cost and this has brought about comparative disadvantage for these two crops.

As 1972 and 1974 respectively represented the periods before and after the energy crisis, their curves are taken for comparison. In 1972, the world market price was US$141 per ton for both rice crops and the DRC coefficients were 1.077 and 1.134 for both crops respectively. In 1974, the rice price in the world market rose to US$527 per ton and the DRC coefficients fell to 0.532 and 0.731 for the first and second crops respectively. Obviously, after the crisis rice improved its standing from international comparative disadvantage to international comparative advantage.

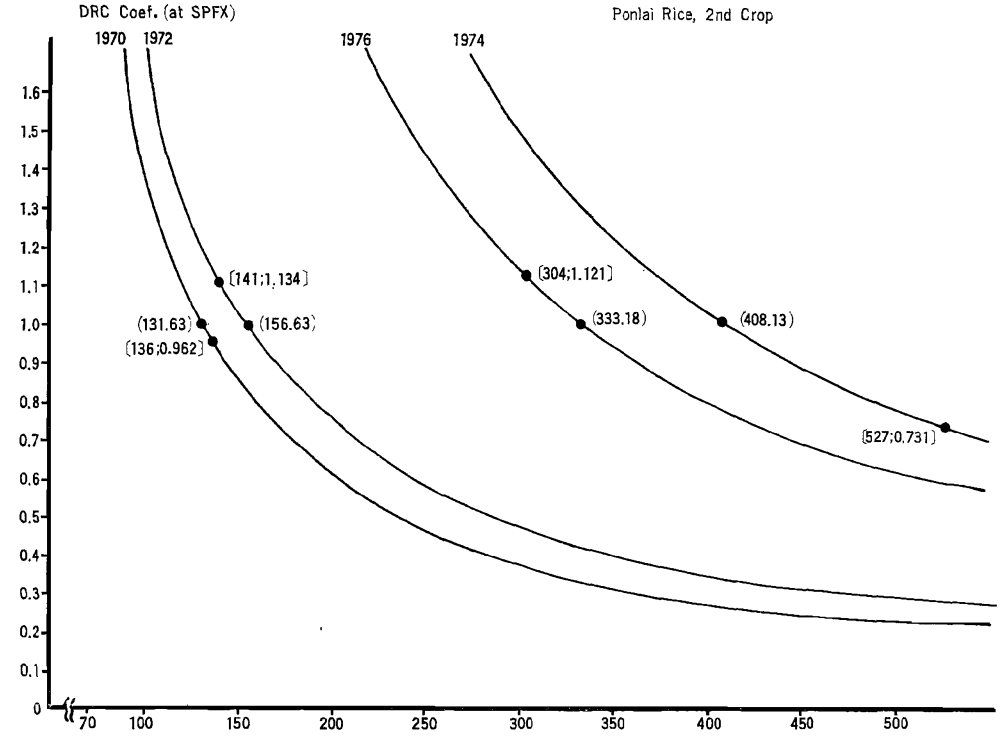
Sugarcane and bananas enjoyed international comparative advantage in both 1972 and 1974. As shown in the figures, the world market prices in 1972 were US$171 per ton and US$132 per ton for sugar and bananas respectively. The corresponding DRC coefficients were 0.535 and 0.325 for sugar and bananas respectively. In 1974, the situation remained about the same, this indicated that the DRC coefficient of 0.323 corresponded to the world market price of US$544 per ton for sugar, and the DRC coefficient of 0.398 corresponded to the world market price of US$136 per ton for bananas. Thus both before the crisis and after the crisis, sugarcane and bananas had international comparative advantage.

The 1972 world market price of corn was US$70 per ton, with DRC coefficient of 1.17. In 1974, the corresponding figures were US$154 per ton for the world market price and 1.356 for the DRC coefficient. This clearly indicates that both before and after the crisis corn had no international comparative advantage at all. And after the crisis, the situation was worse off.

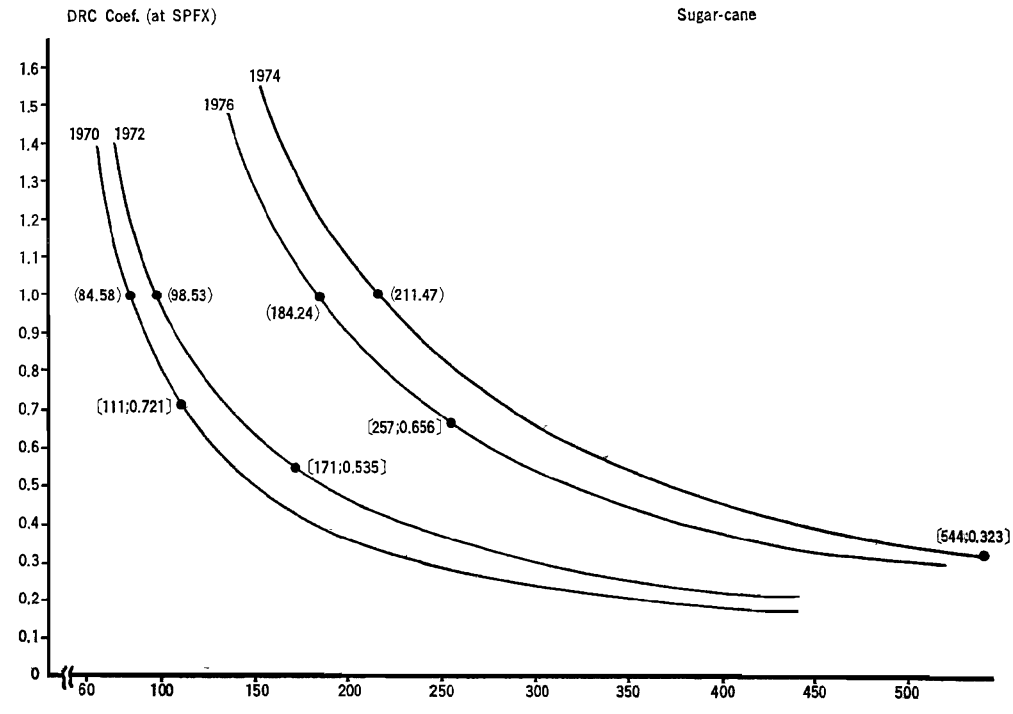
As to soybeans, in 1972 the world market price was US$136 per ton and the DRC coefficient was 0.806. The soybean lost its international comparative advan-



