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**The role of food aid, agricultural development  
and capital formation in economic development:**

**A case study of Taiwan**

by

**Chung-Chi Lu**

**A Dissertation Submitted to the  
Graduate Faculty in Partial Fulfillment of  
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Signature was redacted for privacy.

**In Charge of Major Work**

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## I. INTRODUCTION

### A. The Problem

An examination of the major differences in the economic structure, the institutional arrangements, and the means of production between developing and developed countries adds to our knowledge of the conditions and sources of world-wide poverty, hunger and stagnation. However, this examination does little to increase the understanding of how poverty, hunger and stagnation can be eliminated. In order to learn how to eliminate poverty, it is necessary to study the way in which economic development takes place. Economic development is best conceived as a dynamic, sequential process of expanding an economy by increasing productivity in order to raise the standard of living and general well-being of the society. Changes in one set of factors cause changes in other sets of variables, which in turn may bring about an increase in per capita income. Nor does the process end there. An increase in income can itself set off repercussions that eventually result in a further increase in income. In this respect, Mellor states that

Increased production of agricultural commodities provides the basis for increased income and capital formation in the agricultural sector. The growth of population and income which increases the demand for food, provides a favorable environment for increased agricultural production (81, p. 37).

The problems, both for those who wish to predict future per capita income accurately and for those who want to devise

policies for accelerating economic development, is to discover the key variables and relationships in the development process.

Recent development theory has been concerned with investigating the basic factors that cause economic development of agriculture in the developing nations and the ways in which increased agricultural production and productivity occur. Thus, a primary concern for the developing nations is to determine major factors contributing to economic development of agriculture under pressures of high growth of population.

In most of the developing countries, agriculture is the dominant economic sector. It is the main source of employment, foreign exchange, and food and industrial raw material. Hence, it deserves heavy weight in any development program. It also indicates that increasing agricultural output and productivity is essential to per capita income growth in today's developing nations. Heady notes that the technological advance of agriculture with the improvement of the food supply is a necessary precondition for take-off in economic development of any developing nation in the world (42, p. 32).

It is natural that in the process of economic development the rate of growth of the industrial sector, as measured by production (or employment), should be significantly faster than that of the agricultural sector. In fact there has been a great structural change away from agriculture in favour of manufacturing and other sectors in most countries. In many

countries, this shift has been slowed, because of sluggish agricultural development. A result is the rate of increase in agricultural production in general, and food supply in particular, falls short of the rate of growth of population. Unless the past rate of increase in food production can be increased substantially, net imports of food in years ahead will occur. This would involve a heavy drain on foreign exchange, a relatively scarce resource in most developing countries. Thus, the slow increase in food production may not relieve the present inadequate levels of food consumption and may create serious obstacles to general economic development.

The availability of U.S. food aid has considerably alleviated the food and foreign exchange shortages for some countries like Taiwan, Israel, and Greece. These countries achieved an outstanding records of growth and development.

The capital requirements for overall economic development are extremely large. It is only through overall economic development that the vicious circle of economic stagnation and poverty can be broken. It is generally argued that the major contribution in overall economic development is agricultural development. Hence, if agriculture is to play this important role in economic development, it requires substantial capital inputs.

According to Mellor (81, p. 82), sources of capital for economic development are foreign aid, foreign commercial

investment and domestic saving. Foreign aid in the form food aid can play a significant role in providing capital formation if it is wisely used. As argued earlier, raising productivity in agriculture requires capital. The concept of food as aid and in which food aid can be considered as extra capital available to recipient nations and therefore can be used as a means to increase agricultural productivity. Consequently, substantially increasing agricultural production is achieved. Such growth in agricultural production provides the basis for increased income, which can be taxed later, and capital formation in agriculture sector (81, p. 37).

When the island of Taiwan was returned to China at the end of World War II, it was in a state of ruins and disorganization. Infrastructural facilities suffered severe damage. Total agricultural production was down to about 45 percent of the prewar peak. Hence Taiwan was urgently in need of food and had dim prospects for agricultural self-sufficiency. Effective rehabilitation and recovery programs returned agricultural production to its prewar level by 1951. However, with widespread improvements in health and sanitation conditions during 1950's, the population began to grow at a rapid fashion (over 3.5 percent a year). Consequently, to meet growing demand, Taiwan was faced with the problem of accelerating the rate of growth of agricultural production. Greater production also was required in order to increase per

capita income, improve the standard of living of rural people, and provide capital formation for non-agricultural sectors.

Potentials for increasing agricultural production through expanding the land area under cultivation and increasing irrigated land area had been quite fully exhausted by 1945; yields thus had to be raised to meet population growth. Raising yields requires capital. This was achieved by the introduction of technological, institutional and economical factors through U.S. food aid as a source of capital.

#### B. Objectives of the Study

The major concerns of this study are the growth in Taiwan's agricultural output, the formation of capital, the means by which the increased agricultural output was attained, and the role of American food aid (U.S. surplus agricultural commodities under public law 480) in this process.

Economic growth in Taiwan has relied heavily on improvement of productivity in agriculture since World War II. American food aid has been a major factor contributing to Taiwan's rapid economic growth. American food aid accounted for 26 percent of all U.S. aid to Taiwan during the period 1951-1968. It contributed significantly to the expanded productive capacity of Taiwan's agriculture.

The specific objectives of this study are:

- (1) To examine economic development of Taiwan's agriculture since World War II and the role of the agricultural sector

in capital formation. The focus of this analysis is primarily directed toward:

- a. the process of transferring capital from the agricultural sector to the non-farm sector
  - b. a review of the past growth of Taiwan's agricultural output
  - c. capital contribution of agriculture
  - d. factors contributing the increased agricultural productivity and output in Taiwan.
- (2) To appraise and analyze the economic effects of American food aid program in aiding economic development of Taiwan's agriculture, particular attention is focused on its impact on:
- a. agricultural production
  - b. domestic prices
  - c. foreign trade and the U.S. agricultural market
  - d. balance of the payments
  - e. capital formation
  - f. economic development and growth.

This analytical study of Taiwan's agricultural development represents an effort to appraise the role of American food aid in the development of Taiwan's agriculture. It is hoped that the analysis of this study will be of some value in providing a comprehensive review of agricultural development in Taiwan since World War II. It is hoped that (a) the

results of this study will be useful in planning and implementing national programs of agricultural development in the years ahead toward more effective utilization of our agricultural resources and of American food aid, and (b) Taiwan's experience in achieving a higher level of productivity in agriculture may have important lessons for other developing countries, especially for those where population is increasing rapidly, the possibilities of bringing additional land under cultivation are limited, and capital resources are relatively scarce.

### C. Organization of the Study

With the above objectives in mind, the analysis of this study is carried out under two main parts: The first part is devoted to an investigation of the basic development of Taiwan's agriculture. The second part is focused on an analysis of the impact of U.S. food aid upon Taiwan's agricultural and economic development.

The remaining chapters of this thesis are organized as follows:

Chapter II contains a review of the literature. The major purposes of the review of literature are (a) to find out what work, both theoretical and empirical, has been done in the area of analysis concern, (b) to identify factors contributing to agricultural development, and (c) to provide a

foundation for a theoretical framework.

In Chapter III a theoretical framework is developed to assist in the analysis of how U.S. food aid fits into the process of economic development.

Chapter IV discusses the role of Taiwan's agricultural development in capital formation. Particular attention is focussed on: (1) the process of the transfer of capital from agriculture, (2) an investigation of the past growth of Taiwan's agricultural output, and (3) the capital contribution of agriculture.

Chapter V examines what strategy will bring the most rapid economic growth. How can the productivity in agriculture increase rapidly enough to meet the needs of a growing population as well as satisfy the requirements for overall economic development? What is the source of the increased agricultural production? These questions are considered in Chapter V.

Chapter VI is concerned with the economic effects of Title I commodity imports under food aid programs. In particular, it deals with the effects of food aid on agricultural production, domestic prices, foreign trade, balance of payments, capital formation, and finally, the contribution of the U.S. food aid program (Title I under PL 480 only) to overall economic expansion is analyzed. Special consideration is given to the welfare effect of commodity imports under the entire American food aid programs.

Chapter VII identifies agricultural development problems in Taiwan and suggest the means for overcoming them.

In Chapter VIII, important policy implications for developing countries drawn from the main findings of the study are sketched out.

In the final chapter, basic conclusions of the entire study are summarized.

## II. REVIEW OF LITERATURE

Theoretical and empirical studies on the sources of the increased agricultural output not explained by conventional inputs need to be examined and analyzed carefully in order to develop or modify agricultural development strategy. Theoretical aspects and past experiences on the role of U.S. food aid in agricultural and economic development also need to be investigated in order to find out significant relationship between food aid as a means and agricultural and economic development as an end.

### A. Theoretical and Empirical Studies on the Source of Increased Agricultural Output

Much larger gains in agricultural productivity will be required in developing nations in years ahead if the real income of farm people is increased and agriculture makes a significant contribution to overall economic development. Nicholls (84), Kuznets (71, pp. 59-60), and Rostow (95, pp. 22-24) have stressed that substantial increases in agricultural productivity is a pre-condition for overall economic development in any part of the world.

Heady points out that the development of agriculture is not a mysterious process. He notes:

To search for mysteries in explaining increased farm productivity has become fashionable in recent years. Why these mysteries exist is itself a mystery. Knowledge is already at hand to explain how farm

productivity is increased. The important ingredients are rather obvious; the factors to stress are evident (43, p. 1).

The factors include agricultural policies, planning and programs, family planning, improved institutional arrangements, purchase of productive new inputs, economic incentives, improvement in farm technology, and external assistance and investment. But Heady goes on to say:

What is less obvious is how to overcome the political, cultural, intellectual restraints which prevent nations from boosting agricultural productivity.

It is generally argued that agricultural output and productivity probably can not be much improved in most developing nations without support by government organizations. U.S. agriculture is the most productive in the world and hence able to produce an abundant food supply largely because the stages and condition of economic growth have promoted it, and the nation has had the best public policies to encourage agricultural development (42, p. 5). The critical role of governments in raising agricultural productivity has been clearly stated by F. F. Hill:

...individual farmers or even groups of farmers in developing countries can do little by themselves to provide the means and the setting required for a sharp and significant increase in yields. These are matters for which governments must assume responsibility (118, p. x).

In addition, Haroldsen (36, p. 1) and Kriesberg (69, p. 308) present the same line of argument by saying that governments can play a leading role in accelerating agricultural

development.

Technological innovation has been the major factor contributing to the economic development of many developed nations over past years, and there is no doubt that it plays a vital role in the economic development of developing nations. Since there has in fact been little improvement in technology of production in most developing nations, technological innovation needs to be accelerated in order to fully and efficiently utilize domestic resources available to these nations. Economically this can be done by developing new technology only in those particularly important sectors where imported new technology is not available or can not be applied economically. Fortunately, much new technology appropriate to agricultural production in developing nations can be imported from developed nations, although it is likely to require some modifications to be most efficient under different conditions. As pointed out by Schultz, a continuous flow of new technology is essential for sustained increased in agricultural productivity and output (99, p. 105). He also indicates that price and markets for agricultural inputs, outputs, and consumption goods influence economic incentives to apply improved technology and hence increase agricultural productivity (97, pp. 322-327). Heady (40, pp. 794-805; 41, pp. 155-174), Mellor (81, pp. 288-308), Southworth and Johnston (110, pp. 7-10; 57, p. 582) reach the same conclusion by saying that

technological progress is the most important factor which alters the structure of agricultural production and productivity of farm resources under the constant flow of superior technology in agriculture.

Mosher (83, pp. 63-120) lists the following five factors essential for a successful agricultural development: market for farm products, constantly changing technology, local availability of supplies and equipment, production incentives for farmers, and transportation. He notes that "Each of these is essential. Without any one of them there can be no agricultural development" (83, p. 61).

Schickele (96, pp. 112-133) suggests that the institutional arrangements affecting education, research, agricultural extension, agricultural credit, farm inputs and product markets, land tenure, public safety, and many other rural conditions in many countries is such that individual farmers cannot overcome institutional obstacles to agricultural progress. The development of agriculture requires the modification of existing institutional arrangements so that the technological improvement is generated and economic incentive is created, permitting agricultural output and productivity are increases. Johnston and Mellor also agree that new technology, institutional arrangements and education can play important role in increasing productivity in agriculture. They say:

The low productivity of farm labor, land and other resources in the agricultural sector is largely due to the lack of certain complementary inputs of technical, educational and institutional nature (57, p. 582).

Johnson (58, pp. 209-223) lists four factors, namely, supply of knowledge, the role of government, economic environment (including prices, marketing, the supply of input, and credit), and development systems and dissemination of technology as essential in a package program for agricultural development. In his conclusions, Brown (7, pp. 17-18) describes the package approach under the broad headings of injection of capital inputs and new technology, price incentives for farm products, creating a climate for foreign private investment through government efforts, and allocating more resources to family planning by government agencies.

The urgency of raising agricultural output and productivity widely differs in different countries operating under variant conditions and stages of economic development. The literature reviewed above identifies only some of the key factors that are responsible for the increased agricultural productivity and output which cannot be explained by conventional inputs. Each argument made by each person is not necessarily presented as a critical overview. The comprehensive summary of major factors contributing to the raising productivity in agriculture in developing nations may be represented by Haroldsen. His summary is as follows:

- (1) progress in agricultural development in developing countries depends heavily on their will and commitment to progress, and upon the independent policies and programs they put into being.
- (2) Rapid population growth in underdeveloped countries must be controlled because high rates of increases in farm output can not be maintained over a long period of years.
- (3) Incentives to change must be provided -- not only economic incentives but assurance that the rewards of change will offset the loss of satisfying personal relationships.
- (4) Productive new inputs must be applied: fertilizers, pesticides, improved seeds, and other materials.
- (5) New and improved institutional arrangements affecting such things as land tenure, agricultural credit, input and product markets, public safety, and the generating and disseminating of technical knowledge are needed (36, p. 1).

The production function is a concept in physical and biological science. Heady says that:

The nature of production functions is important in economic development and in determining the extent to which national products can be increased from given resources stock (40, p. 1).

The empirical application of the formal production function concept in agricultural research has gone forward for several decades. The empirical analysis of changes in agricultural output can be investigated through empirical data which can be developed by measuring the functional relationship between physical inputs and outputs in different conditions and stages of economic development. Mellor and Lele (82, pp. 217-232) have made an empirical analysis based on data for India during the first two Five-year Plans. The conclusion reached by them indicated that all of the increase in agricultural output has primarily resulted from increasing traditional inputs and very

little from productive new inputs because of the traditional nature of India's agriculture and availability of traditional inputs.

In a similar study of the United States, Johnson and Gustafson (in 110) concluded an entire different story from the case of India. They pointed out that most of the increase in agricultural production essentially came from the increasing use of productive new inputs and increasing efficiency. Both these results were brought about by improved institutional arrangements which generate and disseminate technical knowledge.

The same point of view also can be shown by Searle who says:

Only twenty years ago, in 1951, food costs were 22.5 cents of every dollar. In 1971, only 16.5 cents of every dollar are needed to meet the same standards. This reduction in the cost of food has been the largest single factor to increase American standard of living.... The American farmer has done all this for society by increasing his own efficiency. In fact, the farmer has increased productivity almost twice as fast as the non-farm industries. As a result of farmers' efficiency, only 5 percent of the population are needed to grow food for the remaining 95 percent. In the last decade alone the farmer has increased his productivity more than he did from the beginning of time until 1960 (101, p. 2).

Mellor notes that the cause of increased agricultural production can be explained by the empirical approach to compare indices of agricultural inputs and outputs. He presents the studies of input and output indices for U.S. and Mexico as follows:

Comparison of such indices of the U.S. show that in the early decades of the twentieth century, when American agriculture was more nearly traditional in nature, indices of inputs and of outputs moved more or less space, so that it can be said that an index of change in quantity of traditional inputs explained essentially all of the increase in production without any necessity to use changes in efficiency of inputs as an additional explanatory variable. In most recent decades, in contrast, output indices have risen sharply while input indices have risen little, so that we must look for other reasons to explain the increases in output. ... Professor T. W. Shultze in his treatment of the subject refers to these inputs under the two headings of changes in technology and improvement in human factor.

Study of input and output indices for Mexico in the period 1925-1949 reveals changes similar to the U.S. experience. In the early part of the period, change in input quantity was roughly proportionate with change in output quantity; however, in the later part of the period the output index had increased substantially more than the input index. This suggests that increased efficiency in resource used accounted for a substantial part of the later increase in production. In turn, it might be assumed that technological change and improvement in the human factor provided this increase in efficiency in input use (81, pp. 238-239).

To provide increased knowledge for planning and implementing country development programs in developing nations, the Agency for International Development asked the Economic Research Service of U.S.D.A. to conduct research on a project entitled "Economic Progress of Agriculture in Developing Nations, 1950-68". This study was to review the progress of 54 developing nations in improving agricultural output and productivity during 1950-1960. In addition, it summarized findings from a detailed analysis for selected countries of the specific relationship between factors and the process of

change in agricultural output and productivity. The countries selected were Greece, Taiwan, Mexico, Brazil, Columbia, India and Nigeria. The variety that characterizes the agricultural economies of these countries because of differences in natural resources, farm technology, topography, cultural patterns, historical experience, sociological forces, stages of economic development, soils, climate, crops, institutional arrangements, population density and a host of other factors is great. But there are important similarities in agricultural development. Agriculture is the major sector of the economy in all seven countries and is the main source of income, employment, food, and raw materials required by the industrial sector. All seven nations had some difficulty to provide productive employment opportunities for increasing numbers of workers. All nations achieved greater growth since 1950, with gross domestic product tripling in Taiwan, doubling at least in Mexico, Greece, and Brazil, and nearly doubling in Columbia and India. Although, the generalizations of agricultural development strategy in different countries must be avoided, in one form or another most of these developing nations face a basic issue of agricultural development strategy. A number of factors commonly operative in all these countries can be abstracted for investigation. The weight imposed on individual factors will be different for particular nations, and for stages and conditions of economic development. However, all

factors, systematically summarized in their study are operative to some degree in all countries. Accordingly, the major findings of factors affecting growth rates in agricultural output and productivity from seven study countries may be considered in seven categories as follow:

- (1) Growth in use of the traditional inputs of labor, land, and capital goods produced on farms (such as draft animal and certain tools and equipment).
- (2) Technological advances (such as improved crop varieties and associated production and cultural practices, including diffusion of knowledge about these advances among farmers).
- (3) Supplies of capital inputs from nonfarm sources (such as fertilizer, pesticides, tools, and equipment).
- (4) Improvement of land and water resources (including land clearing, leveling, drainage, irrigation, and flood control facilities).
- (5) Growth in domestic and export markets for agricultural products.
- (6) Institutional arrangements affecting land tenure, farm credit, marketing, transportation, and infrastructure facilities to improve education, health, and other services for rural people.
- (7) External assistance and investments (129, pp. 32-33).

A study of agricultural development in Korea indicates that fertilization, water resource development, productive agricultural inputs and improvements in farm practice as land-substituting techniques have played a very important role in the process of economic development in Korea (73).

The experience of successful economic development of Taiwan's agriculture provides another historical example of agricultural development with using scarce resources. The pattern of development of Taiwan's agriculture is similar to

Japan's experience. As Johnson has pointed out:

The Taiwanese experience is interesting as an example of the Japanese approach to agricultural development in a different setting (55, p. 252).

Therefore, a brief review of Japan's case is emphasized here with particular attention on the process and the means of achieving outstanding records of agricultural outputs and productivity.

If there is any country whose experience may provide some indicators for economic development of agriculture today, it is probably Japan. A century ago Japan was a poor country, with a feudal political structure and a substantial population confined in a small land area. Today, Japan is a major industrial country which is one of few nations to have developed a successful approach to the development of agriculture. The interest of Japan's experience of agricultural development for the Asian developing countries lies in the fact that Japan was the first country in Asia which was very successful in bringing about a striking transformation in agricultural productivity. The development of Japanese agriculture with maintenance of small-scale farming is of deep interest to Asian developing nations, too. In these countries the present system of agriculture is one in which a relatively large agricultural population subsists on small-scale units of production. This is urgency to have a rising agricultural productivity to meet the food needs of increasing population

and also as an essential part of overall economic development.

Tang (114) points out that the increase in agricultural output and productivity in Japan has been much greater than the increase of physical inputs. He also examines the role of education, research and extension, and other non-conventional inputs in facilitating the technological change that has account for so much of the increase in agricultural production.

The successful story of Japanese agricultural development has increasingly attracted many economists and is cited widely in recent economic development literature. In evaluating Japan's experience, Johnston says:

...success was dependent not only on appropriate policy decision but also on their effective implementation, including an energetic response on the part of the mass of the nation's farmers. The question arises whether there was something unique about the ability of officials and entrepreneurs in Japan to pursue a goal with determination or in capacity for hard work that was characteristic of Japanese farmers. This may be so, although it seems improbable that Japan has a monopoly on such quantities. Certainly of greater importance is the fact that in Japan the institutional requirements, broadly defined, for an effective approach to agricultural development were fulfilled. In terms of Brewster's analysis, the Japanese manifested the ability to create the organizations, public and private, that were necessary for development and widespread use of increasingly productive technologies... (56, p. 299).

In essence, the Japanese approach to successful agricultural development resulted from such key factors such as:

- (1) providing direct incentives to farmers through land reform,
- (2) developing a strong base of agricultural science and technology at early stages of economic development prior

to the war,

- (3) developing productive new inputs and widespread adoption of innovational techniques through the majority of farmers such as improved varieties, fertilizer, and other biological-chemical form of capital,
- (4) improving institutional arrangements and technology, and
- (5) emphasizing strong agricultural research, education and extension fully supported by government.

#### B. Theoretical Aspects and Past Experiences on the Role of U.S. Food Aid in Agricultural Development

So far our review of literature has been concerned with the means of agricultural development by which substantial increase in agricultural output and productivity can be achieved. As indicated earlier, increase in agricultural productivity requires capital which is the most limiting resource in developing nations. The basic principles as to the ways in which food aid can be used as a means to promote overall economic development in developing nations is not new. A FAO report in 1955, a pilot study in India laid the theoretical groundwork for facilitating development through capital transfers of surplus farm products (32). The provision of American food aid, defined as a specialized form of American economic aid and as assistance on concessional terms for promoting economic development, is today an accepted thought controversial aspect of U.S. economic policy toward

developing nations and attracts much public interest. In this respect, Haroldsen argues:

The need for rapid economic development and increased food supplies in less advanced nations is fact. The existence of a surplus in the United States also is fact. To some persons it also is an apparent fact that food from the United States is needed to get this development on its way (35, p. 397).

Thus food aid provided by the U.S. would be twice blessed because it could enable developing nations to relax their limited capital and foreign exchange and hence to permit them to buy the materials of economic development while, at the same time, relieving American food surpluses. American food aid thus became a tool for presumably harmonizing economic interests between U.S. and recipient country.

Much discussion has occurred regarding both the usefulness and possible economic effects of U.S. food aid in developing nations. Food aid can be used to improve nutrition, mostly through direct feeding, and to meet famine conditions caused by crop failure. Food aid also can be used as means to promote economic development. In this respect, Heady and Timmons stress:

Food aid for development can assist capital investment in two ways. First, funds which would go into food purchases abroad at unfavorable rates of exchange become available for investment within the country. Second, under Title I of Public Law 480, local currencies become available for internal developmental investment (45, p. 190).

The basic principles as to how food aid contributes to overall economic development may best be stated as follows, according to the report given by the Organization For Economic Cooperation and Development:

Firstly, economic development involves a rising demand for food: this increase may be particularly large because at low income levels a substantial part of any increase in income is spent on food. The increased demand is added to the rise in food requirements resulting from the rapid population growth which is taking place in most underdeveloped countries.

Secondly, food production in many underdeveloped countries is already inadequate and can not easily be expanded in line with rising demand. Present low levels of agricultural productivity are often due to traditional farming structures and methods which can not quickly be changed; literacy and lack of trained staff for research and advisory work are other common obstacles to progress.

Thirdly, most underdeveloped countries are short of foreign exchange, and need to use a large part of what have to import the capital equipment on which their development depends. If they are forced by a shortfall in domestic food production to import food, the smallness of their foreign exchange reserves may mean that their ability to import capital goods is reduced and their development is likely to be retarded. Further, a country with a chronic food shortage may find it particularly difficult to reach a higher level of development if it has regularly to import large quantities of food (85, pp. 16-17).

From these three basic considerations, it follows that an expanding economy leads to increased demand for food either from domestic production or from imports which at times can not be met in developing nations. Consequently, food prices are increased, eventually leading to overall inflation which will impede economic development. Under these circumstances

it has been proposed that the possibility of obtaining food aid from U.S. is supposed to provide developing nations with extra resources to use for investment and other economic development purposes so that they can break out of a situation of economic stagnation and set off a process of rapid economic development, and hence a steady rise in real income per capita. These are all potential contributions of food aid in the total framework of economic development. Now let us turn to their closer relationship to agricultural development.

Theoretically, the analysis of the impact of food aid on the process of agricultural and economic development should be effectively evaluated in terms of general rather than a partial framework. Heady and Timmons indicate:

The net effect can't be measured by studies in a few scattered countries, but must reflect the aggregative outcome through world markets and feedback effects on supply and development of agriculture in third country (45, p. 191).

However, there is no global study of the impact of food aid on the recipient countries since the effects are so complex to measure. It is possible, empirically, to make quantitative studies which reflect the individual outcomes over individual recipient countries, or individual elements within individual countries. In this respect, Heady and Timmons also note:

Its contribution to agricultural development per se, at least, has been nil, and more likely negative. We, of course, can find individual elements which are positive. Examples are use of counterpart funds to initiate a needed research project, to set up a productive demonstration, and to provide a seed expansion and distribution center. In the past,

however, explicit restraints were placed on using counterpart funds for purpose which increase food production in the recipient country. The negative elements are spread more widely over the world and are more complex to measure (45, p. 191).

An analysis of past experiences of food aid programs indicates that in many cases a significant contribution has been made to a substantial acceleration in the development of agriculture in developing countries (3;24;31;84;110, pp. 347-349; 119 and 124). On the other hand, some economists have warned that large-scale shipments of food aid may depress the market for domestic agriculture, hence eventually retard national progress of agricultural development in some of developing nations (5; 24, pp. 136-139; 29;30; and 100).

As early as 1960, Schultz pointed out that food aid might have a price-depressing effect on domestic agriculture of recipient countries which could dampen agricultural development (100, pp. 1028-1029). Empirical studies for Israel, Columbia, Japan and Pakistan are reported and evaluated by Witt and Eicher (131) come to different conclusions, and indicate that food aid has a wide range of possible effects depending upon the use and policies of recipient countries. For example, American food aid to Israel made a significant contribution to expanded food production and general economic development during 1955 to 1960. Israel used food aid as a productive resource to achieve outstanding records of development. As pointed out by Kahn (64, p. 591), for Israel, food

aid under Title I "has been almost as good as free dollars." The impact of U.S. food aid on Pakistan indicated little evidence either of accelerating the development program or of an improvement in domestic agriculture as a direct outcome of food aid. However, the impending inflation and food shortage were alleviated by food aid.

The assessments of the impact of U.S. food aid on India varies widely. Sen indicates that food aid was integrated into Indian's development program and was used as a source in implementation of successive five-year development plans (102). Crawford points out that U.S. food aid made a big contribution to Indian development, but commercial purchase of food grains were substantially decreased, and hence enabled India to stretch its foreign exchange earnings (25). Khatkhate's study shows that the deflationary monetary effect of food aid was offset by increased government debt and a large development program in India. Per capita food consumption increased slightly as a direct result of U.S. food aid (100, p. 420).

The economic effects of U.S. food aid in six selected developing nations -- Israel, India, Turkey, Greece, Columbia and Spain -- have been studied by U.S.D.A. during the period of 1955 to 1963 (3). These studies indicate that (1) considerable progress in increasing agricultural output was achieved in each of these six nations. However, high population growth in India, Columbia and Turkey offset the rate of

progress in expanding output, (2) U.S. food aid to Turkey, Greece, Spain came at a critical time in their economic development where the availability of food aid served as a powerful engine to stimulate the further growth of their economies, (3) in Turkey, Greece, Spain, Israel, and Columbia, the availability of food aid provided much opportunities for greater flexibility in planning for more effective utilization of agricultural resources. In India, there appears to be less flexibility in shifting agricultural resources among the major crops because of physical, economic, and population factors. (4) U.S. food aid served as a tool to promote price stability and reduce inflationary pressures for more efficient use of agricultural resources. (5) Food aid affected the prices of domestic farm products, particularly, cash crops. Hence, the greatest impact was on commercial producers of cash crops such as cotton, grain and tobacco. Producers also responded to changes in price-cost relationships in the use of yield-increasing inputs, such as improved seeds, fertilizer and insecticides.

In summarizing the possible effects of U.S. food aid, Heady and Timmons conclude:

Food aid is viewed as a transitional and emergency policy. It gives way to intermediate-period policies of funds for countries to meet food deficits from the world markets and to buy and produce the inputs needed for developing their own agriculture and to begin exchanges in the world markets for goods and services. The longer run policies -- which must be initiated now -- rely on education, technical assistance, loans, and

other measures whereby less developed countries may draw upon the reservoir of knowledge now available and develop the social, economic and political structures conducive to its use. They also include population control through birth reduction to a degree that per capita availability of food and other material essentials is increased (45, p. 213).

In summary, the several empirical studies in recipient countries indicate that foreign trade, balance of payments, consumer welfare, and social development can all be improved through the use of food aid while the development in agriculture can be either retarded or benefited, depending on its use. Therefore, food aid, like other foreign aid programs, must be evaluated against the broad pattern of economic, political and social variables of the individual country. Food aid can and does make some contribution to the development of agriculture of some developing nations, but there are many limitations in their use.

### III. ECONOMIC FRAMEWORK FOR ANALYSIS OF DEVELOPMENT THROUGH FOOD AID

Economic development is more than economic growth, or the process of expanding the economy through increased productivity to increase the standard of living. It calls for major structural and institutional changes in gross domestic product, income distribution, the level of employment, balance of payment, the price level, integration of traditional and modern sectors, development of new and improved institutional arrangements consistent with the requirements of modern commercial production. Therefore, an analysis of the impact of food aid in the process of economic development cannot be effectively explained in terms of a partial equilibrium framework. Food aid affects the efficiency of resource allocation, the share of GNP between public and private sectors, and even the economy's structure and political institution in the recipient country. In what follows, we will outline several growth models for analyzing the impact of food aid in the process of economic development.

#### A. Harrod-Domar Growth Model

The first framework considered is the Harrod-Domar growth model (27,28,37 and 38). The model emphasizes the role of capital investment in the economy. A basic principle emphasized by Harrod and Domar and incorporated in all modern

growth theory is the dual effect of investment. Net investment constitutes a demand for output and it increases the capacity of the economy to produce output. For example, building and equipping a new factory generates a demand for brick, machinery, steel, etc., and the factory once built and equipped, increases productive capacity of the economy. The economy's net investment in any period thus has a demand and a capacity effect.

The Harrod-Domar model can be summarized in three equations which include the concepts of the incremental capital-output ratio and the average savings-gross national product ratio. The equation of the system of the model is as follows:

$$S_t = s_t \cdot Y_t \quad (1)$$

$$I_t = k_t \cdot \frac{dY}{dt} \quad (2)$$

$$S_t = I_t \quad (3)$$

Where  $S_t$  = gross domestic saving at time t

$Y$  = gross national product (GNP)

$s$  = average ratio of saving to GNP

$I$  = gross domestic investment

$k$  = incremental capital output ratio

$$Y = Y_{t+1} - Y_t, \text{ or } \frac{dY}{dt}$$

From the relationships among Equations 1, 2, and 3, we can derive the conclusion of this model as 4:

$$\frac{\frac{dY}{dt}}{Y} = s \cdot k^{-1} \quad (4)$$

To take per capita GNP into consideration, we need to introduce one more equation, namely:

$$y_t = \frac{Y_t}{L_t} \quad (5)$$

where  $y$  = per capita GNP

$L$  = population

Population growth can be taken as given in this case.

Equation 5 is linear in logs and can be rewritten as

$$\ln y_t = \ln Y_t - \ln L_t \quad (6)$$

Because the change in the natural log of a variable is the same thing as the relative rate of change of that variable, the function can be rewritten as Equation 7.

$$\frac{dy}{dt} \cdot \frac{1}{y} = \frac{dY}{dt} \cdot \frac{1}{Y} - \frac{dL}{dt} \cdot \frac{1}{L} \quad (7)$$

where  $\frac{dy}{dt} \cdot \frac{1}{y}$  = the rate of growth in per capita GNP

$\frac{dY}{dt} \cdot \frac{1}{Y}$  = the rate of growth in GNP

$\frac{dL}{dt} \cdot \frac{1}{L}$  = the rate of growth in population (i.e., labor force)

Putting Equation 4 into Equation 7, we got

$$\frac{dy}{dt} \cdot \frac{1}{y} = s \cdot k^{-1} - \frac{dL}{dt} \cdot \frac{1}{L} \quad (8)$$

The implication is that labor and capital are combined in fixed proportions. This creates the well known "razor-edge" situation. The stability of steady-state growth equilibrium is thus endangered. In order to assure steady-state growth, it is necessary to relax one or another of the restrictive assumptions of the Harrod-Domar analysis. As shown by Equation 8, there are two critical assumptions: one is a constant saving-income ratio (s) and another is a constant capital-output ratio (k). Both k and s are behavioristic parameters. One way to assure continuous steady-state growth is to make the capital-output ratio flexible, as a number of writers have suggested (39, p. 643; 98, p. 282). In order to investigate how U.S. food aid might best fit into the process of development in developing nations, we need to add some assumptions, in addition to the one of flexibility of k, as follows:

- (1) All U.S. food aid is exclusively considered as extra capital available to the developing country which must be invested in the economy for the purpose of promoting economic development.

- (2) There is no effect of U.S. food aid on taxation.
- (3) There is no effect of U.S. food aid on domestic savings.
- (4)  $k$  will be varied through technological, institutional and economical changes.
- (5) The period of time to be considered is one of long run.

Given these five assumptions, we will be able to find out some mechanism by which the process of economic development is generated through Equation 7. It is generally agreed that the constant  $k$  exists over the short run; but  $k$  will vary with technological, economical and institutional factors over long run period for most developing nations. Experience indicates that developed countries such as United States, Britain, and Canada have been unable to change  $k$  over time periods as long as the past 50 years, as pointed out by Thorbecke (116). The long run U.S. food aid to developing nations would accelerate their economic development through increasing the magnitude  $s \cdot k^{-1}$  so that  $s \cdot k^{-1} > dL/dt \cdot 1/L$  and per capita GNP,  $dy/dt \cdot 1/y$ , can increase substantially. In order to have an increase in magnitude  $s \cdot k^{-1}$ ,  $k$  must be decreased (i.e., capital-output ratio declines). Heady notes that "decreasing  $k$  is a fundamental step in development" (39, p. 643). Food as aid and as a means can help to decrease the magnitude of  $k$  through technological, economical and institutional changes, hence promote general economic development. Since in most developing countries, the agricultural sector produces a significant

proportion of GNP in the economy, the improvement in the agricultural sector through U.S. food aid has greater impact on GNP, hence per capita GNP (i.e.,  $dy/dt \cdot 1/y$ ). As far as agricultural sector itself is concerned, the magnitude of  $k$  should be decreased as far as possible through utilization of food aid as a means of increasing productivity in agriculture and eventually promoting general economic development.