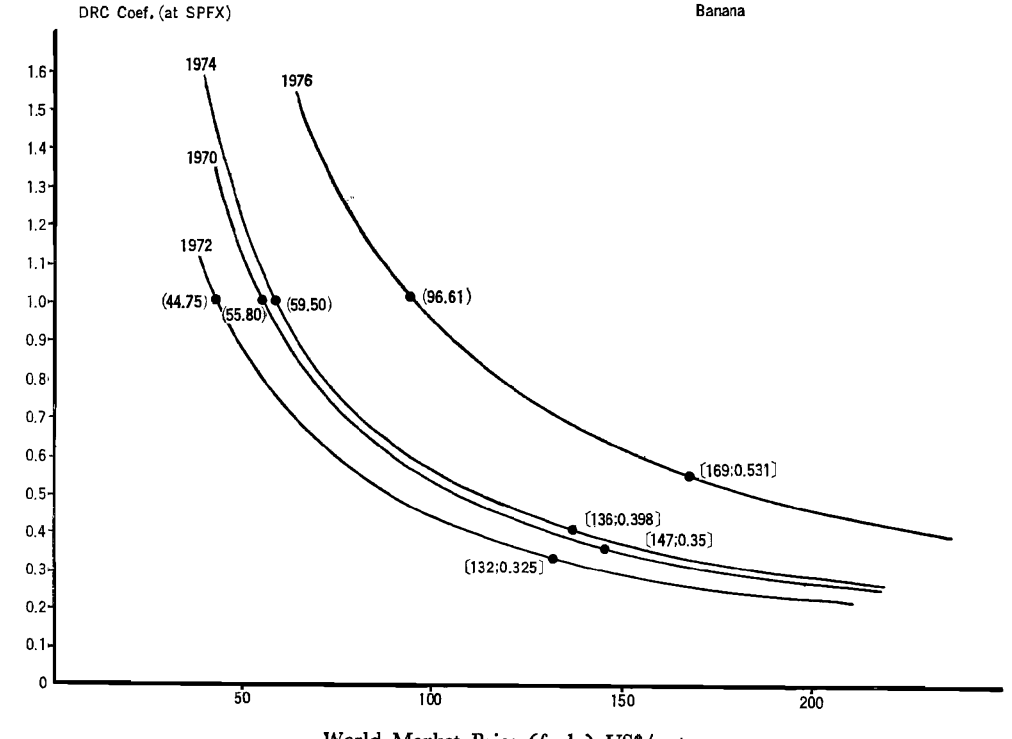
World Market Price (f.o.b.) US$/m.t.



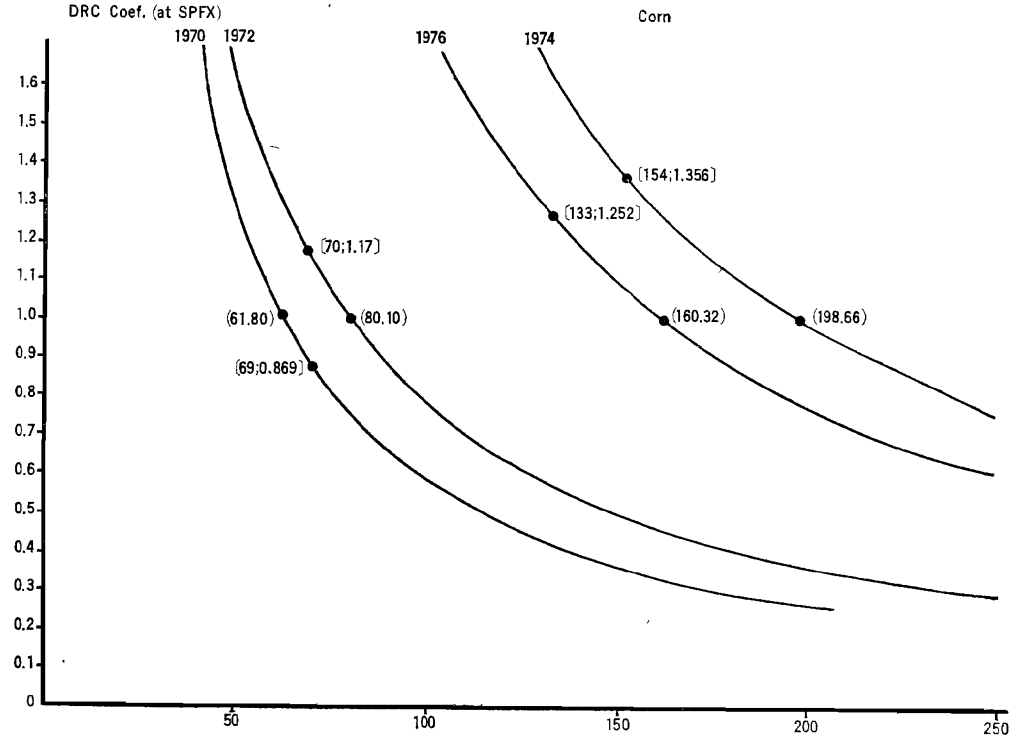
World Market Price (f.o.b.) US$/m.t.