Productive capacity not only grows as a result of net investment expenditure through U.S. food aid, but also becomes more efficient as the result of technical progress. By technical progress we mean improvements in the efficiency of the stock of capital that results from technological and organizational changes and improvements in the quality of the labor force that resulted from improvements in education, research, extension, training and health condition (98).

According to Harrod-Domar growth theory, if we want the economy to grow more rapidly, we can attempt to make capital more productive (i.e., decreasing value of  $k$ ). Decreasing the magnitude of  $k$  implies that the output of the economy must increase at a faster rate than before because each dollar invested increases the full employment level of output by more output than previously existed.

## B. Solow Growth Model

Another framework for analysis is Solow's dynamic growth model (109). The basic Solow model treats the capital stock as a unique, homogeneous resource that can be reshaped and adjusted to be used with any quantity of labor. Therefore, the Solow model differs from the Harrod-Domar model in the formers' assumption of automatic full utilization of capital and labor. All economic activity is carried out in perfect competition with flexible prices of inputs and outputs serving to balance supply and demand in all markets. The Solow dynamic model is focused on the growth path that will be followed by a system whose labor and capital remain fully utilized as the quantity of these resources grows over time.

Solow's production function, assumed to be homogeneous of degree 1 in capital (K) and labor (L) is

$$Y = F(K,L) \quad (9)$$

Where Y denotes total output, K is capital and L is labor.

The final result developed through Equation 9 can be represented by Equation 10<sup>1</sup>.

$$\dot{r} = s \cdot F(r,l) - n \cdot r \quad (10)$$

which is expressed in terms of total capital.

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<sup>1</sup>The Equation 10 is resulted from the process of Equation (a) through equation (j) as follows:  
 (a) I = S Investment = saving (footnote continued on following page)

Where  $r$  = capital-labor ratio  
 $\dot{r}$  = the rate of growth of capital-labor ratio  
 $s$  = saving ratio  
 $n$  = the rate of growth of population

In Solow's model, the shape of the production function can produce either single or multiple equilibrium points; it entirely depends on the nature of the production function, i.e., the shape of  $s \cdot F(r, l)$ . Suppose production function

(footnote continued from preceding page)

- (b)  $I = dK/dt$  or  $\dot{K}$  Net investment is just the rate of increase of capital stock  
 (c)  $S = s \cdot Y$  Saving is constant proportion of income  
 (d)  $\dot{K} = s \cdot Y$  Basic identity at every instant of time  
 (e)  $Y = F(K, L)$  Homogeneous first degree production function  
 Inserting (e) in (d) we get  
 (f)  $\dot{K} = s \cdot F(K, L)$

In absence of technological change  $n$  is Harrod's natural rate of growth, thus

(g)  $L_t = L_0 \cdot e^{nt}$

In (f)  $L$  stands for total employment; in (g)  $L$  stands for the available supply of labor. By identifying the two we are assuming that full employment is perpetually maintained. When we insert (g) in (f) to get

(h)  $\dot{K} = s \cdot F(K, L_0 \cdot e^{nt})$

(h) is a differential equation in single variable  $K$ . We introduce new variable  $r = K/L$ , the ratio of capital to labor. Hence we have  $K = r \cdot L = r \cdot L_0 \cdot e^{nt}$ . Differentiating with respect to time we get

(i)  $\dot{K} = L_0 \cdot e^{nt} \dot{r} + n \cdot r \cdot L_0 \cdot e^{nt}$

Substituting this in (h)  $(\dot{r} + n \cdot r) L_0 \cdot e^{nt} = s \cdot F(K, L_0 \cdot e^{nt})$ . But because of constant return to scale we can divide both variables in  $F$  by  $L = L_0 \cdot e^{nt}$  provided multiply  $F$  by the same factor, thus  $(\dot{r} + n \cdot r) L_0 \cdot e^{nt} = s \cdot L_0 \cdot e^{nt} F(K/L_0 \cdot e^{nt}, 1)$ , and dividing out the common factor we arrive finally at

(j)  $\dot{r} = s \cdot F(r, 1) - n \cdot r$

Here we have a differential equation involving the capital-labor ratio alone.

indicated by Equation 9 produces a production curve of a multiple equilibrium as shown in Figure 1. The curve  $s \cdot F(r, l)$  shows actual savings and, hence, investments per man at the actual capital-labor ratio  $r$ . The line  $n \cdot r$  shows the investments required to keep the capital-labor ratio unchanged at its actual level. The implication of the model is shown as follows:

$r_1$  refers to economic development for developing nations which is a traditional economy, with low  $r$ . Most economists call this a low level equilibrium trap. It has a stable equilibrium point at a low  $r$ .

$r_2$  is associated with a take-off point in terms of economic development. It is an unstable equilibrium point, and hence can go either way.

$r_3$  corresponds to a highly developed economy for developed nations. Capital accumulation is then generated. It is a stable equilibrium at higher  $r$ .

The major feature of most developing nations is a shortage of capital. Capital accumulation cannot be generated because the economy is always trapped in  $r_1$ . The figure illustrates the fact that if the initial increased capital is insufficient enough to go beyond  $r_2$ , the path of change will eventually lead to a return to the equilibrium position  $r_1$ . But if the increase in capital is substantially large so that  $r$  does rise beyond  $r_2$ , the path of changes is one of capital

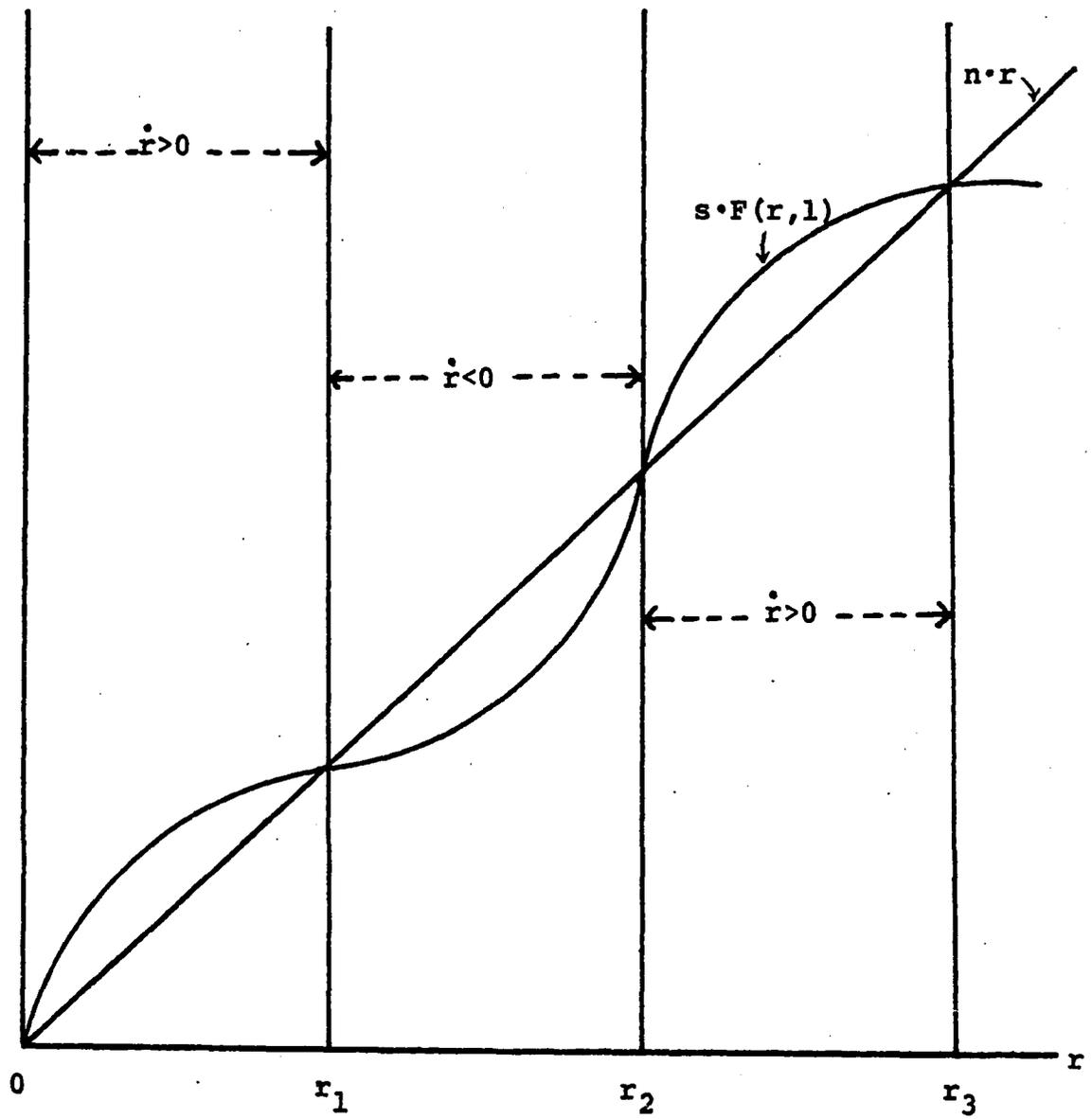
$s \cdot F(r, l), n \cdot r$ 


Figure 1. Possible growth patterns

Source: (109).

accumulation.

Now let us inquire how U.S. food aid has the fundamental purpose of fitting into optimal economic development programs of developing nations starting at a low level and desiring rapid economic progress.

Assumptions here are the first three of five assumptions given in the Harrod-Domar model. We assume that total U.S. food aid is denoted by  $A$ ; thus per capita food aid is  $A/L$  where  $L$  is total population.

Let  $A/L = a$ . Thus Equation 10 will become Equation 11.

$$r = s \cdot F(r, l) + a - n \cdot r \quad (11)$$

where  $r = 0$  implies  $s \cdot F(r, l) + a = n \cdot r$ .

Equation 11 represents an upward shift of the production curve from  $s \cdot F(r, l)$  to  $s \cdot F(r, l) + a$  as indicated in Figure 2.

Figure 2 indicates that  $r_1$  move up to  $r_1'$ ;  $r_2$  move down to  $r_2'$ ;  $r_3$  move up to  $r_3'$ . Hence the range of unstable equilibrium is narrowed down; this gives many chances for developing nations to jump over the take-off point (i.e.,  $r'$ ) once capital in the form of food aid is introduced and invested. Consequently, capital accumulation is generated; a highly developed economy is achieved; higher per capita income is obtained.

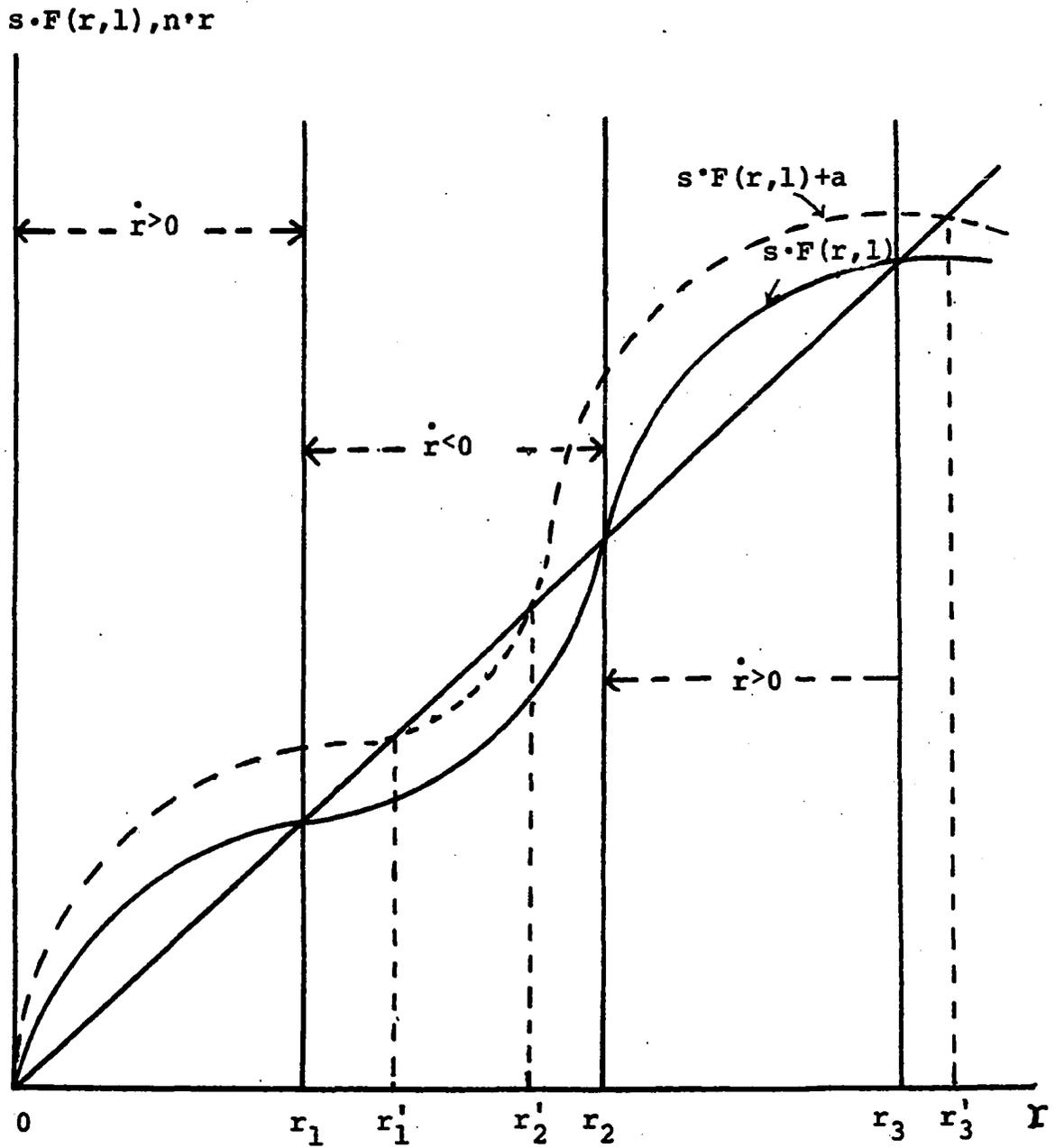


Figure 2. Possible growth patterns with food aid  
 Source: (Derived from Figure 1).

### C. Keynesian Growth Model

The third framework for analysis is concerned with the development process through social overhead capital. This framework subscribes to the theory that underdevelopment is due to a serious lack of social overhead capital. Because of the lack of social overhead capital, returns to private investments is low. Hence, there is private capital outflow to developed countries in response to higher returns elsewhere. Development policy calls for massive public investments such as in education, transportation, irrigation, communication etc. In particular, development calls for integration of a dual economy. The scope for private investments in a traditional agricultural sector is almost negligible. After all, any opportunity for such investment must have been exploited since a traditional agricultural sector has been stagnant for many years. The modernization of the agricultural sector needs public investment in education, research, extension, irrigation, land reform, new productive inputs, and institutional arrangements. After a certain level of public capital has been accumulated, returns to private investments then will increase. At this moment, there will be an increase in savings and private investments. Foreign private capital inflow might even be forthcoming. Hence the private capital outflow is at most a temporary phenomenon, which will be reversed later in the development process.