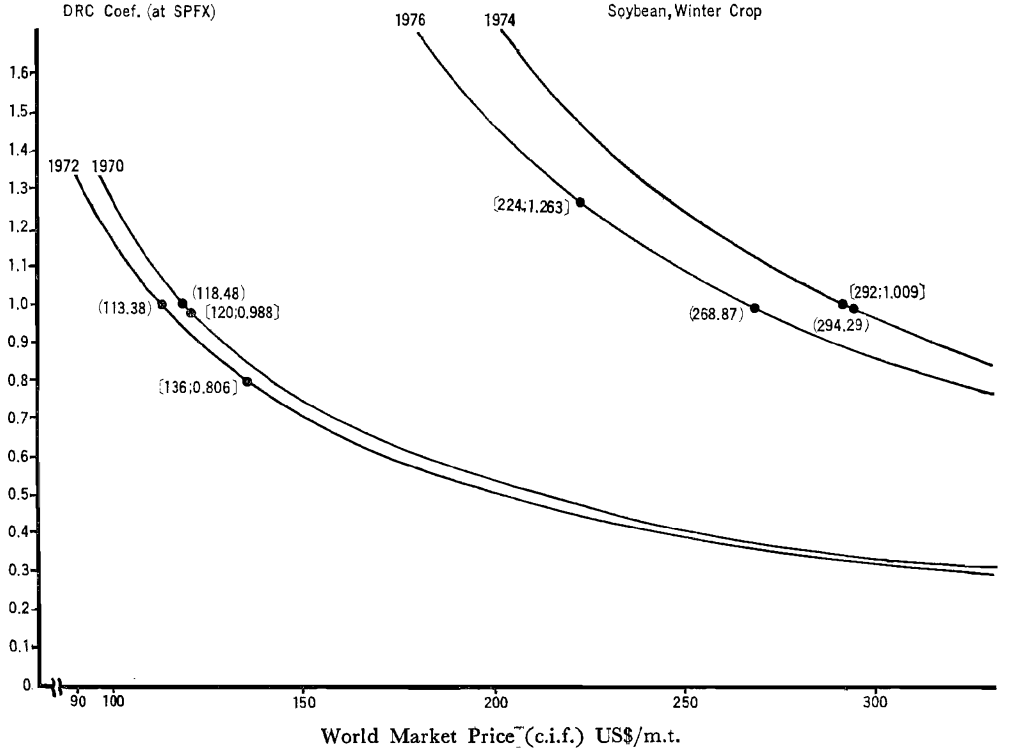


World Market Price (f.o.b.) US$/m.t.



World Market Price (f.o.b.) US$/m.t.


DRC Coef. (at SPFX)
Corn
1970
1972
1976
1974
(154;1.356)
(133;1.252)
(70;1.17)
(61.80)
(80.10)
(160.32)
(198.66)
(69;0.869)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
200
250
World Market Price (c.i.f.) US$/m.t.


DRC Coef. (at SPFX)
Soybean, Winter Crop
1976
1974
1972
1970
(224;1.263)
(292;1.009)
(268.87)
(294.29)
(118.48)
(113.38)
(120;0.988)
(136;0.806)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
90
100
150
200
250
300
World Market Price (c.i.f.) US$/m.t.

tage in 1974 when the world market price was US$292 per ton and the DRC coefficient was 1.009.

VI. AGRICULTURAL INCENTIVES AND EMPLOYMENT

In recent years agricultural employment has been greatly imfluenced by the national economic development. Generally speaking, the expansion of the industrial sector absorbs a great deal of farm labor, and the agricultural labor input decreases as economic development continues. Farming has gradually changed from labor-intensive to capital-intensive.

As indicated in Table 10, from 1970 to 1976, the labor input of each crop decreased while its capital input expanded.

Table 10. Change in Labor/Capital Ratio

Unit: per hectare

Activity and Year		(1) Direct Labor Use (man-days)	(2) Capital NT$	(3) (1)/(2) %	Change in Labor Capital Ratio
Soybean	1970	96.33	3,683.59	2.62	—
	1972	75.75	5,557.73	1.36	− 1.26
	1974	70.80	8,828.61	0.80	− 0.56
	1976	58.80	9,536.85	0.62	− 0.18
Corn	1970	119.98	6,917.39	1.73	—
	1972	67.90	3,504.19	1.94	0.21
	1974	90.43	11,742.04	0.77	− 1.17
	1976	67.93	14,309.39	0.47	− 0.30
Ponlai Rice, 1st Crop	1970	114.10	8,061.07	1.42	—
	1972	101.85	7,989.10	1.27	− 0.15
	1974	89.40	15,261.62	0.59	− 0.68
	1976	75.28	17,903.53	0.42	− 0.17
Ponlai Rice, 2nd Crop	1970	110.40	7,454.45	1.48	—
	1972	100.30	8,121.24	1.24	− 0.24
	1974	86.96	14,926.71	0.58	− 0.66
	1976	77.77	15,929.47	0.49	− 0.09
Sugarcane	1970	266.48	21,527.17	1.24	—
	1972	249.50	25,325.66	0.99	− 0.25
	1974	210.41	49,972.55	0.42	− 0.57
	1976	154.55	51,662.16	0.30	− 0.12
Banana	1970	340.50	38,985.02	0.87	—
	1972	303.55	38,312.44	0.79	− 0.08
	1974	277.42	46,206.58	0.60	− 0.19
	1976	225.84	60,532.32	0.37	− 0.23

The per-hectare labor input for the first rice crop fell from 114.1 mandays in 1970 to 75.3 man-days in 1976, while for the second crop it dropped from 110.4 man-days to 77.8 man-days. In the same period, the per hectare labor input for sugarcane decreased from 266.5 man-days to 154.6 man-days, for bananas from 340.5 man-days to 225.8 man-days, for corn from 119.8 man-days to 67.9 man-days, and for soybeans from 96.3 man-days to 58.8 man-days. On the contrary, the per hectare capital input for the first and second crops rose from NT$8,061 in 1970 to NT$17,903 in 1976 and NT$7,454 in 1970 to NT$15,929 in 1976 respectively. During the same period, the per hectare capital input for other crops also increased from NT$21,527 to NT$51,662 for sugarcane, from NT$38,985 to NT$60,532 for bananas, from NT$6,917 to NT$14,309 for corn and from NT$3,684 to NT$9,537 for soybeans. Obviously, the rapid expansion of industry and the accompanying high labor absorption have not only pushed up the relative share of capital input, but brought about application of more capital in substitution for labor. The labor/capital ratio has been on the decrease.

Table 11 represents the factor share of value added.

Table 11. Change in Labor and Capital Share of Value Added

Activity and Year		Value of Output (1)	Cost of Intermediate Input (2)	Value Added (1)−(2)=(3)	Factor Share of Value Added			
					Labor		Capital	
					%	Value	%	Value
Soybean	1970	8,476.01	3,526.53	4,949.48	48.0	2,375.75	52.0	2,573.73
	1972	13,424.30	5,352.88	8,081.42	45.4	3,668.96	54.6	4,412.46
	1974	18,934.03	8,457.82	10,476.21	48.5	5,080.96	51.5	5,395.25
	1976	18,119.91	9,113.61	9,006.30	51.9	4,674.27	48.1	4,332.03
Corn	1970	13,917.16	6,632.76	7,284.40	40.4	2,942.90	59.6	4,341.50
	1972	6,811.00	3,325.79	3,485.21	52.0	1,812.31	48.0	1,672.90
	1974	19,214.34	11,091.49	8,122.85	45.3	3,679.65	54.7	4,443.20
	1976	21,705.41	12,737.61	8,967.80	41.8	3,748.54	58.2	5,219.26
Ponlai Rice 1st Crop	1970	17,261.37	7,752.65	9,508.72	44.8	4,259.91	55.2	5,248.81
	1972	17,461.56	7,589.12	9,872.44	53.3	5,262.01	46.7	4,610.43
	1974	63,309.80	14,326.21	48,983.59	50.1	24,540.78	49.9	24,442.81
	1976	38,735.01	17,070.84	21,664.17	49.5	10,723.76	50.5	10,940.41
Ponlai Rice 2nd Crop	1970	17,156.44	7,141.93	10,014.51	48.5	4,857.04	51.5	5,157.47
	1972	17,011.64	7,714.41	9,297.23	52.9	4,918.23	47.1	4,379.00
	1974	46,584.68	13,996.83	32,587.85	52.6	17,141.21	47.4	15,446.64
	1976	35,747.43	15,153.38	20,594.05	52.7	10,853.06	47.3	9,740.99
Sugarcane	1970	46,372.02	19,060.25	27,311.77	33.1	9,040.20	66.9	18,271.57
	1972	74,216.48	22,615.11	51,601.37	37.9	19,556.92	62.1	32,044.45
	1974	216,695.10	44,402.47	172,292.63	33.2	57,201.15	66.8	115,091.48
	1976	118,382.55	45,852.02	72,530.53	34.2	24,805.44	65.8	47,725.09
Banana	1970	149,322.73	35,850.09	113,472.65	24.5	27,800.80	75.5	85,671.85
	1972	166,668.48	34,739.11	131,929.37	30.5	40,238.46	69.5	91,690.91
	1974	190,744.24	41,251.23	149,493.01	39.1	48,451.77	60.9	91,041.24
	1976	242,536.05	54,606.54	187,929.51	37.5	70,473.57	62.5	117,455.94

As indicated, the labor share of the value added of each crop showed a slight increasing trend in the period under review. As described above, the labor input for each crop fell substantially and increase in the labor share of the value added was greatly affected by drastically rising wage rates. Compared with the labor share of the value added, the capital share of the value added decreased. With this characteristic of the factor share of the value added, Taiwan's farming system was still labor-intensive when the factor input was measured in monetary terms. But this would not be true in physical terms.