The required public investments in social overhead capital is massive. It is commonly argued that the tax base in developing countries is small and tax rates are already high. Raising the tax rates is not politically feasible and may even cripple the accumulation of private capital. Therefore, the actual public investments have been limited by the ability of government to tax from a small tax base. An inflow of foreign aid, or foreign aid in the form of food aid, will be used the most profitably in the public sector. In this respect, Thorbecke (116) presented an explanation regarding how public investment might eventually create a favorable environment in encouraging both private domestic investment and private foreign investment. He presented the model as shown in Figure 3. In the figure, MEI stands for marginal efficiency of investment;  $i$  is the market rate of interest;  $I$  is the level of investment. Both  $i_1$  and  $MEI_1$ , are assumed to be given by the economy. The level of  $I$  is determined by the relationship between  $i$  and  $MEI$ , according to Keynes (103, pp. 216-223). At  $OI_1$ , the level of investment is so low that not enough major structural and institutional changes occur. Thus, the economy is in a low level equilibrium trap. It is possible, however, if a certain amount of social overhead capital provided by foreign aid in the form of food aid had been forthcoming in the forms of transportation, power, infrastructure, dams, irrigation, land reform, etc. It would result in an upward shifting from  $MEI_1$ , to  $MEI_2$ , and hence would have

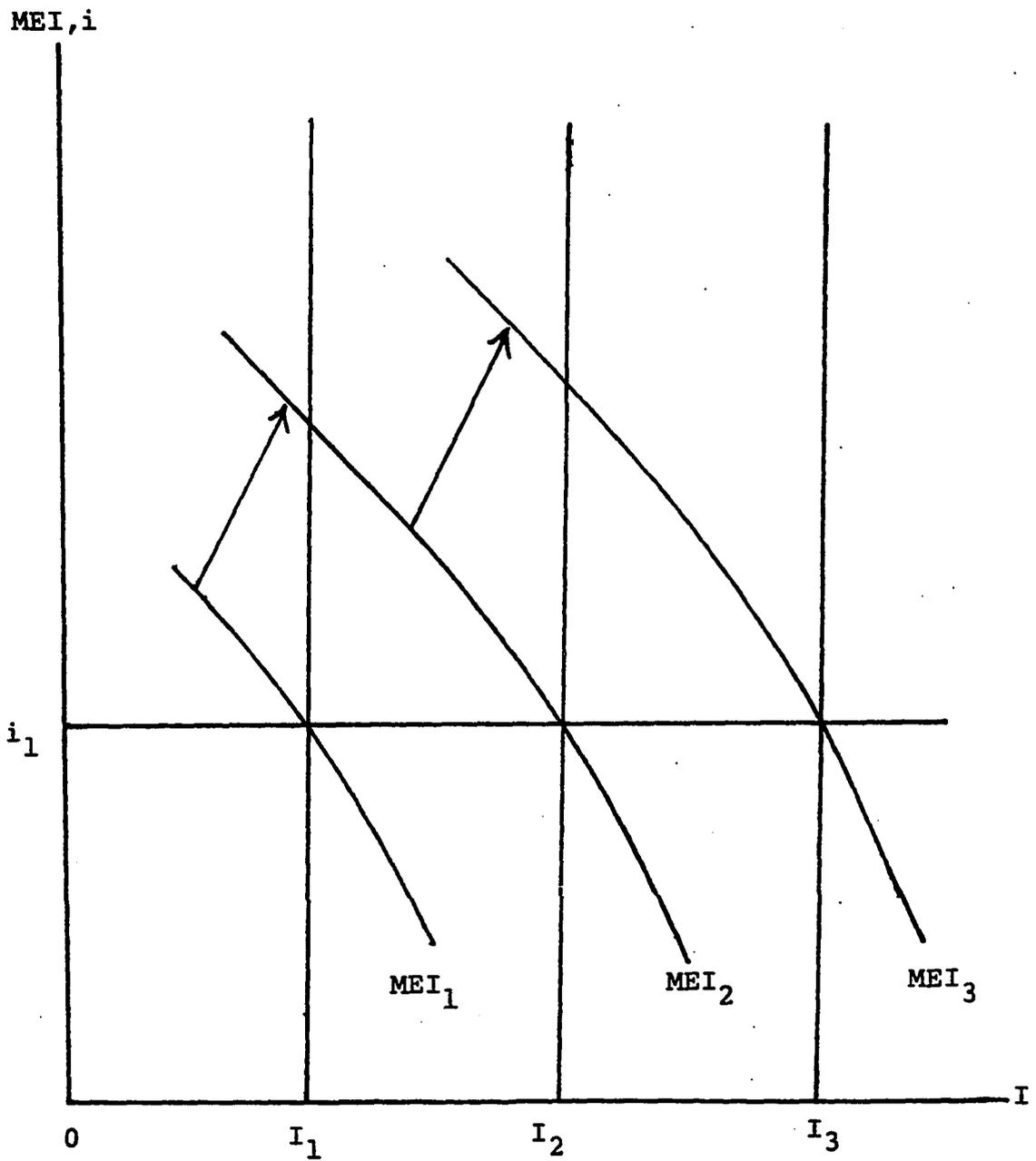


Figure 3. Capital accumulation through social overhead capital investment provided by foreign aid in the form of food aid

Source: (116).

some impact on the profitability of private investment. Consequently, the amount of  $I_1I_2$  of private investment would be forthcoming. Similarly, if social overhead capital increased further provided by continued inflow of foreign aid in the form of food aid, then the new curve of marginal efficiency of investment,  $MEI_3$ , is created. Consequently,  $I_2I_3$  would be the amount of private investment forthcoming. This sequence would be present as long as social overhead capital increases continually.

In essence, all three of the theoretical models mentioned above, under certain assumptions, demonstrates a common fact; namely, that by increasing the inflow of foreign capital aid in the form of food aid, capital accumulation is generated and a highly developed economy is furthered. Therefore, it is possible to promote overall economic development through food aid as a means of increased productivity in agriculture.

#### IV. THE ROLE OF AGRICULTURAL DEVELOPMENT OF TAIWAN IN CAPITAL FORMATION

##### A. Process of Transfer of Capital Formation from Agriculture

In recent years the Taiwan economy has undergone rapid industrialization. In order to have industrialization, it had to increase output and earnings from the agricultural sector. Capital goods for industrialization must usually be imported abroad, and increased agricultural output can be an important means to earn foreign exchange to pay for it. And industries must have markets for their products. The larger the market within the country itself, the faster industries can grow. If farm income remain so low that few market purchases can be made, domestic industries will be retarded in their development. More practical importance is the need for the closest possible relationship between the production of agricultural and industrial commodities. For Taiwan, the stabilization of the overall economy depends largely upon the prosperity of rural communities.

The increase of agricultural production and farm income will raise the level of national income and general productivity. For the purpose of analyzing the role of agriculture, it is important to know the effects which an increase of agricultural income and production will have on other sectors of the economy through the outflow of capital from the

agricultural sector or the increase in demand for non-agricultural products. Therefore, the development of agriculture is primarily concerned with the means of increasing net agricultural surplus from agriculture. To the developing countries, mobilization of internal capital out of the agricultural sector must depend upon agricultural development.

Substantially increasing agricultural productivity and production can help to permit the capital formation necessary for national economic growth. Capital formation in agriculture that is used both within the agricultural sector and non-farm sector of the economy is of particular importance in the early stages of economic development. Agriculture produces a significant share of the national product and receives a considerable proportion of national income, and probably makes an important contribution to savings for capital formation in both the agricultural and the non-farm sectors of the economy. As economic growth proceeds, the proportion of national savings derived from agricultural incomes naturally becomes smaller. The most important matter for economic growth is to assure that appropriate transfer mechanisms are available to provide the flows of capital needed for both between sectors and within them at each point in the process of economic development. In a somewhat different form the same argument has been emphasized by Southworth and Johnston (110, pp. 34-36), Heady (39, pp. 378-379) and Mellor (61, pp. 84-100).

Southworth and Johnston note:

Development of agriculture can contribute materially to overall economic development, and it requires a major inflow of certain forms of capital. The precise nature and size of the flows of capital into and out of agriculture will depend on complex factors specific to each development situation (110, p. 34).

Heady stresses the same argument by saying that:

As industry becomes established in greater degree but farm employment absorbs major part of the population and labor force, the contribution of agriculture has still been of important magnitude in economic expansion. In this stage of preconditions to take-off, the contribution is not simply in physical quantity of food for sustenance of non-farm population but in the transfer of capital accumulation from agriculture to industry. In some nations, this transfer took place in majority through direct taxation of surplus income of agriculture and its reinvestment in social overhead capital.... But a more important process in this transfer was the eventual movement of capital to non-farm sectors, with the migration of labor to urban areas,.... (39, p. 378).

As pointed out by Mellor earlier in Chapter I, he stresses that substantially increasing agricultural production provides the basis for increased capital formation and income in the agricultural sector (81, p. 37). With regard to agriculture's contribution to capital formation, Mellor states as follow:

The contribution of the rural sector to capital formation may be marshaled in four ways. It may be extracted by the government through the medium of taxes. Agricultural production may be increased sufficiently to bring about a relative decline in agricultural prices and thereby favor increased profits in non-farm sector with consequent favorable effects on savings and investment in that sector. Agriculture may form capital directly within its own sector and minimize its demands for capital from other

sectors. Finally, agriculturists may invest directly in other sectors -- perhaps after its own development has increased demand for products from other sectors and the profitability of such investments. In such investments they may use financial intermediaries, including postal savings banks, as in Japan (81, p. 84).

Increased agricultural output and productivity in Taiwan has made three main contributions to economic development of the non-agricultural sectors. Firstly, it has supplied an increasing amount of food and other farm products to feed a growing population. This has helped to stabilize commodity prices and wages. Secondly, it has provided labor forces for employment in non-agricultural sectors, served as a source of capital for non-agricultural sectors, and earned foreign exchange that helped finance imports of scarce capital goods. Thirdly, it has provided raw material for the agricultural processing industry, and provided a major market for industrial goods and services. With respect to this point (agriculture's contribution in economic growth), Kuznets points out:

...if agriculture itself grows, it makes a production contribution; if it trades with others, it makes a market contribution; if it transfers resources to other sectors, these resources being productive factors, it makes a factor contribution (70, p. 114).

Our major concern of the role of increased agricultural output in capital formation will be analyzed according to Kuznets' measurements of the contribution of agriculture.

## B. A Review of the Past Growth of Agricultural Output in Taiwan

The product contribution of agriculture to economic growth of a nation is from the growth of farm product within the sector itself, according to Kuznets (70, p. 105). Thus, the first part of this chapter presents a brief review of the past growth of agricultural output in Taiwan.

The record of successful economic development in Taiwan since World War II has been heavily dependent upon the rate of progress in achieving higher levels of agricultural output and productivity. These rates were achieved by the introduction of technological, institutional and economical factors. Contributing the necessary capital for these investments was U.S. food aid. However, high growth rates in agricultural production also were attained before the war. Therefore, it is useful for us to review and investigate the growth of Taiwan's agriculture before World War II as well as the post-war period.

### 1. Agricultural output growth before World War II

Taiwan was under Japanese colonial rule from 1895 to 1945, when it was restored to China. Taiwan started its agricultural development program as early as 1920 and had already registered substantial progress in increasing agricultural output before World War II. During this period, a strong base of agricultural science and technology was established by the Japanese. Large-scale construction of

irrigation, transportation, marketing facilities, and installation of power plants was achieved as a base for agricultural and industrial development. New inputs such as improved varieties of rice, sugarcane, other crops, fertilizer, and other biological-chemical forms of capital were introduced from abroad. Adaptive research to develop varieties suited to Taiwan's agricultural conditions was carried out. In the area of trade, agricultural and processed agricultural products, especially rice and sugar, were the most important exports. Manufactured goods made up most of the imports. The most important trade partner was Japan. During most of the period, Japanese policy was primarily oriented toward developing the island of Taiwan as a source of agricultural products and certain raw materials for Japan and as a market for manufactured goods of Japan.

An analytical review of agricultural development in Taiwan, using an input-output and productivity approach, was completed by Hsieh and Lee (51) in 1958. This study covers the period 1910-1956, with projections of agricultural outputs and factor inputs for 1960 and 1970. Table 1 indicates the average annual growth rate of agricultural output (including only crops and livestock) in different stages of agricultural development in Taiwan, 1910-1956.

Table 1. Annual growth of agricultural output and total population in Taiwan, 1910-56<sup>a</sup>

Period	Average annual growth rate of agricultural output	Average annual growth rate of total population
1910-20 <sup>b</sup>	1.40%	1.30%
1920-39 <sup>c</sup>	4.50	2.40
1939-45 <sup>d</sup>	-12.33	1.00 <sup>e</sup>
1945-52 <sup>f</sup>	12.90	3.82
1952-56 <sup>g</sup>	4.96	3.64
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1910-39 average	3.45	2.02
1945-56 average	9.90	3.76
1910-56 average	2.70	2.30

<sup>a</sup>Source: (51, p. 4).

<sup>b</sup>Initial stage of agricultural development under Japanese colonial rule of Taiwan.

<sup>c</sup>Continued development of agriculture under Japanese colonial rule of Taiwan.

<sup>d</sup>Agricultural development under the impact of World War II.

<sup>e</sup>The low rate of population growth in this period was due mainly to the effects of war and the return of Japanese to their homeland after the war.

<sup>f</sup>Recovery and rehabilitation stage of development of agriculture after the war.

<sup>g</sup>Further development of agriculture after the rehabilitation stage.

This study shows that during the Japanese occupation agricultural output (1) expanded slowly increasing at an average annual growth rate of 1.4 percent during the period 1910-1920, (2) accelerated considerably between 1920 and 1939 rising at an average annual growth rate of 4.5 percent, and (3) declined to -12.33 percent per year averagely in 1939-1945 because of the impact of the war damage. Except in the war-time period 1939-1945, the average annual growth rate of agricultural output, 3.45 percent over the period 1910-1939, exceeded that of population, 2.02 percent, by a wide margin, experiencing a long upward trend of agricultural output over a period of 30 years as shown in Table 1. It also shows that post-war recovery was achieved roughly by 1952, and that since then the growth rate of agricultural output had been remarkable. Since Taiwan's agriculture suffered serious damage during the war, the two period of wartime (1940-1945) and reconstruction and recovery (1945-1951) should be eliminated from consideration if any comparison of growth rate of agricultural output between prewar and post-war period is to have meaning.

The impressive record of the Japanese government in increasing agricultural output of Taiwan also can be judged from Table 2. It indicates that total inputs used in agriculture increased by 1.62 percent from 1935 to 1939, while aggregate output increased by 6.97 percent, or more than four times the rate of the input increases. Efficiency of

agricultural production in Taiwan increased in the period 1935-1939 as indicated by the downward trend of the index of input per unit of output. It means that the input required for producing per unit of output in agriculture declined, reflecting an increase of agricultural production efficiency. As pointed out by Hsieh and Lee .

The upward trend of production efficiency in the period of 1935-1939 was gained by the extension of new crop varieties, more input of fertilizer under rapid biological innovations, more irrigation facilities and services, extension of multiple cropping and improvement of farming practices under direction of Japanese technicians. The output increase in the period 1935-1939 was about 10 percent. The gain in production efficiency during this period was accompanied by extensive advancement in land and labor productivity before World War II (51, pp. 46-47).

Ho's study, using a Cobb-Douglas type production function, indicates that the growth in agricultural output until the 1920's can be essentially explained by increases in conventional inputs such as land, labor, fertilizer, and land under irrigation (46, p. 324). From the 1920's until the end of Japanese occupation, new agricultural technology based on modern, non-conventional inputs had provided an important source of growth in agricultural output. According to the previous Cobb-Douglas production function analysis, 75 percent of the increase in agricultural output could be explained by conventional inputs. The remaining 25 percent of the output increases could be explained only by unknown factors, or technological change (62, p. 325).

Table 2. Production efficiency<sup>a</sup>  
Base year: 1935-1937

Year	Aggregate output index	Aggregate input index	Production efficiency (index of input per unit of output)
1935	97.52	98.64	101.14
1936	101.21	101.36	100.15
1937	101.27	100.01	98.76
1938	105.74	99.60	94.19
1939	106.50	100.26	94.14
1940	92.62	98.60	106.46
1941	92.30	96.79	104.86
1942	94.02	95.39	101.40
1943	90.30	92.28	102.19
1944	78.57	83.80	106.66
1945	48.35	75.85	156.88

<sup>a</sup>Source: (Compiled from 62, Appendix Table 3).

Both studies (46,62) argued that technological progress in agriculture contributed to the much greater proportional output increase than did the increase of inputs as shown in Table 2. Table 3, as an example, can be used to illustrate this point. Over the period 1910-1940, the four principal crops, brown rice, sweet potatoes, sugarcane, and peanuts, occupied more than 80 percent of the total cultivated area throughout (62, p. 18). The index numbers clearly indicate that percentages of increase in output over the whole period was substantial for all four crops. The percentages of increase were more notable for sugarcane, peanut, and sweet

potato production than for brown rice. But since brown rice production was such a large part of total production, occupying roughly 60 percent of the total cultivated area, its growth in production was the chief determining factor in the overall growth in agricultural output. Both yield and area increases contributed to the growth in output of the four crops. It can be seen that the overall percentage increase in yield for all four crops was much greater than that of the percentage of increase in area over the period 1910-1940.

An analysis of the data given in Tables 1, 2, and 3 convincingly show that two important factors contributing to the growth in agricultural output and productivity were increases of input factors and technological progress during the prewar period.

It is to be noted that the slow path of economic transformation also occurred during the period under study. The agricultural labor force accounted for 71 percent of total labor forces in 1915, it still accounted for 68 percent in 1930, and then declined to 62 percent in 1940. The percentage of the farm labor force to the total labor force dropped by 11 percent over a period of 25 years (66, p. 37). The trend of agricultural population also showed the same path of slowing change as the farm labor force. The ratio of agricultural population to total population declined from averaging 63 percent in the period 1911-1920 to 52.8 percent in 1941-1950,

Table 3. Indices of area, yield and production for major crops 1911-1920 to 1941-1950<sup>a</sup>

Crop	1911-1920	1921-1930	1931-1940	1941-1950
<b>Area</b>				
Brown rice	100	113.4	134.6	132.8
Sweet potatoes	100	109.6	173.4	164.1
Sugar cane	100	115.4	119.4	111.9
Peanuts	100	121.6	144.0	218.6
<b>Yield</b>				
Brown rice	100	115.5	139.6	120.1
Sweet potatoes	100	130.6	163.3	129.6
Sugar cane	100	155.7	242.3	184.5
Peanuts	100	138.0	155.7	116.0
<b>Production</b>				
Brown rice	100	131.1	188.0	159.6
Sweet potatoes	100	143.3	195.8	212.8
Sugar cane	100	179.8	289.3	208.4
Peanuts	100	168.0	224.8	253.7

<sup>a</sup>Source: (Derived from 112, pp. 23,36,39 and 47).

dropping by 10 percent, but the absolute number of agricultural population increased steadily over the whole period of 1910-1940 (63, p. 7). This slow path of economic transformation also reflected a slow unbanization.

## 2. Agricultural output growth during 1952-1969

The period since 1952 includes four Four-Year Economic Development Plans (1953-1956, 1957-1960, 1961-1964, and 1965-1968) and 1969, the first year of the fifth Four-Year Economic Development Plan (1969-1972). Wartime destruction and disorganization left total agricultural production in 1945 far below prewar levels. Agricultural production and crop output did not recover to prewar peak level until 1952.

Tables 4 and 5 show some broad indicators of agricultural development since 1952. Taiwan had remarkable growth in the period 1952-1969. On the basis of average annual growth rate in the period 1952-1969, total agricultural production recorded the increase at 4.9 percent, group products -- crops, forestry, fisheries and livestock increased at 4.0, 5.1, 9.2, and 7.2 percent respectively. In regards to the agricultural production index, taking the year of 1952 as the basic year as 100, the general index in 1969 was 123.7, among which, crop was 94.7; forestry, 132.8; fishery, 344.8; and livestock, 226.5. This is a remarkable record in Taiwan's agriculture. Crops and livestock are of major importance in Taiwan's economy. In 1969, crop and livestock products represented, respectively 56.5 percent and 24.4 percent, totalling 81 percent, of the total value of agricultural production at the current prices while fishery and forestry products constituted only, respectively, 12 percent and 7 percent of that of agricultural production (111, p. 3).