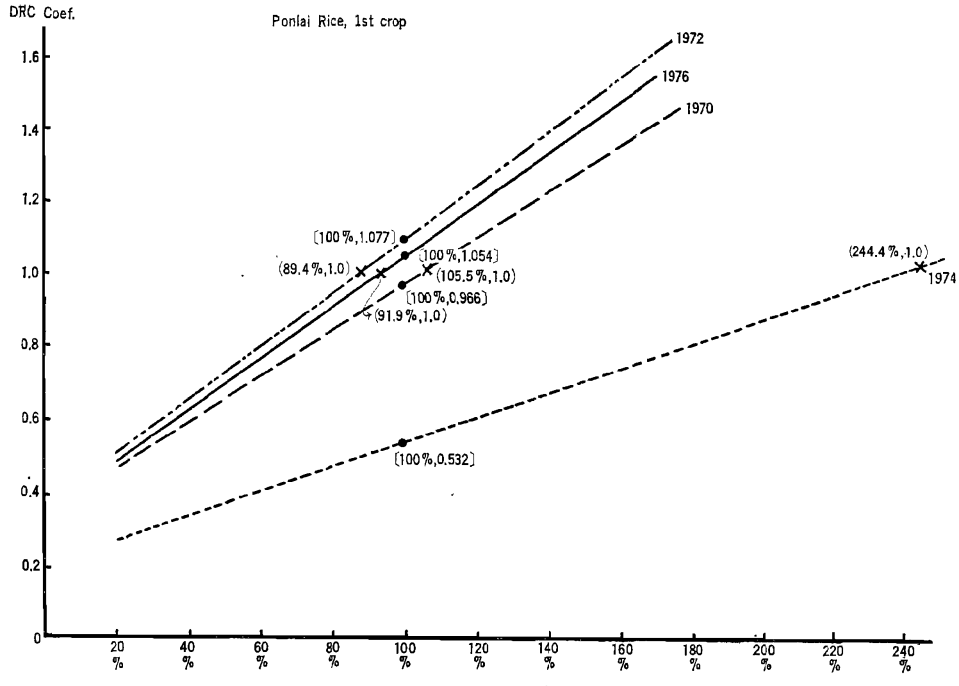
Sensitivity of the DRC coefficients to proportionate change in the labor input of each crop is represented by the attached figures in which the curves represent the correlation between labor input and DRC coefficient. It can be seen from the figures that there was a comparative advantage for both the first and second rice crops to increase the labor input up to a suitable percentage in 1970 and 1974 because the DRC coefficients in these two years were all less than 1. On the contrary, there was an excessive labor input in rice production in 1972 and 1976 when the DRC coefficients were all more than 1. This means that in 1972 and 1974 reducing the labor input until DRC coefficient were less than 1 for rice production would improve the international comparative advantage of rice.

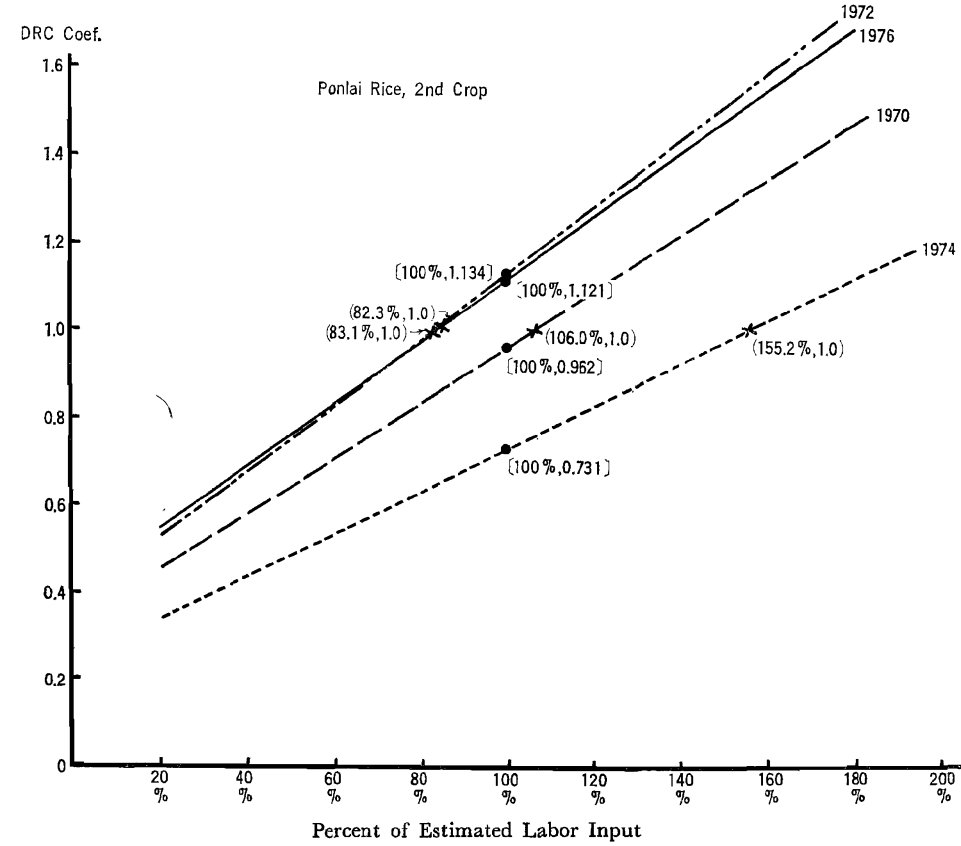
In the years studied, the labor input for both sugarcane and bananas production could be greatly raised. Take 1976 for example. An increase by 86.4 percent in the labor input for sugarcane production and by 246.1 percent in the labor input for bananas production could still leave a comparative advantage for the exports of these twe crops. It is clear the production of both sugarcane and bananas has a great potential to increase agricultural employment.