During the early stage of agricultural development under Japanese colonial rule of Taiwan, much emphasis was placed upon increasing crop production, however since early 1950's production of livestock and poultry products had increased far more rapidly than crop output as indicated in Tables 4 and 5. The raising of livestock and poultry had been a secondary but significant aspect of Taiwan's agriculture during the period

Table 4. Agricultural production - annual growth rate (%)<sup>a</sup>

Period	General index	Agriculture	Forestry	Fisheries	Livestock
1953	9.8	8.1	0.5	5.0	25.2
1954	2.3	1.5	3.7	16.6	2.6
1955	0.3	-1.6	2.6	17.4	4.1
1956	7.8	8.5	0.2	5.4	6.7
1957	7.1	6.0	14.9	6.4	11.2
1958	7.5	5.7	18.5	8.4	13.4
1959	1.1	0.3	19.9	4.3	-1.3
1960	1.4	1.9	2.0	4.4	-3.9
1961	8.5	7.1	10.9	18.9	10.7
1962	2.1	1.2	1.6	3.5	6.3
1963	-0.5	-1.5	-1.2	7.3	0.5
1964	12.7	14.0	21.4	8.0	6.0
1965	7.4	8.3	3.6	1.8	7.0
1966	5.2	4.7	-9.0	11.8	11.0
1967	5.9	4.1	3.9	8.7	13.9
1968	6.1	4.9	5.0	20.3	5.7
1969	-1.0	-3.8	-6.1	10.1	6.8
1953-60 average	4.6	3.7	7.5	8.4	6.9
1961-68 average	5.9	5.3	4.2	9.9	7.6
1953-69 average	4.9	4.0	5.1	9.2	7.2
1965-69 average	4.7	3.6	-0.7	10.4	8.8

<sup>a</sup>Source: (92, p. 32).

Table 5. Agricultural production - index numbers<sup>a</sup>

Period	Index (Base: 1952=100)				
	General index	Agricultural	Forestry	Fisheries	Livestock
1952	100.0	100.0	100.0	100.0	100.0
1953	109.8	108.1	100.5	105.0	125.2
1954	112.2	109.7	104.3	122.4	128.4
1955	112.6	108.0	107.0	143.6	133.6
1956	121.4	117.2	107.3	151.4	142.6
1957	130.0	124.2	123.3	161.0	158.6
1958	139.8	131.3	146.0	174.6	179.9
1959	141.3	131.7	175.0	182.0	177.6
1960	143.2	134.2	178.5	190.1	170.7
1961	155.4	143.7	198.0	226.0	189.0
1962	158.7	145.5	20.13	234.0	200.9
1963	157.9	143.4	198.8	251.1	201.8
1964	178.0	163.4	241.3	271.3	214.0
1965	191.2	177.0	250.0	276.2	228.8
1966	201.1	185.3	227.5	308.8	254.0
1967	213.0	192.9	236.3	335.6	289.2
1968	226.0	202.3	248.0	403.9	305.7
1969	223.7	194.7	232.8	444.8	326.5

<sup>a</sup>Source: (16, p. 31).

under study. Farmers raise livestock as a sideline to cropping activity in order to augment income, supplement the diet, acquire draft animals, and obtain fertilizer. In recent years, livestock activities in Taiwan, especially the raising of hogs, have gradually developed into full-fledged modern enterprises instead of being a sideline production of farmers. This development was made possible by the government's positive promotion and encouragement of the so-called "Integrated hog-raising and chicken-raising program" under which the production and sale of hogs and chickens are incorporated into a

single operation (111, p. 227). The development of livestock industry also is attributable to the adoption, under integrated programs, of scientific livestock raising and managerial techniques, the use of highly efficient mixed feeds and the adoption of many other effective measures, such as the extension of superior breeds and prevention and treatment of animal plagues.

A significant portion of the expanded output of livestock and poultry had been based on the importation of feed grains. Expansion in livestock and poultry production had been used to compensate for the limited arable area and mainly for domestic consumption. The development and the importance of livestock industry in Taiwan's agriculture can be clearly seen in Tables 4, 5 and 6. In 1969 total hog production in Taiwan was worth 7,300 million, new Taiwan dollar (NT\$), representing 64.4 per cent of the total livestock production.

Cattle are raised mainly for draft purposes. Dairy products are not part of the traditional diet, but consumption is now rising rapidly, requirements being covered mainly by imports. Government is actively promoting the development of the infant dairy industry, and it is believed that self-sufficiency can be achieved within a decade by bringing mountain slope land into the production of forage crops.

Table 6. Value of crop and livestock products as percent of total value of agricultural output<sup>a,b</sup>

Year	Common crop	Special crop	Horticultural crop	Livestock product	Total
	%	%	%	%	
1960	54.866	13.096	7.452	24.564	100
1961	53.741	14.213	7.118	24.905	100
1962	51.584	13.398	8.142	26.860	100
1963	48.550	14.276	10.344	26.810	100
1964	46.950	18.230	10.643	24.158	100
1965	46.970	13.710	14.641	24.665	100
1966	47.473	11.975	15.326	25.208	100
1967	47.148	11.009	15.921	25.907	100
1968	44.721	10.467	17.168	27.629	100
1969	42.594	10.702	17.989	28.696	100

<sup>a</sup>Source: (111, p. 27).

<sup>b</sup>Agricultural output as referred to here includes only crop and livestock products.

a. Growth in crop output Our analysis of total crop output will concentrate on six major crops, i.e., brown rice, sweet potatoes, sugarcane, banana, peanuts, and pineapple because they are the major sources of domestic food and foreign exchange. The overwhelming importance of these six crops is indicated in Table 7, which shows that rice, the staple food of Taiwan, is the most important crop in terms of its value of total crop output, followed by sweet potatoes, sugarcane, banana, peanuts, and pineapple. Rice alone accounted for about averagely one-half of total crop value throughout the whole period. Together these six major crops

accounted for 81 percent, 78 percent and 70 percent of the total value of crop output, respectively, for 1960, 1965, and 1969. While in terms of percentages of crop area, as shown in Table 8, rice alone again accounted for about averagely one-half the total crop area throughout the period. Together these six major crops constituted 80.5 percent, 76.0 percent and 66.3 percent of the total crop area, respectively, for 1952, 1960, and 1965. Therefore, it is possible to obtain a whole picture of the change in total crop output by examining these six major crops. Table 9 presents the index numbers of area, production, and yield of these major crops during the period 1952-1969.

Table 7. Value of major crops as percent of total value of crop production, 1960-1969<sup>a</sup>

Period	Rice	Sweet potatoes	Sugar cane	Peanuts	Banana	Pineapple
1960	57.0	11.1	6.9	4.0	1.2	1.2
1961	56.0	10.9	7.9	3.7	1.3	1.0
1962	55.0	11.0	7.4	3.4	1.4	1.3
1963	54.4	8.2	8.5	3.2	1.9	1.3
1964	47.6	10.5	13.8	3.6	4.0	1.2
1965	48.9	9.4	8.5	3.3	6.7	1.2
1966	49.1	10.2	7.4	3.2	6.6	1.3
1967	48.2	11.1	5.4	3.7	6.9	1.4
1968	48.0	9.8	5.8	2.7	6.3	1.4
1969	44.7	11.5	5.5	2.6	5.2	1.7

<sup>a</sup>Source: (computed and compiled from 65, pp. 58, 85, 120, 123, 145 and 146).

Table 8. Percentages of crop areas<sup>a</sup>

Year	Rice	Sweet potatoes	Sugar cane	Peanut	Banana
1952	53.32	15.84	4.43	5.49	1.06
1953	53.03	16.20	5.14	5.63	0.87
1954	52.24	16.65	4.29	6.32	0.84
1955	51.10	16.71	3.55	6.54	0.73
1956	52.60	15.29	4.02	6.53	0.64
1957	51.23	14.96	4.28	6.78	0.74
1958	50.04	14.70	4.35	6.69	0.89
1959	49.72	14.51	4.24	6.35	0.83
1960	49.07	15.07	4.08	6.44	0.81
1961	49.53	14.92	4.23	6.24	0.93
1962	50.39	14.82	3.95	6.11	0.94
1963	48.52	15.27	4.06	6.33	0.95
1964	48.28	15.53	4.00	6.37	1.14
1965	48.23	14.60	4.60	6.47	1.71
1967-69	46.55	14.00	5.81	-	-

<sup>a</sup>Source: (9, p. 61 and 62, pp. 20-21).

Table 9 shows that the growth in output over the whole period was substantial for all six crops. Indeed, there was a decline in the planted area for rice, sweet potatoes, and sugarcane, on the one hand, while banana and pineapple crops showed a substantial increase in planted area, on the other hand. Planted area for peanuts increased steadily. Thus, we may conclude that yield per hectare increases contributed to output expansion of rice, sugarcane and sweet potatoes while both yield and planted area increases contributed to increased production of bananas, peanuts and pineapples. A look into the data provided in Tables 7, 8 and 9, convincingly shows the

Table 9. Index number of area, production and yield of seven major crops, Taiwan, 1952-69<sup>a</sup>

	Rice (Brown)			Sweet potatoes			Sugar cane		
	Planted area	Production	Yield per Ha	Planted area	Production	Yield per Ha	Harvested area	Production	Yield per Ha
1952	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1953	99.0	104.5	105.5	101.8	108.9	106.9	115.5	174.8	151.2
1954	98.8	107.9	109.2	106.0	122.3	115.3	97.6	75.1	134.5
1955	95.5	102.8	107.6	105.1	116.6	110.8	79.4	126.8	159.4
1956	99.7	114.0	114.3	98.5	122.8	124.5	92.7	132.1	142.4
1957	99.6	117.1	117.5	97.9	128.8	131.5	100.2	147.5	147.1
1958	99.0	120.6	121.8	97.9	141.5	144.4	103.5	156.6	151.3
1959	98.7	118.2	119.7	97.0	138.4	142.7	105.2	168.5	166.4
1960	97.5	121.7	124.8	100.8	142.5	141.3	97.4	140.3	143.8
1961	99.5	128.4	128.9	100.9	154.7	153.1	102.2	165.0	161.3
1962	101.0	134.5	133.1	100.0 <sub>b</sub>	147.3	147.2	95.4	127.9	134.0
1963	95.3	134.3	140.8	97.1 <sub>b</sub>	102.7	105.7	96.0	135.5	141.1
1964	97.3	143.1	146.9	105.3 <sub>b</sub>	160.1	152.0	96.9	140.5	144.8
1965	98.3	149.5	152.0	100.2 <sub>b</sub>	149.8	149.4	112.9	197.6	174.9
1966	100.3	151.5	151.0	100.8 <sub>b</sub>	165.5	164.1	107.8	185.8	172.3
1967	100.1	153.7	153.5	101.2 <sub>b</sub>	177.9	175.7	92.0	140.4	152.6
1968	100.5	160.3	159.5	102.9 <sub>b</sub>	164.8	160.1	97.8	172.2	175.9
1969	100.1	147.8	147.7	99.7 <sub>b</sub>	177.1	177.6	95.2	146.0	153.3

<sup>a</sup>Source: (computed from 16, pp. 33-36).

<sup>b</sup>Harvested area.

Table 9 (Continued)

	Banana			Pineapple			Peanuts		
	Harvested area	Production	Yield per Ha	Harvested area	Production	Yield per Ha	Planted area	Production	Yield per Ha
1952	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1953	80.8	89.9	110.9	98.2	109.9	112.5	101.9	100.1	98.2
1954	79.6	91.7	115.5	94.8	104.4	111.3	116.4	109.7	94.6
1955	68.1	79.2	116.4	98.2	112.3	115.8	118.5	110.8	93.5
1956	61.4	54.9	90.0	110.3	132.3	120.1	121.3	136.3	112.4
1957	71.9	86.5	120.4	124.1	157.6	128.7	127.9	156.0	122.1
1958	87.8	104.1	118.0	144.8	218.0	152.1	128.3	160.6	121.0
1959	82.8	97.7	118.3	153.4	232.5	153.0	122.3	161.6	132.1
1960	80.8	106.8	131.9	167.2	265.6	159.4	124.0	170.1	137.2
1961	94.2	121.3	129.0	167.2	276.5	166.0	121.7	174.2	143.1
1962	94.9	131.8	139.0	181.0	306.4	170.2	118.8	159.0	133.8
1963	93.6	123.9	132.1	165.5	260.2	159.0	116.6	152.3 <sup>b</sup>	130.4
1964	115.2	250.7	217.4	181.0	361.1	201.6	124.4	192.7 <sup>b</sup>	154.9
1965	174.5	430.5	246.1	191.3	368.0	194.5	127.9	209.5 <sup>b</sup>	163.8
1966	232.4	493.8	212.2	206.8	430.8	209.6	120.9	191.5 <sup>b</sup>	158.2
1967	280.8	595.0	217.6	205.1	471.7	232.8	120.8	228.1 <sup>b</sup>	188.7
1968	278.9	604.2	216.3	203.4	496.1	241.0	117.6	177.3 <sup>b</sup>	150.7
1969	239.4	547.9	228.4	213.7	374.4	243.3	112.8	167.8 <sup>b</sup>	148.8

superiority of Taiwan's agriculture. The high growth rate of per hectare productivity of all major crops was achieved during the period 1952-1969.

b. Sources of increased crop production Crop output can be increased in two ways: expanding the cultivated area and increasing yields per hectare of cultivated area. In Taiwan, the potential for achieving large increases in agriculture by expanding the land area under cultivation was quite fully exploited by 1945. Thus, much of the increased crop output after 1945 was from increased output per hectare of cultivated area. Increases in crop production per hectare of cultivated area also came from two sources: increased multiple cropping (growing more than one crop a year on the same land) and increased crop production per hectare of crop area. The relative importance of these different sources of expansion in crop production had changed over time since 1953 as shown on Tables 10 and 11. Table 11 indicates that much of the expansion in agricultural output was achieved by introducing new farming methods to increase crop output per hectare. Crop output per hectare, either per hectare of cultivated land or per hectare of crop area, increased over 3 percent a year in different periods except the period 1965-1969. Nearly all of the increase in crop output in Taiwan was from increased output per hectare. For example, from 1953-1960, increased crop production per hectare of cultivated land accounted for nearly

Table 10. Annual growth rates in crop production, cultivated land, crop area, and multiple cropping in Taiwan, 1953-69<sup>a</sup>

Unit: percent

Period	Crop production	Cultivated land	Crop area	Multiple cropping ratio
1953	8.1	-0.34	0	0.34
1954	1.5	-0.11	0.86	0.75
1955	-1.6	-0.11	-1.57	-1.43
1956	8.5	0.34	2.81	2.44
1957	6.0	-0.34	1.69	1.99
1958	5.7	1.26	1.72	0.50
1959	0.3	-0.67	0.25	0.94
1960	1.9	-1.02	0.06	1.10
1961	7.1	0.34	1.56	1.19
1962	1.2	0	-0.24	-0.26
1963	-1.5	0	-0.31	-0.32
1964	14.0	0.11	2.91	2.00
1965	8.3	0.90	1.62	0.74
1966	4.7	0.67	1.00	0.31
1967	4.1	0.89	-0.70	-0.84
1968	4.9	-0.22	0.23	0.42
1969	-3.8	1.66	-0.47	-2.17
1953-60 average	3.7	-0.10	0.72	0.82
1960-69 average	4.1	0.33	0.79	0.21
1953-69 average	4.0	0.16	0.63	0.45

<sup>a</sup>Source: (Derived from 92, pp. 28 & 32).

all of the expansion in crop production. However, from 1961 to 1965, and 1965 to 1969, expansion in cultivated land accounted for 8.2 percent and 22 percent, and increased crop production per hectare of cultivated land for 91.8 percent and 78 percent of the expansion in total crop production (Table 11). In the whole period 1953-1969, the share of increases in total crop output from increase in cultivated land and per hectare of cultivated land was 4 percent and 96 percent,

Table 11. Annual growth rates in crop production, cultivated land, crop area, production per hectare, and multiple cropping in Taiwan, 1953-69<sup>a</sup>  
Unit: percent

Items	1953 to 1960	1961 to 1965	1965 to 1969	1960 to 1969	1953 to 1969
A. Crop production	3.70	5.80	3.60	4.10	4.00
B. Cultivated land	0.10	0.48	0.78	0.33	0.16
C. Crop production per hectare of cultivated land	3.70	5.32	2.82	3.77	3.84
D. Crop area	0.72	1.10	0.33	0.79	0.63
E. Crop production per hectare of crop area	2.98	4.65	3.15	3.51	3.49
F. Multiple cropping ratio	0.82	0.67	0.33	0.21	0.45

<sup>a</sup>Source: (compiled from Table 10).

<sup>b</sup>Growth rate in cultivated land plus growth rate in crop production equals growth rate in production (i.e.,  $B+C=A$ ), and growth rate in crop production per hectare of crop area plus growth in multiple cropping ratio equals growth rate in crop production per hectare of cultivated land (i.e.,  $E+F=C$ ) (29, p. 21).

respectively.

Regarding crop area, the growth rate was 0.63 percent during the period 1953-1969 (see Table 11). This increase in crop area includes the effect of multiple cropping. All the growth has resulted from higher crop yields and more multiple cropping. However, higher yields per hectare of crop area had been more important than increased multiple cropping as a source of increased crop production per hectare of cultivated

land. As indicated in Table 11, in the periods 1953 to 1960 and 1960 to 1969, increased crop production per hectare of crop area accounted for about 78 percent and 94.5 percent and increased multiple cropping for about 22 percent and 5.5 percent of the increase in crop production per hectare of cultivated land, respectively. In the whole period from 1953 to 1969, the share of increases in crop production per hectare of cultivated land from increases in crop production per hectare of crop area and multiple cropping was 88.3 percent and 11.7 percent, respectively.

Christensen's study of Taiwan's agricultural development indicate that:

The growth in crop production per hectare of crop area is the most remarkable. It has involved shifts to crops that mature in a short time and that have a high value per hectare planted. Shifts in crop pattern to include more vegetables and other high value crops have contributed in increase crop production per hectare of crop area (22, p. 21).

The very high growth rates in crop output per hectare in Taiwan during the period under consideration was highly significant, since it indicates there may be large potentials for increasing crop yields in other developing nations on land already under cultivation.

### C. Net Transfer of Capital

Past experience indicates that rising productivity and output in agriculture can be a major source of capital for the non-farm sector during the early stages of economic development

in Japan and the United States. It is also true for the case of Taiwan. Therefore, it is particularly important to observe the net real outflow of capital from agriculture as a source of capital formation to be used in industrial sectors and other forms of production in the non-farm sector. Table 12 shows net real outflow of capital from agriculture for selected years. It can be seen from Tables 4, 5 and 12 that the amount of net real outflow of capital from agriculture have increased together with growth in agricultural productivity. It is also evident that increasing productivity in agriculture made it possible to channel a part of net returns from agriculture into capital formation for use in both agricultural and non-agricultural sectors.

Kuznets notes that:

agriculture makes a market contribution to economic growth by (a) purchasing some production items from other sectors at home or abroad; (b) selling some of its products, not only to pay for the purchases listed under (a) but also to purchase consumer goods from other sectors or from abroad, or to dispose of the product in any other than consumption within the sector (70, pp. 109-110).

According to Kuznets' argument, the market contribution of agriculture to economic growth in Taiwan would be analyzed in terms of the difference between total farm cash sales and total farm purchases in the period of 1935-1969.

In his study of "Intersectoral Capital Flows in the Economic Development of Taiwan, 1895-1960" and "Strategies for Transferring Agricultural Surplus Under Different Agriculture

Table 12. Net real outflow of capital from agriculture sector to other sectors of the economy of Taiwan  
Unit: 1935-37 constant price<sup>a</sup>

Period	Million Taiwan dollars
1935	68
1940	51
1950	68
1955	97
1950-55	112.76
1956-60	96.2
1960	100
1961-65	107.4
1966-69	144.2

<sup>a</sup>Source: (22, p. 26; 75; and 78, p. 231).

Situations in Taiwan", Lee has estimated the flow of products and fund out of the agricultural sector to other sectors of the economy of Taiwan and from other sectors into the agricultural sector (74,141). The total value of the outflow of products, i.e., total farm cash sales, from agricultural sector for sales to non-farm household, foreign countries, and processors has exceeded the total value of the inflow of current inputs, fixed capital and consumer good, i.e., total farm purchases, that went into the agricultural sector in the period 1911-69 as shown in Table 13. For example, the net outflow, measured at 1935-37 Taiwan dollars (T\$), was T\$112.8 million averagely in the period 1950-55, T\$107.3 million averagely in the period 1961-65, and T\$144.6 million for 1966-69. Improvements in agricultural output and productivity have

Table 13. Intersectoral resource flows in Taiwan, 1911-69<sup>a</sup>  
(Millions of Taiwan dollars at 1935-37 prices)

	1911-15	1921-25	1931-35	1936-40	1950-55	1961-65	1966-69
Agricultural output	162.9	238.0	361.4	422.5	513.3	801.6	1,044.9
Marketed share (per cent)	56.3	63.8	71.7	71.4	58.0	60.6	61.9
Resource transfer share (per cent)	30.5	26.1	24.8	21.1	22.0	13.4	13.8
Total farm cash sales	91.6	151.7	259.3	301.6	297.8	485.8	646.8
Percentage breakdown							
Sales to non-farm households	32.6	26.5	23.2	22.6	46.4	40.6	42.5
Sales to foreign countries	16.9	23.2	34.4	32.3	5.5	7.4	8.2
Sales to processors	50.5	50.3	42.4	45.1	48.1	52.0	49.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total farm purchases	42.1	92.6	169.8	212.5	185.0	378.5	502.4
Percentage breakdown							
Current inputs	18.3	27.4	32.3	31.6	32.2	32.6	35.6
Fixed capital	2.3	7.9	5.6	3.6	3.3	10.4	15.6
Consumer goods	79.4	64.7	62.1	64.7	64.5	57.0	48.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

<sup>a</sup>Source: (74,141).

depended on the purchase of current inputs, i.e., capital goods. Without these current inputs, productivity in agriculture could not have increased as much as it did.

#### D. Capital Contribution of Agriculture

The factor contribution of agriculture to economic growth primarily involves a transfer of productive resources from the agricultural sector to the non-agricultural sectors. As pointed out by Kuznets:

The resources being transferred are either capital, or rather funds for financing acquisition of material capital, or labor (70, p. 114).

The two factors, capital and labor, are analyzed.

There are six kinds of contributions which agriculture makes to the capital of the non-agricultural sectors of the economy. They are agricultural savings and capital formation in agriculture, agricultural export earnings, land tax, low compulsory purchasing price of paddy rice, high government exchange price of fertilizer to rice and human capital transfer through labor migration.

##### 1. Agricultural savings and capital formation

Capital formation in agriculture is an important factor in both agricultural and economic development and agricultural savings are a principal source of capital. In the late 19th century, Japan provided the best example of the utilization of agricultural savings for non-agricultural investment and

thereby stimulating general economic development. Thus, we can also judge the growth of the agricultural sector on the basis of the rate of agricultural savings and of capital formation.

Table 14 shows that, over the period from 1952 to 1969, not only did agricultural savings finance agricultural investment, but also most of this savings was diverted to finance non-agricultural investment. Considering the average of the period, agricultural savings diverted to finance non-agricultural investment was valued at NT\$2,816 million, which accounted for almost 55 percent of the total agricultural savings, NT\$5,163 million. The percentage of agricultural savings diverted to finance non-agricultural investment had increased markedly from 19.19 in 1953 to the peak of 65.64 in 1967 and finally declined to 62.51 percent in 1969.

The distribution of gross domestic capital formation and total fixed capital formation between agriculture and industry in the period 1952-68 is shown in Table 15, which shows a decrease in the ratio of agricultural fixed capital formation to both gross domestic and total fixed capital formation. The percentage of the agricultural sector in total fixed and gross domestic capital formation had declined sharply from 24.2 percent and 17.0 percent in 1952 to 11.7 percent and 10.0 percent in 1968, respectively, while that of the industrial sector had increased from 30.1 percent and 22 percent in 1952

Table 14. Agricultural savings and non-agricultural investment, 1952-69, Taiwan<sup>a</sup>  
Unit: NT\$ million

Period	(A)	(B)	$\frac{(B)}{(A)} \%$
	Total agricultural savings <sup>b</sup>	Agricultural savings used in non-agriculture <sup>b</sup>	
1952	710	-645	-
1953	1,918	308	19.19
1954	427	-1,077	-
1955	1,313	173	13.18
1956	2,019	633	31.35
1957	2,413	1,138	47.16
1958	2,520	1,022	40.56
1959	3,264	1,293	39.61
1960	3,868	2,048	52.95
1961	4,959	2,787	56.20
1962	4,195	2,201	52.47
1963	5,105	2,900	56.81
1964	7,047	4,351	61.74
1965	9,112	5,601	61.47
1966	9,521	5,815	61.08
1967	10,257	6,733	65.64
1968	11,804	7,610	64.47
1969	12,471	7,795	62.51
Average	5,163	2,816	54.54

<sup>a</sup>Source: (Compiled and computed from 86, p. 31).

<sup>b</sup>Based on 1964 constant prices.

to 45.2 percent and 38.9 percent in 1968, respectively.

However, the absolute amount contributed by the agricultural sector to total fixed capital formation in 1968 was about nine times the value of 1952. This factor contribution was made by the agricultural sector. These data reveal the fact that as

Table 15. Distribution of gross domestic and total fixed capital formations 1952-68<sup>a</sup>  
Unit: NT\$ million

Year:	Total fixed capital formation	Agricultural fixed capital formation			Industrial fixed capital formation		
		Amount	% of total fixed capital formation	% of gross domestic capital formation	Amount	% of total fixed capital formation	% of gross domestic capital formation
1952	1,940	470	24.2	17.0	683	30.1	22.0
1953	2,678	693	25.9	21.4	814	30.4	25.2
1956	4,591	1,038	22.6	18.7	1,753	38.2	31.7
1957	5,283	891	16.9	14.0	2,230	42.2	35.0
1958	6,765	1,316	19.5	16.6	2,890	42.8	36.6
1959	8,595	1,813	21.1	18.5	3,570	41.5	36.5
1960	10,361	1,897	18.3	15.0	3,845	37.1	30.5
1961	11,349	2,212	19.5	15.8	4,209	37.1	30.2
1962	11,623	2,128	18.3	14.5	4,583	39.4	31.3
1963	13,335	2,290	17.2	14.8	4,971	37.3	32.2
1964	14,872	2,606	17.5	13.3	5,862	39.4	29.8
1965	19,090	3,306	17.3	12.6	7,729	40.5	29.6
1966	23,974	3,567	14.9	12.2	10,474	43.7	35.9
1967	30,185	3,585	11.9	9.0	14,499	48.0	40.2
1968	37,130	4,329	11.7	10.0	16,795	45.2	38.9

<sup>a</sup>Source: (Compiled and computed from 92, p. 22).

the result of rapid economic growth in Taiwan, the industrial growth rate increased faster than that of agriculture. This is a usual tendency of a developing economy. But this does not mean that it is unnecessary to increase agricultural investment on farms to develop the agricultural resources. In fact, the development of agricultural resources is urgently needed now to increase the supply of food and other agricultural products in the year ahead.

Now, let us examine the relationship between capital formation in agriculture and the total value of agricultural production in the period 1952-1968. Table 16 shows that the annual growth rate of capital formation in agriculture increased 14.6 percent averagely while that of the total value of agricultural production increased 12.4 percent in the period under review. This indicates that the annual growth rate of agricultural fixed capital formation increased more rapidly than that of the total value of agricultural production, reflecting the increase in the capital-output ratio. Total fixed capital formation in agriculture averaged around nine percent of the total value of agricultural production during the period under study.

## 2. Agricultural export earnings

Foreign trade is one of the most important economic concerns of Taiwan. Taiwan's economy must depend primarily upon international trade. Hence, expansion of Taiwan exports

Table 16. Capital form in agriculture and total value of agricultural production, 1952-68, Taiwan<sup>a</sup>

Period	Total fixed capital formation in agriculture (1)		Total value of agricultural production <sup>b</sup> (2)		(1) as percentage of (2)
	NT\$ million	Annual rate of growth	NT\$ million	Annual rate of growth	%
1952	470		6,145		7.6
1953	693	47.4	9,097	48.0	7.6
1956	1,038	49.8	11,160	22.7	9.3
1957	891	-14.1	13,135	17.7	6.8
1958	1,316	47.6	14,537	10.7	9.1
1959	1,813	37.8	16,619	14.3	10.9
1960	1,897	4.6	21,867	31.6	8.7
1961	2,212	16.6	24,427	11.7	9.1
1962	2,128	-3.8	24,833	1.7	8.6
1963	2,290	-7.6	26,056	4.9	8.8
1964	2,606	13.8	31,205	19.8	8.3
1965	3,306	26.9	32,157	3.1	10.3
1966	3,567	7.9	33,970	5.6	10.5
1967	3,585	0.5	37,209	9.5	9.6
1968	4,329	20.7	40,631	9.2	8.8
1952-68 average <sup>c</sup>		14.6		12.4	8.9

<sup>a</sup>Source: (Computed from 92, p. 22 and 111, p. 24).

<sup>b</sup>Including crop and livestock production.

<sup>c</sup>Not including 1954 and 1955.

is a necessary step toward accelerated economic development. It is generally argued that foreign agricultural trade should play an important role in the economic development of developing countries. Past experience indicates that Japan, America, Russia and Canada used exports of agricultural products to finance imports of capital goods and to serve the foreign trade during their take-off stage of economic development (95, p. 48).

The data in Table 17 indicates that Taiwan's economy is heavily dependent on agricultural exports. Exports of agricultural and processed agricultural products had registered large gains in term of export earnings, and increasing from \$114 million in 1952 to \$305 million in 1969, but their relative shares in total export earnings had sharply fallen from 26.9 percent and 68.3 percent, totaling 95 percent, in 1952 to 11 percent and 16.4 percent, totaling 27.5 percent, respectively, in 1969. While industry's share had increased considerably from 4.8 percent in 1952 to 72.5 percent in 1969. This change in composition of exports reflects first the growth of import-substitution industries and then the development of export industries. This change also confirms the general argument that in a developing economy, the agricultural share in the total foreign export earnings will gradually decline.

Table 17. Composition of exports<sup>a</sup>

Period	Value (US\$1,000)				Percentage distribution			
	Total	Agri-cultural products	Processed agricultural products	Industrial products	Total	Agri-cultural products	Processed agricultural products	Industrial products
1952	119,527	32,194	81,637	5,696	100.0	26.9	68.3	4.8
1953	129,793	17,019	103,275	9,499	100.0	13.1	79.6	7.3
1954	97,756	14,481	75,571	7,704	100.0	14.8	77.3	7.9
1955	133,441	39,600	83,582	10,259	100.0	29.7	62.6	7.7
1956	130,060	19,504	93,343	17,213	100.0	15.0	71.8	13.2
1957	168,506	28,071	125,820	14,615	100.0	16.6	74.7	8.7
1958	165,487	39,135	103,725	22,627	100.0	23.6	62.7	13.7
1959	163,708	38,462	86,088	39,158	100.0	23.5	52.6	23.9
1960	174,195	18,638	96,551	59,005	100.0	10.7	55.4	33.9
1961	218,324	30,694	94,068	93,362	100.0	14.1	43.1	42.8
1962	244,379	30,978	89,314	124,087	100.0	12.7	36.5	50.8
1963	363,467	48,204	158,617	156,646	100.0	13.3	43.6	43.1
1964	469,468	68,003	194,730	206,735	100.0	14.5	41.5	44.0
1965	495,813	116,121	152,124	227,568	100.0	23.4	30.7	45.9
1966	584,239	112,819	150,633	320,787	100.0	19.3	25.8	54.9
1967	675,092	121,298	148,457	405,337	100.0	18.0	22.0	60.0
1968	841,775	109,261	173,365	559,149	100.0	13.0	20.6	66.4
1969	1110,623	122,723	182,253	805,647	100.0	11.1	16.4	72.5

<sup>a</sup>Source: (92, p. 34).

Agricultural export earnings were primarily from a few agricultural products, namely, sugar, rice, banana, and canned pineapple during the period 1952-69 as shown in Table 18. Historically, sugar has long been the most valuable agricultural product in export earnings. As indicated by Table 18, more than 50 percent of the total foreign exchange was obtained from sugar alone until 1956. In the years 1960, 1965, and 1969, the sugar's share of total foreign export value declined substantially to 42.7, 13.7 and 4.3 percent, respectively. The same situation is true in the case of rice. Nevertheless, despite the decline in agriculture's share of the total value of exports, agricultural exports still remain an important source of foreign exchange earnings in Taiwan's economy. The diversification of agricultural exports has accounted for an increase from a few major products in 1952 to ten in recent years. The major agricultural products for export now include canned mushrooms, asparagus, tea, citronella oil, fresh fruits and vegetables in addition to the four major crops mentioned earlier. The development of diversification of agricultural exports has helped to make up foreign exchange losses from reduced exports of sugar and rice. These new agricultural export crops have shown remarkable growth rates since they were developed on export products. For example, mushrooms and asparagus exports did not begin until 1960 and 1964, respectively, but by 1969 their combined value reached

Table 18. Value of major crop exports and their percentage distribution in selected years<sup>a</sup>

Period	Sugar	Rice	Banana	Canned pineapple
I. Amount (\$1,000)				
1952	69,684	23,240	6,634	2,012
1956	76,060	12,837	3,146	6,109
1960	74,401	4,320	7,135	8,487
1964	135,403	18,044	33,468	13,911
1966	61,709	32,980	54,714	19,307
1967	43,689	21,186	63,673	19,297
1968	50,525	13,930	57,162	18,974
1969	47,621	4,148	59,231	20,657
II. Percentage in total value of agricultural exports				
1952	58.30	19.44	5.55	1.68
1956	58.48	9.87	2.42	4.70
1960	42.71	2.48	4.10	4.87
1964	28.84	3.84	7.13	2.96
1966	10.56	5.65	9.37	3.30
1967	6.47	3.14	9.43	2.86
1968	6.00	1.65	6.79	2.25
1969	4.29	0.37	5.33	1.86

<sup>a</sup>Source: (9, p. 33).

\$63.9 million, accounting for 5.75 percent of total value of foreign exports (9, p. 33).

Total agricultural export earnings over the period from 1952-69 estimated by Pein (86, p. 35), taking 1964 constant prices as base, valued at NT\$26.052 billion, averaging NT\$1.447 billion each year over the past 18 years.

### 3. Land tax

Land tax, the forced extraction of surplus from agriculture, is the most important direct tax on agriculture, hence it is commonly considered as the main source of government tax revenue in developing nations. The government taxed away much of the increase in farmers' incomes to finance capital formation elsewhere in the economy. The historical experience of Japan represents one of the outstanding examples. During the late nineteenth and early twentieth century, about 50 to 85 percent of Japan's government tax revenue came from agricultural sources (81, p. 85). The tax burden on agriculture, as a percentage of agricultural income, was much heavier than for other sectors of the economy. However, the land tax in Taiwan did not play as predominant role as it did in Japan. During the early stage of economic development prior to World War II, the percentage of land tax in Taiwan in total tax revenue was 38.9, 27.6, and 6.5 percent in the years 1905, 1935, and 1943, respectively (74, p. 252). When these figures are compared with the Japanese land tax share in total tax

revenue it is clear that capital transfer through land tax was not the most important contribution of agriculture in Taiwan in the early period. This fact also indicates that the share of land tax in total tax revenue declined rapidly during the prewar period, but the absolute amount of land tax increased steadily (66, p. 124).