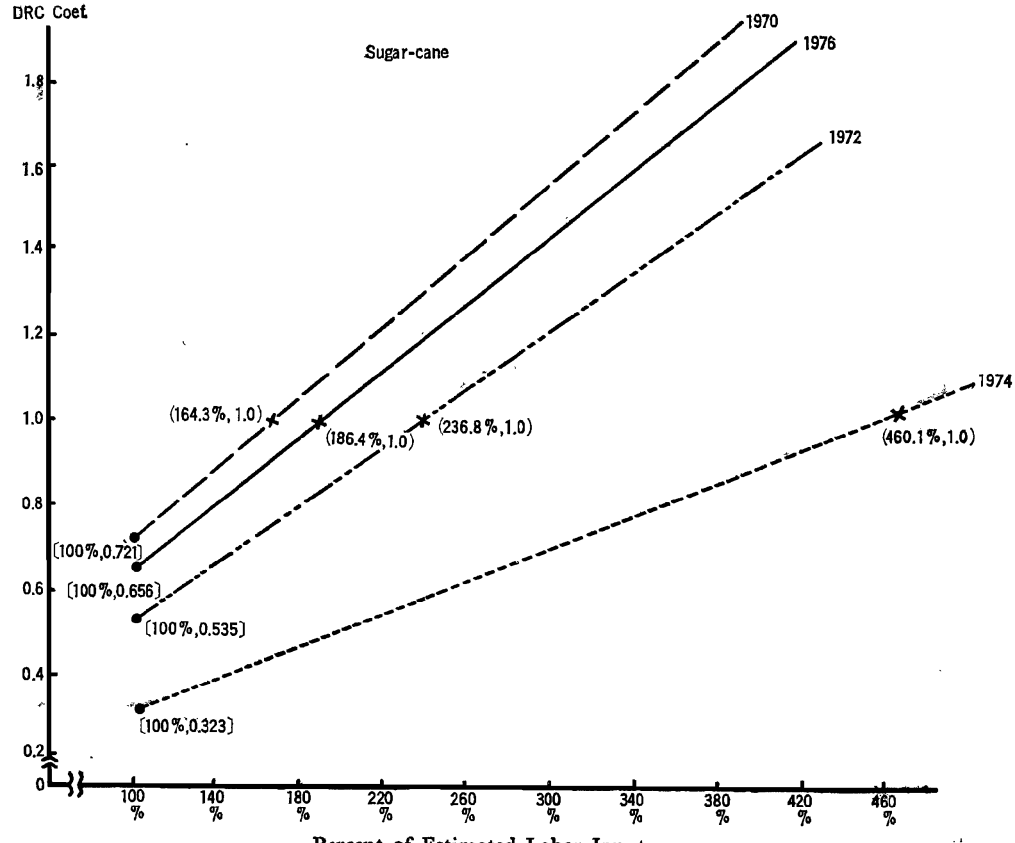
With respect to corn and soybeans, except for 1970 for both crops and 1972 for soybeans, the labor input surpassed the proper amount and this resulted in the comparative disadvantage for corn and soybean production. In 1976 for example, the labor input dropped by more than 30.1 percent for corn and 31.3 percent for soybeans and created a comparative advantage for the production of these two crops. The fact that corn and soybeans have no comparative advantage can be understood in view of the labor input for these two crops.

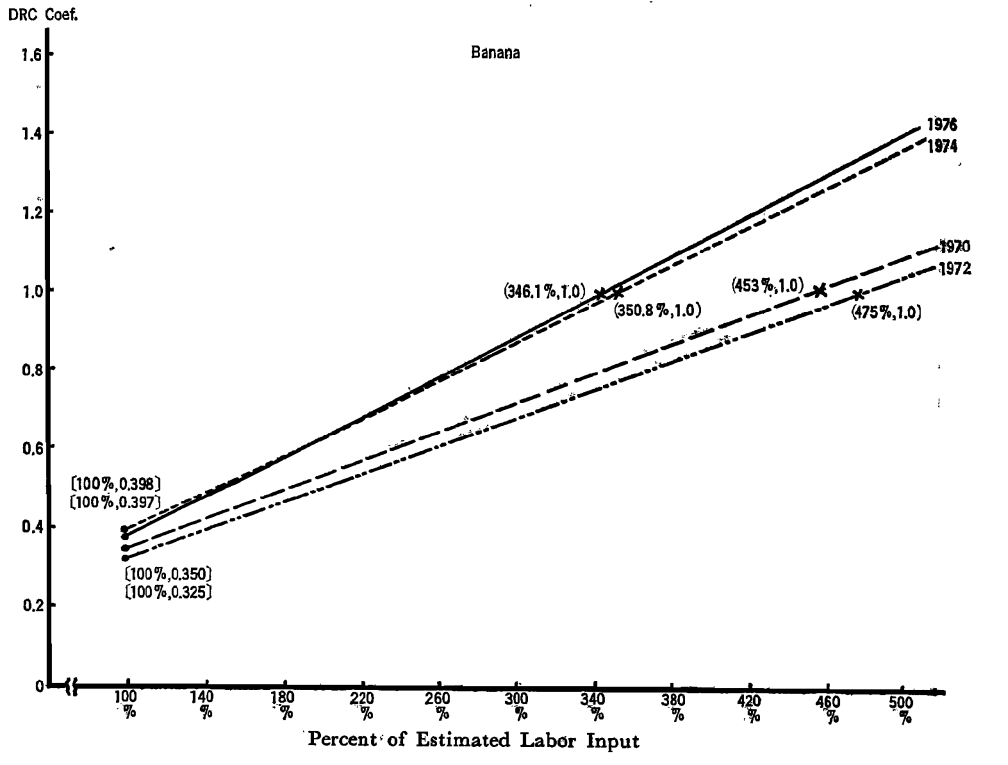
VII. SUMMARY AND CONCLUSIONS

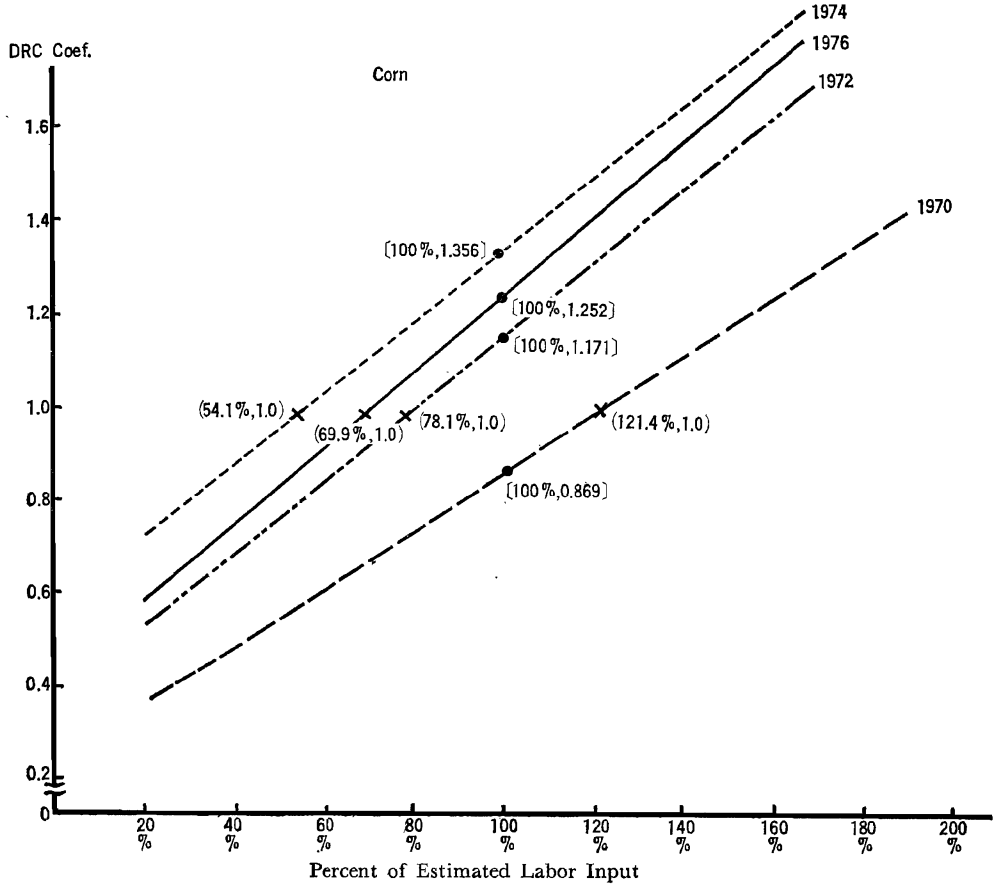
The results of this study show that the production of bananas and sugarcane has a comparative advantage because their DRC coefficients are below 1. Rice, soybeans and corn can not be produced economically because they have a DRC

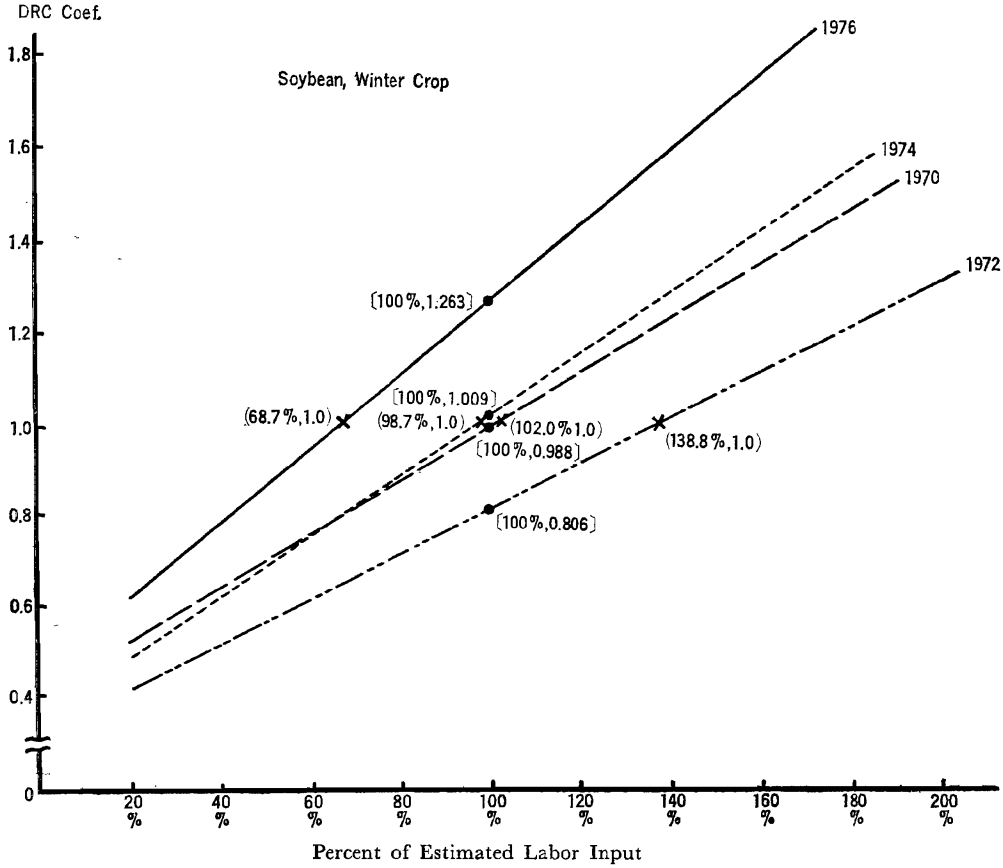

DRC Coef.
Ponlai Rice, 1st crop
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
1972
1976
1970
1974
(100%,1.077)
(100%,1.054)
(89.4%,1.0)
(105.5%,1.0)
(100%,0.966)
(91.9%,1.0)
(244.4%,1.0)
(100%,0.532)
20 %
40 %
60 %
80 %
100 %
120 %
140 %
160 %
180 %
200 %
220 %
240 %
Percent of Estimated Labor Input