During the post-war period 1952-69, the land tax varied from five percent to nine percent of the government total tax revenue as indicated by Table 19. The absolute value of the land tax increased considerably from NT\$283 million in 1954 to NT\$3.014 billion in 1969 while the percentage of land tax in the government total tax revenue grew from 6.5 percent in 1954 to 9.25 percent in 1969 (see Tables 19 and 20). As seen in Table 19, the main sources of the government tax revenue came from customs duties, commodity tax, and tobacco and wine monopoly revenue, accounting for more than one-half of government total tax revenue throughout the period 1954-69. The land tax as a percentage of the total value of agricultural production ranged from two percent to near five percent, averaging about three percent during the period 1954-68 as shown on Table 20.

#### 4. Low compulsory purchasing price of paddy rice

Rice is by far the most significant component in the group of cereals in Taiwan's diet. For example, rice accounted for 84 percent of all cereals in terms of annual per capita

Table 19. Major composition of government taxation revenue, Taiwan, 1952-1969<sup>a</sup>

Period	Customs duties	Commodity tax	Tobacco and wine monopoly revenue	Land tax	Income tax	Business tax
I. Amount (NT\$ million)						
CY <sup>b</sup>	1952	520	109	421	151	141
	1953	513	161	590	257	151
Jan.-June,	1954	421	100	398	36	81
FY <sup>c</sup>	1954	1,014	409	895	283	176
	1957	1,648	695	1,442	511	360
	1958	1,545	854	1,663	432	422
	1960	1,618	970	1,886	462	501
	1961	1,823	1,147	2,286	622	561
	1962	1,963	1,017	2,740	645	621
	1963	2,242	1,455	2,886	778	683
	1964	2,694	1,788	2,883	742	760
	1965	3,477	2,073	3,273	886	900
	1966	4,110	2,382	3,697	1,077	951
	1967	4,447	2,955	4,244	1,134	960
	1968	5,655	3,654	4,779	1,906	1,208
	1969	7,405	3,657	5,433	3,014	1,719

II. Percentage (%)							
CY	1952	21.99	4.61	17.80	6.38	13.49	5.96
	1953	17.53	5.50	20.16	8.78	10.01	5.16
Jan.-June,	1954	24.24	5.76	22.91	2.07	7.95	4.66
FY	1954	23.30	9.40	20.56	6.50	8.91	4.04
	1957	23.53	9.92	20.59	7.30	8.80	5.14
	1958	20.35	11.25	21.91	5.69	9.87	5.56
	1960	18.23	10.93	21.24	5.20	10.29	5.64
	1961	18.92	11.90	23.73	6.46	10.18	5.82
	1962	19.36	10.03	27.02	6.36	8.02	6.12
	1963	19.92	12.93	25.64	6.91	6.82	6.07
	1964	20.98	13.93	22.45	5.78	8.81	5.92
	1965	22.81	13.60	21.47	5.81	8.95	5.90
	1966	23.78	13.78	21.39	6.23	7.41	5.50
	1967	22.87	15.19	21.82	5.83	7.07	4.94
	1968	23.23	15.01	19.63	7.83	7.48	4.96
	1969	22.71	17.35	16.67	9.25	7.81	5.27

<sup>a</sup>Source: (Compiled from 92, pp. 109-110).

<sup>b</sup>From 1952 through 1953 are referred to calendar year.

<sup>c</sup>From 1954 through 1969 are referred to fiscal year.

Table 20. Land tax in Taiwan<sup>a</sup>

Period <sup>b</sup>	Value (NT\$ million)	% of total tax revenue	% of total value of agricultural production
CY 1952	151	6.38	2.45
1953	257	8.78	3.22
FY 1954	283	6.50	3.58
1957	511	7.30	3.89
1958	432	5.69	2.97
1960	462	5.20	2.11
1961	622	6.46	2.54
1962	645	6.36	2.59
1963	778	6.91	2.98
1964	742	5.78	2.37
1965	886	5.81	2.75
1966	1,077	6.23	3.17
1967	1,134	5.83	3.04
1968	1,906	7.83	4.69
1969	3,014	9.25	--
1952-1969 average		6.69	--
1952-1968 average		6.50	3.05
1954-1968 average		6.33	3.06

<sup>a</sup>Source: (92, p. 109; computed from 92, p. 109 and 212, p. 24).

<sup>b</sup>1952 and 1953 are referred to calendar year while 1954-1969, excluding 1955, 1956, and 1959, are referred to fiscal year.

consumption in 1965 (12, p. 83). Thus, it can be seen that a change in the price of rice will exert great impact on prices of other commodities. In order to maintain price stability in the economy and meet the needs of the government budget, the government has been imposing a policy of a low rice price. The compulsory purchase price of rice forces large landowners and cultivators to deliver relatively large amounts of paddy rice at the official low price so as to eliminate the role played by landlords in agriculture. It can be seen from the third column of Table 21 that the official purchasing price of paddy rice from farmers averaged about 72 percent of the wholesale market price during the period 1952-68. The total income loss of rice farmers caused by the government low purchasing price was about NT\$1,122 billion as shown in the last column of Table 21. This is a remarkable capital contribution of rice farmers to government revenues.

A low price of rice has brought significant gains to consumers in view of the fact, as indicated previously, that rice accounted for more than three-quarters of their food diet. Historical experience of Taiwan indicates that the rice price not only was low, but also the long-term trend of agricultural prices was low (66, p. 120). These relative low prices of rice and agricultural products would have two favorable effects on the economic growth in Taiwan: (1) consumers will spend less on food and other agricultural products,

Table 21. Amount of paddy rice purchased gross farm income loss caused by government regulation, Taiwan<sup>a</sup>

	Official purchasing price NT\$/M.T. (1)	Whole sale market price NT\$/M.T. (2)	Ratio $\frac{(1)}{(2)}$	Price spread <sup>b</sup> (2)-(1) NT\$/M.T.	Amount of paddy rice purchased	Reduced gross farm income NT\$ million
1952	980	1,810	0.54	830	77,527	64.3
1953	1,460	2,150	0.67	690	76,526	52.8
1954	1,460	1,840	0.79	380	75,705	28.8
1955	1,530	2,120	0.72	590	69,602	41.1
1956	1,600	2,210	0.72	610	74,104	45.2
1957	1,680	2,450	0.68	770	77,492	59.7
1958	1,800	2,450	0.73	650	75,101	48.8
1959	1,920	3,090	0.62	1,170	67,901	79.4
1960	2,560	3,900	0.65	1,340	69,498	93.1
1961	2,830	3,930	0.72	1,100	75,241	82.8
1962	2,900	3,780	0.76	880	73,898	65.0
1963	2,960	3,990	0.74	1,030	67,410	69.4
1964	3,040	4,110	0.73	1,070	76,257	81.6
1965	3,010	4,090	0.73	1,080	79,687	86.1
1966	3,220	4,270	0.75	1,050	73,314	77.0
1967	3,410	4,270	0.79	860	80,012	68.8
1968	3,650	4,570	0.79	920	84,986	78.2
Total					1,274,261	1,122.1

<sup>a</sup>Source: (Computed from 113, pp. 138-139, p. 149, and pp. 158-59).

<sup>b</sup>Amount official purchased price of paddy rice below whole sale price of paddy rice.

hence they are able to buy non-agricultural commodities, eventually stimulating industrial production, in one hand; (2) the industrial sector would gain from these low prices because of a wage level in the industrial sector are remained stable easily and of the cost of raw materials provided by agricultural sector as production inputs of industrial sector is low (66, p. 121). But an important question in connection with low prices of rice and agricultural products may be raised that government low agricultural price policy may depress farmers' income, hence the incentives for increasing agricultural output, particularly, rice production would be consequently retarded. Past achievements of Taiwan's agricultural output, as shown in Tables 4 and 5, provides that the answer is "no". Total rice production steadily increased from 1.6 million metric tons in 1952 to 2.3 million metric tons in 1969, an increase of 48 percent in 18 years in despite of cultivated area remaining almost constant throughout the entire period (92, p. 33).

##### 5. High government exchange price of fertilizer to rice

The use of various kinds of chemical fertilizer is found to have played a very important part in raising agricultural productivity and output in Taiwan. The application of fertilizers had more than doubled from 458,369 metric tons in 1952 to 993,288 metric tons in 1969 (92, p. 37). The fertilizer-rice barter system was set up primarily in providing

a high quality and ample quantities of chemical fertilizers to farmers through the government, and was designed in order to get rice in return. This system also enabled the government to collect a substantial revenue through this operation in order to meet the budget deficit. Collection of rice by the government under a barter system has been undertaken on an area basis by the district offices of the Bureau of Food, a governmental agency (74, p. 178). Fertilizer-rice barter exchange, usually at an unfavorable ratio to farmers set by the Bureau of Food, could be either spot or loan, but repayment for loan is confined to rice in kind.

A study of the fertilizer-rice barter system in Taiwan in 1959 by Shih and others indicated that farmers exchanged 5 million metric tons of fertilizers and the government got 3.88 million metric tons of rice in return at the existing ratio; while the government should only get 2.87 million metric tons of rice from farmers by providing the same amount of fertilizers to farmers if the market ratio was applied. Therefore, it is clear that the net amount of rice obtained by the government through an unfavorable exchange rate was 1.01 million metric tons, amounting to NT\$404 million in 1959 alone (108, pp. 1-30). The study also estimated that the total loss to farmers, i.e., the total revenue obtained by the government under the fertilizer-rice barter system, was about NT\$4 billion in the past ten years from 1950 to 1959. Lee notes that the

total profit gained by the government through the operation of the barter system nearly valued NT\$423 million each year up to 1962 (74, p. 184).

A study of the capital contribution from Taiwan's agriculture by Pein indicates that the capital contribution generated from the operation of the fertilizer-rice barter system has been one of the important sources to finance non-agricultural sectors (86, pp. 34-35). This may be seen from the analysis of the statistical figures on Table 22 over the past 18 years from 1952 to 1969. The total profit obtained by the government totaled NT\$11.571 billion from 1952 through 1969 cumulatively, or averaging NT\$643 million in each year of the period 1952-69. This is a significant capital contribution to the national economy made by agricultural sector through rice farmers. As pointed out by Kao that rice farmers have made dual capital contributions to the economy by selling their rice to the government at the enforced low purchasing price and by exchanging various kinds of fertilizers to their rice at an unfair exchange ratio during the post-war period (66, p. 123).

In regard to the exchange rates between rice and fertilizers, Lee has criticized as follows:

The exchange rates between different fertilizers and paddy rice were pegged by the Provincial Food Bureau and are adjusted from time to time, ...the exchange rates were not determined by domestic production costs or import prices plus handling charge

Table 22. Earnings from the fertilizer-rice barter system<sup>a</sup> Unit: Metric tons & NT\$

Period	Fertilizer price per metric ton set by government	Production cost of fertilizer <sub>b</sub> per metric ton <sup>b</sup>	Price spread	Quantity of fertilizer distributed	Total earnings to government or total loss to farmers
1952	1,414	1,084	330	164,302	126
1953	1,693	885	808	272,246	419
1954	1,537	1,170	367	436,065	299
1955	1,653	1,258	395	473,514	318
1956	1,795	1,974	-179	545,019	-150
1957	1,986	1,963	23	544,419	17
1958	1,798	1,844	-46	552,581	-34
1959	2,151	2,196	-45	575,276	-33
1960	3,188	2,145	1,043	545,408	628
1961	3,426	2,307	1,119	546,710	654
1962	3,157	2,267	890	653,463	610
1963	3,371	2,144	1,227	751,746	951
1964	3,487	2,166	1,321	605,201	800
1965	3,726	2,592	1,134	959,758	1,070
1966	3,825	2,614	1,211	994,377	1,160
1967	4,133	2,372	1,761	718,161	1,182
1968	4,052	1,933	2,119	1,024,143	1,902
1969	3,791	1,844	1,947	1,006,108	1,652
Total					11,571
Average					643

<sup>a</sup>Source: (86, pp. 34-35).

<sup>b</sup>Referring to domestic production costs and import prices plus handling charge and custom duty.

and custom duty but by monopolistic decisions regarding minimizing profit in consideration of farmers' demand for fertilizers. This is an economically inefficient way to squeeze agriculture. The reason why the Chinese government adopted this measure to collect more rice from farmers was the fact that there was no alternative. Adjustment of the exchange rate without consideration of changes in domestic production costs and international prices seems arbitrary (74, pp. 181-183).

## 6. Human capital transfer

Rising levels of productivity of farm workers, resulting from the use of more capital and improved farm technology, made possible the lease of large numbers of farm workers for work in non-agricultural sectors. Kuznets notes that:

This transfer of workers from the agricultural to the non-agricultural sectors means a sizeable capital contribution because each migrant is of working age and represents some investment in past rearing and training to maturity (70, p. 118).

Thus, agriculture makes an important contribution to national economic growth through providing the human capital transfer from agricultural to non-agricultural sectors.

In the United States, some estimates suggest the flow of human capital, a one-way net transfer from agricultural to non-agricultural sector, amounts to over \$20 billion annually (42, p. 24). This is quite a large amount of human capital transfer. The flow of human capital transfer from agriculture over the period 1951-61 made by Kao who shows that:

During these past 11 years, the estimated out-migrants from agriculture were about 350,000 persons, .... For the purpose of illustrating this factor contribution, let us assume that past investment in each migrant is about NT\$5,000, thus, such contributions made by the agricultural sector during this period amounts to NT\$1.75 billion (66, p. 137).

Pein estimates that about 416,000 farm people moved to non-agricultural sectors in Taiwan during the period 1952-69 (86, pp. 29-30). On the average, about 19,000 farm people moved to non-agricultural sectors each year during the same period. If we use Kao's estimation of past investment in each migrant, i.e., NT\$5,000, the total outflow of human capital transfer for 416,000 farm people during the period 1952-69, would be NT\$2.08 billion. This is a significant human capital contribution of the agricultural sector to non-agricultural sector of the economy. Thus, agriculture made an important contribution to rapid growth of the non-agricultural sectors of the Taiwan economy through migration.

#### E. Concluding Remarks

The role of Taiwan's agricultural development in capital formation has been examined by using Kuznets' approach in the period 1952-69. His measurements on the contribution of agriculture is mainly based on the product, market, and factor contributions of agricultural sector as they relate to economic growth through capital formation.

The preceding analysis suggests that many types of capital contributions were made by Taiwan's agriculture during the post-war period. The first one, net transfer of capital, was analyzed in terms of selling agricultural products to the domestic and foreign markets, and purchasing farm inputs and consumer goods and services from the non-farm sector, i.e. the market contribution of agriculture. The discussion on the second and the third, agricultural savings and capital formation and agricultural export earnings, were closely related to the changes in the structure of Taiwan's economy. As indicated previously, the increasing export of agricultural products made funds available to import capital goods required for economic development. The analysis of the land tax, the low compulsory purchasing price of paddy rice, and the high government exchange price of fertilizer to rice, a compulsory transfer from agriculture, are the results of government taxation and regulation.

In addition to the capital contribution, the agricultural sector also contributed surplus labor to the process of economic growth in Taiwan. The outflow of farm labors into non-farm sectors involved a great amount of human investment made by the agricultural sector, contributed a larger amount of human capital transfer to the non-farm sector, and hence made possible the development of the non-farm sector. It can

be seen from the analysis of this chapter that rice farmers made a significant contribution to the overall development of Taiwan's economy.

V. FACTORS CONTRIBUTING TO INCREASED  
AGRICULTURAL PRODUCTIVITY AND  
OUTPUT IN TAIWAN

The major concern for the developing countries is to find the principal factors contributing to economic development of agriculture under pressures of high population growth. In Chapter II, theoretical and empirical studies on the sources of increased agricultural output and productivity were examined and discussed extensively. In Chapter IV, we demonstrate that substantial increase in agricultural productivity and output has provided the basis for capital formulation and income increased in Taiwan's agriculture after the end of the war. How did Taiwan achieve remarkable performance in increasing its agricultural output and productivity in the post-war period? An attempt is made in this chapter to identify and then explain basic factors responsible for such a high growth rate in Taiwan agricultural production.

Several previous attempts have been made to discuss basic factors contributing to increase in agricultural productivity and output in Taiwan. Christensen (22), Shen (106), Ho (48, pp. 115-180), and Lee (74, pp. 60-134) have made rather extensive discussion. Kao (66, pp. 68-95), Shen (104, pp. 14-18), Hsieh and Lee (51, pp. 103-105), and U.S.D.A. study (129, pp. 78-89) have also listed some important factors to explain economic development of Taiwan's agriculture. After

comprehensively reviewing their studies, we found that the factors that have contributed to rapid agricultural growth in Taiwan are of various kinds and they are complementary to each other. The most important factors affecting Taiwan's agricultural growth and development are the following:

- A. The foundation of basic agricultural science and technology laid by Japanese colonial rule
- B. The Chinese-American Joint Commission on Rural Reconstruction
- C. The land reform program
- D. National agricultural planning and policy
- E. Technological innovations
- F. Agricultural education, research, and extension
- G. Farm service organizations
- H. Land and water resources development
- I. Economic incentives
- J. Agricultural credit
- K. U.S. food aid program

A host of major factors are required as cooperative agents. These factors along with the simultaneous development of interactions between the agriculture and non-agricultural sectors provide the answer to the question how Taiwan improved its agriculture during the post-war period.

A. Basic Foundation of Agricultural Science and Technology Laid by Japanese Colonial Rule

As mentioned in Section A of Chapter IV, Taiwan started its agricultural development programme as early as 1920 and had already achieved impressive progress in increasing agricultural productivity and output before World War II. During Japanese colonial rule from 1895 to 1945, a strong base of agricultural science and technology was established. The Japanese built the basic foundations for the development of Taiwan's post-war agriculture. To this point, Liu says that:

Agricultural development in prewar Taiwan, if examined from the point of view of the mechanics of economic development, is the fundamental factor determining the course of post-war industrialization (79, p. 63).