DRC Coef.
Ponlai Rice, 2nd Crop
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
1972
1976
1970
1974
(100%,1.134)
(100%,1.121)
(82.3%,1.0)
(83.1%,1.0)
(106.0%,1.0)
(100%,0.962)
(155.2%,1.0)
(100%,0.731)
20 %
40 %
60 %
80 %
100 %
120 %
140 %
160 %
180 %
200 %
Percent of Estimated Labor Input


DRC Coef.
Sugar-cane
1970
1976
1972
1974
(164.3%, 1.0)
(186.4%, 1.0)
(236.8%, 1.0)
(460.1%, 1.0)
(100%, 0.721)
(100%, 0.656)
(100%, 0.535)
(100%, 0.323)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
100 %
140 %
180 %
220 %
260 %
300 %
340 %
380 %
420 %
460 %
Percent of Estimated Labor Input


DRC Coef.
Banana
1976
1974
1970
1972
(346.1%, 1.0)
(350.8%, 1.0)
(453%, 1.0)
(475%, 1.0)
(100%, 0.398)
(100%, 0.397)
(100%, 0.350)
(100%, 0.325)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
100 %
140 %
180 %
220 %
260 %
300 %
340 %
380 %
420 %
460 %
500 %
Percent of Estimated Labor Input


DRC Coef.
Corn
1974
1976
1972
1970
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
(100%,1.356)
(100%,1.252)
(100%,1.171)
(54.1%,1.0)
(69.9%,1.0)
(78.1%,1.0)
(121.4%,1.0)
(100%,0.869)
20 %
40 %
60 %
80 %
100 %
120 %
140 %
160 %
180 %
200 %
Percent of Estimated Labor Input


DRC Coef.
Soybean, Winter Crop
1976
1974
1970
1972
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0
(100%,1.263)
(100%,1.009)
(68.7%,1.0)
(98.7%,1.0)
(102.0%1.0)
(100%,0.988)
(138.8%,1.0)
(100%,0.806)
20 %
40 %
60 %
80 %
100 %
120 %
140 %
160 %
180 %
200 %
Percent of Estimated Labor Input

coefficient of greater than 1. However, the Taiwanese farmer does not necessarily conform to criteria for DRC coefficients. With government price incentives the private profitability of rice, soybeans and corn reveals only positive advantage which gives farmers an incentive to produce these three crops at desired levels. On the contrary, sugarcane and bananas are subject to relatively high negative effective rates of protection. The contract between the government and the sugarcane farmer allows the former to purchase from the latter the needed raw materials at a low price so as to reduce sugar production cost. And the government also has a policy to reduce banana acreage and yield in order to expand the production of other main food crops.

The analysis of the sensitivity of the DRC coefficients to input costs indicates that labor, land, capital and fertilizer have a positive slope which means that increase in input costs would result in a higher DRC coefficient. Increased production costs would therefore affect comparative advantage. The curve of labor input has the highest slope among the cost items which shows the greatest sensitivity to labor input.

With respect to the energy and food crisis, there was a significant difference in the DRC coefficient. Rice, sugar and bananas had a lower DRC coefficient after the crisis. On the contrary, corn and soybeans had a higher DRC coefficient in the post-crisis period. It is clear that the crisis raised the DRC coefficient for import goods but decreased it for export products. This made it more difficult for the government to maintain domestic production of corn and soybeans in competition with imported corn and soybeans, but the farmers were encouraged to expand rice, sugarcane, and banana production for export.

As we see from the curve which represented the correlation between the world market price and the DRC coefficient, the significant changes of rice, sugarcane, corn and bananas reveal that the comparative advantage of these four crops has been worse off since the crisis. Only bananas did not experience a great alteration after the crisis, because the world market price of bananas has drastically increased along with the energy crisis which made domestic production profitable.

The elasticities of the DRC coefficients with respect to labor ranged from 0.603 to 0.662 for the five selected crops, which indicate the most sensitive effect on the DRC coefficient among all cost items. Thus technological change with increased labor productivity would affect the comparative advantage of crop production.

Sensitivity of the DRC coefficients to proportionate change in the labor input of each crop indicates that a comparative advantage for both the first and second

rice crops would increase the labor input up to a suitable percentage in 1970 and 1974, because the DRC coefficient in these two years were less than 1. And there was an excessive labor input in rice production in 1972 and 1976 when the DRC coefficients were above 1.

The labor input for both sugarcane and banana production could be greatly raised. It means that the production of both sugarcane and bananas has a great potential to increase agricultural employment. The labor input of corn and soybeans surpasses the proper amount and this resulted in the comparative disadvantage for their production. Farm mechanization may be the only alternative to reducing labor costs of corn and soybean production.

Judging from the increasing trend of the DRC coefficient, agriculture tends to be a high cost industry in the future. Particularly, grain production has the highest DRC coefficient and a positive protection rate for which the government has to provide a great deal of budget in order to subsidize grain production. This increasing burden on the government will create a serious problem for future agricultural development. The critical problem we will face in the future is that whether it is worthwhile to maintain domestic grain production with a high DRC coefficient in order to secure national food supply or to import more grain from abroad and set aside some agricultural resources to produce cash crops which will make agriculture more profitable. Comparative advantage analysis produces a set of useful indicators which is of reference value but can not serve as a basis for policy-making. The final decision, however, will have to depend on the wisdom of our policy-makers.