In a similar vein, Ho has concluded that:

A major factor in Taiwan's post-war economic development is that the island already possessed a progressive and productive agricultural sector when it was returned to Chinese rule in 1945. The transformation of Taiwan's agriculture was the major accomplishment of the Japanese Colonial Administration... (46, p. 313).

It can be clearly seen that a strong base of agricultural science and technology was one of the important factors in the promotion of industrialization in Taiwan's postwar economy, in that it contributed greatly not only to meet the demands of the rapidly growing population, but also to the supply of new materials to the industrial sector.

However, one more factor contributed to post-war development of the Taiwan economy. It was the historical reorganization of the Taiwan economy after the end of World War II. This historical reorganization of Taiwan economy included the transfer of key enterprises which accounted for 90 percent of the total capital, to government operation (79, p. 64). This was accomplished by requisitioning Japanese assets. Due to this action, all key Japanese enterprises in Taiwan were placed under control of the Taiwan government, and then government enterprises bore the major responsibility of industrialization in Taiwan.

Thus we may conclude that the pre-war productive capacity of agriculture and the key government enterprises, laid the basic foundation for Taiwan's post-war basic agriculture, economic development, and the mechanism of capital formation.

B. The Chinese-American Joint Commission on  
Rural Reconstruction (JCRR)

JCRR was established at Nanking, mainland China in 1948 and moved to Taipei, Taiwan in 1949. JCRR played a leading role in the development of Taiwan's agriculture (106). It acts as an agent for the government for handling U.S. technical assistance, economic aid, and food aid. The JCRR program is a coordinated effort to apply practical solutions to rural problems of Taiwan. JCRR is not an operating agency. It provides technical and financial assistance to government

agencies and public organizations to carry out JCRR approved projects, JCRR set up five major objectives which have been followed successfully since its inauguration. These objectives are:

(1) to improve the living conditions of the rural people, (2) to increase the production of food and other important crops, (3) to develop the ability of the rural people to rehabilitate their own communities for laying the foundation of a strong and democratic China, (4) to help the build up and strengthening of the agricultural agencies of the Chinese government and the people, and (5) to foster rural leadership of different levels by conducting training classes and in-service program (16, p. 439).

This set of objectives has also been shared by the planners of the agricultural four-year plans (106, p. 34).

During the period from August, 1949 to June, 1966, JCRR sponsored 6,568 projects for rural and agricultural development on Taiwan and offshore islands, and spent \$7.1 million and NT\$4,371 million on those projects (20, p. 265). The projects were concerned with technical improvements, institutional changes and readjustment. For the realization of these objectives set by JCRR, it has been (1) encouraging or carrying out research on the production and marketing of crops, livestock and poultry, forestry, and fisheries and research relating to technological innovations in land improvement and reclamation, irrigation and flood control works; (2) encouraging production of new farm products and adoption of new agricultural technology on the basis of the results of domestic

research by means of financial and other forms of assistance; (3) encouraging and assisting research programs on the potential foreign markets for Taiwan's agricultural products; (4) helping to modify and readjust existing institutional and organizational patterns to make scientific farming an effective agent of growth; (5) cooperating with government agencies in setting up market grades and standards for export of agricultural products; (6) giving assistance to domestic and foreign investors in agricultural industry; (7) assisting exporters in the promotion of agricultural products in foreign markets; (8) assisting an active national family planning to reduce population growth rate at a reasonable levels; and supporting such other programs as agricultural education, research and extension, rural health, and farmers' organizations (106, 170). By means of these effective approaches, agricultural production has been boosted, and agricultural development stimulated. On the other hand, JCRR has also played an active role in formulation in planning and implementing the agricultural program of the economic development plans. As pointed out by Tsiang, as quoted by Christensen:

The role played by JCRR in agricultural development has been that of catalytic agency. By providing technical and some financial assistance, JCRR has been able to stimulate improvement in agricultural policies and implementation methods, to motivate project difficult to activate, and to generate a selfhelp spirit among the local agencies (22, p. 10).

The JCRR program has provided one of the best examples of effective technical cooperation between the U.S. and Taiwan. JCRR selected the most important agricultural production problems, established priorities, and made grants to stimulate the expansion of agricultural research, education and extension in order to solve them.

As has been shown in Chapter IV, the expanded productive capacity of agriculture was and is the sound base for economic development of Taiwan. JCRR has helped the people in rural community to have a better life. It also has helped Taiwan to make a significant achievement in Taiwan's agriculture, on the basis of which industry can develop and progress. This is how the post-war economy of Taiwan, which was predominantly agricultural, has now become industrialized, with industry assuming greater importance as development proceeds. JCRR's contribution to Taiwan's agricultural development can best be stated by Shen as follows:

The JCRR's contributions should not be measured alone in cold statistics of increased production, more significant, although less frequently recognized, is the training in leadership and democratic processes it has produced among the farmers and also among officials. Such values are bound to be reflected in the political evolution of the country (106, p. 31).

### C. The Land Reform Program

Taiwan could not have attained the remarkable progress in agricultural development without having successfully carried out the land reform program. This program completely changed the structure of Taiwan's rural economy and created the general climate for agricultural development and the advancement of production (10, p. 2). Land reform in Taiwan was based on the realization of the "land-to-the-tiller" ideal as the only effective solution to the agrarian problems.

The basic obstacles confronting Taiwan's agriculture in pre-land reform days were characterized by (1) the irrational land tenure system and the concentration of land ownership and tenancy over half of cropland. Two-thirds of all irrigated land was operated by tenants who paid 50 percent or more of their crops in rent and (2) lack of capital formation. With agriculture contributing the largest share in national income, lack of capital formation retarded the growth of farm sector as well as non-farm sector of the economy. These two obstacles were sources of social friction, a low growth rate of the economy, depriving farmers' incentive and curtailing the productivity of land; thus they intensified the poverty of the rural society. Because of their poverty, farmers were by no means able to make effective utilization of land resources, and because of uncertainty of tenure, tenants were not willing to make any long-term improvement of land. A program of land

reform was introduced in three stages, all put through step by step and in a peaceful manner so as to eliminate these obstacles.

1. Land reform program

The program was started in 1949 and was implemented in three stages. First in 1949 land rent was reduced to a maximum of 37.5 percent of main crops; next in 1951 public farm lands were sold to tenants; and finally land-to-the-tiller program was launched in 1953 (14, pp. 18-91).

a. Reduction of farm rent to 37.5 percent of crop yield

The farm rent reduction program called for the compulsory reduction of all farm rental rates from 50 to 70 percent, to a maximum rate of 37.5 percent of annual main crop yield. The program also provided for the protection of the rights of tenants by requiring the farm lease contracts to be drawn in written form to formalize a maximum term of six years for any contract, renewable upon expiration and prohibited landlords from collecting deposit money and advance payments.

b. Sale of public farm land      To abolish farm tenancy on public land and to set an example for the implementation of the land-to-the-tiller policy on privately tenanted land, the government sold 3,300 hectares of public farm land to tenant farmers experimentally in 1948 (9, p. 53). In 1951, the government promulgated the Regulations Governing the Sale of Public Farm Land to Established Owner-Farmers in Taiwan, and

started to sell public farm land to incumbent tenant farmers. From 1948 to 1969, the government sold approximately 112,000 hectares of public lands, including 45,000 hectares of paddy fields to tenant farmers (9, p. 53). The sale price was fixed at 2.5 times the annual main crop yield to be amortized by tenant purchases in 20 installments over 10 years (106, p. 60).

c. Implementation of land-to-the-tiller program The program marked the most important stage of land reform. In 1953, the government promulgated the Land-to-the-Tiller Act. Private tenanted holdings in excess of 3 hectares of paddy land and 6 hectares of dry land were purchased by the government and resold to incumbent tenants. The terms of sale were similar to those for public land. The government compensated landlords by paying them 70 percent of the purchase price with commodity bonds redeemable in kind (rice) and 30 percent in stock shares in four government enterprises. About 194,800 farm families had acquired land under this program with total area amounting to 139,260 hectares (9, p. 54).

## 2. Impact of land reform in Taiwan's economy

The land reform program was actually a compulsory re-organization of farm tenure system. The program took 14 years to complete. Past evaluation of the land reform program indicated that it had a profound and favorable effect on Taiwan economy. Significant changes in land ownership distribution took place. Owner-tillers increased from 36 percent

in 1949 to more than 80 percent in 1969; tenant farmers decreased from 39 percent to 9 percent and part ownership from 25 percent to 11 percent (92, p. 29). The most outstanding results of land reform were the changes in farmers' income. As a result of the reduction in rent payments and change in the land ownership distribution, significant changes in farm income distribution took place: the portion of rent reduced shifted from the landlord to the tenant and then the shift of income resulted in a redistribution of wealth among different tenure groups of farmers. Other aspects of changes in farmers' income were the increase in their income. What the land lord lost, which was resulted from rent reduction, was exactly the increment the tenant gained. This was the immediate effect on Taiwan rural economy as result of the land reform program (68, p. 123). Regarding to this respect, Hsieh and Lee stated that:

After the implementation of land reform programs, the share of labor income in agriculture increased by 10 percent of gross farm income as a result of the reduction of rental rate of farm land. As estimated real farm income increased by an average annual rate of 7.7 percent in this period, the real income shared by farm family labor rose in fact by more than 30 percent after the land reform program. Such significant increase of farm labor income provided an important incentive for farmers to adopt new cultural method and to use more capital and labor inputs in production resulting in a higher level of agricultural efficiency (51, p. 52).

Table 23. The structures of farm income distribution in Taiwan before and after land reform program<sup>a</sup>

	Year	Land income %	Capital income %	Labor income %
Before land reform program	1941	52.20	11.48	36.32
	1942	51.99	11.44	36.57
	1943	45.65	10.04	44.31
After land reform program	1953	37.39	8.23	54.38
	1954	38.05	8.37	53.58
	1955	38.19	8.40	53.41
	1956	36.28	7.98	55.74

<sup>a</sup>Source: (51, p. 51).

It can be seen from Table 23 that the structure of farm income distribution by major factors of production such as land, capital and labor, in the period after land reform program had completely been changed. Kao's study also reveal that total net farm income increased by 3.4 times, from NT\$2,251 million in 1950 to NT\$7,735 million in 1955, while the total gross farm income also grew nearly triple, from NT\$3,481 million in 1950 to NT\$10,419 million (66, pp. 89-91). It has been estimated that land reform considerably increased farmers' income by 235 percent from 1948 to 1968 (9, p. 56). This substantial increase in farmers' income increased their

consumption level and improved their living standard.

### 3. Increases in agricultural productivity and output

The increases in agricultural productivity and output after land reform were obvious from Table 24. Taking 1948 as the base year, total agricultural production increased by 40 percent in 1952, 54 percent in 1954 (the year of after implementation of land-to-the-tiller policy), and 213 percent in 1969. Total crop production increased by 34 percent in 1952, 72 percent in 1954, and 164 percent in 1969; livestock production increased by 86, 145, and 515 percent in 1952, 1954 and 1969, respectively. Yield per hectare is generally considered as the major indicator of productivity. As indicated by Table 25, yields per hectare of most crops have increased substantially since the implementation of land reform in Taiwan, as indicated in Table 24 also. From 1948 to 1969, rice yield increased 97 percent, sugarcane 106 percent and sweet potatoes 78 percent. Owner-cultivators achieved substantially larger in yield per hectare than tenants. Hence, they had more incentive and greater investment resulted from the successful land reform program.

In addition to the increases in yield per hectare of most crops, the diversification of farm production introduced by Taiwan's farmers after land reform contributed significantly to higher productivity. The farmers took the opportunities to grow new crops and raised more livestock, invest more

Table 24. Index numbers of agricultural production<sup>a</sup>

Items	1948 <sup>b</sup>	1952 <sup>c</sup>	1954 <sup>d</sup>	1969
Total production	100	140	157	313
Crop production	100	134	172	264
Livestock	100	186	245	615

<sup>a</sup>Source: (computed and compiled from 111, pp. 22-23).

<sup>b</sup>Before implementation of 37.5 percent land rent limitation program.

<sup>c</sup>After implementation of 37.5 percent land rent limitation program.

<sup>d</sup>After implementation of land-to-the-tiller policy.

Table 25. Index numbers of yield per hectare of major crops<sup>a</sup>

Items	1948	1952	1969
Rice	100	134	197
Sugarcane	100	134	206
Sweet potatoes	100	100	178

<sup>a</sup>Source: (computed and compiled from 62, p. 25, p. 36 and p. 47; and 92, p. 33 and p. 36).

capital and better utilize available land, water and labor resources (22, p. 77 and 103, pp. 29-31).

Studies of the impact of land reform on agricultural production made by Tang and Hsieh covering the period 1950-1955 (115, p. 133), Hsieh and Lee covering the period 1953-1956 (62, p. 50) and the Economic Commission for Asia and the Far East, the United Nations, covering the period from 1953-54 to 1961-62 (67, p. 153), reached the same conclusion: the substantial increase of crop yields was due to the increase in farm income after land reform.

As regards to changes in farm inputs, Ho's study indicates that the arable land remained stable with only a one percent increase from 1951-1965. In contrast, inputs of labor, working capital and fixed capital increased by 10 percent, 130 percent and 92 percent, respectively. The overall increase in farm inputs was nearly 32 percent (47, p. 212). Changes of farm inputs after 1951 suggests an inter-relationship between structural change in Taiwan's agriculture and the advance in farm technology and enterprise.

All studies mentioned previously arrived at the same conclusion; namely, the increase in agricultural productivity and output was due mainly to land reform. But they failed to identify other important factors which also had favorable effects on the productivity of agriculture. Thus, we can not ignore Koo's statement quoted by Kao:

Of all crops, rice productivity has risen more than ever before since land reform. We do not contend that land reform is the sole contributing factor in this achievement. Rather it is significantly correlated with other factors which can cause quick increase of the agricultural output in general... (65, p. 622).

Therefore, we might conclude that land reform in Taiwan is an indispensable factor for increasing agricultural productivity, but it is not certain to what extent it did contribute to the increase in agricultural productivity and output.

#### 4. Impact of land reform on capital formation

In recent years, many studies, such as Raup (87, 88), Timmons (117), Tang and Hsieh (115), Koo (68), Warriner (130) and Mellor (81, pp. 248-256), concerning the contribution of land reform to agricultural development concluded that capital formation in agricultural sector can be created and transferred to non-agricultural sector of the economy to stimulate overall economic development. Timmons notes that:

The generalized role of land tenure institutions in agricultural and national development is to facilitate and not hinder the achievement of development goals set by and for a country. The agricultural sector in less developed countries usually employs a large proportion of the population. Apart from immigration of people from other countries, population increases from an excess of births over deaths are greatest in this sector. Thus, agricultural development plays a major role in achieving national development through increased productivity per worker and capital formation. It provides laborers for other sectors and generates markets for non-agricultural products and services.

Within the agricultural sector, land tenure institutions affect productivity per worker and hence the potential market for non-agricultural products and services, capital, and labor to be released for other sectors (117, p. 86).

The first impact of land reform was to promote capital formation by rice farmers. The expansion of owner-tillers facilitated capital formation through the system of procurement of rice by Taiwan Food Bureau, through agricultural export earnings and transfer of human capital. The system of procurement of rice is carried out by means of collecting land tax in kind, compulsory bartering of rice for fertilizer and low compulsory purchasing price of paddy rice. This system is a peculiarly effective device to achieve forced savings and capital accumulation by rice farmers in Taiwan and has played an important role in the development and stabilization of the Taiwan economy.

The second impact of land reform towards the development of the Taiwan economy is the transfer of landlord capital to the industrial sector of the economy. A special feature of the Land-to-the-Tiller Program was designed to help industrial development through transferring capital to the industrial sector under government's procurement methods. As mentioned previously, 70 percent of the land price were paid in commodity bonds redeemable in kind, and 30 percent in stock shares in four government enterprises. Those shares transferred to landlords were valued at \$166 million (9, p. 56). In addition

to those shares, the landlords received, within ten years (1953-1962), an annual total of about \$11 million from the installment payments plus interest of commodity bonds. A large portion of this annual income received by landlords had been used for investment in the non-farm sector, under government direction and supervision. Thus the landlords were encouraged to transfer their investment from land to industry. Consequently, the scope of private enterprise was expanded. This is an important factor in the rapid development of Taiwan's industry and hence national economic growth.

As a concluding remark for this section it may be pointed out that the success of land reform program in Taiwan has enabled farmers to improve their economic life and social position. It also helped the rapid development of Taiwan's agriculture, which, in turn, stimulated the development of non-farm sector. Land reform provided a solid foundation, not only for agricultural development, but also for economic development of Taiwan as a whole. Thus, land reform has brought stability and progress of the Taiwan economy.

#### D. National Agricultural Planning and Policy

A key feature of the development plan in any developing countries is to increase the agricultural output. Food products are receiving higher priority than non-food items, due to the widening gap between food consumption and food

production. Another goal is to expand production of agricultural raw materials for domestic industry and for foreign exports.

During rehabilitation of the post-war Taiwan economy from 1945 to 1952, agricultural rehabilitation received the highest priority in government planning. Land reform had been carried out to improve the general climate for agricultural development and the advancement of agricultural production, but no integrated agricultural development plan was formulated and put into operation.

Agricultural policies in Taiwan since 1953 have been designed to support a series of four-year economic development plans (104, p. 5). Although its relative importance has been declining, as indicated in Table 26, agriculture still dominates the Taiwan economy. It is not only a source of food but also a source of investment capital and raw materials required by the industrial sector. As the development of agriculture is so closely interrelated with non-agricultural development, many problems facing agriculture today originate from other sectors of the economy. Thus, the economic development program in general is dependent, to a considerable extent on the success or failure of agricultural development program. This implies that programming of agricultural development should take into full account all aspects and problems of economic development in general. That is why the agricultural

Table 26. Industrial origin of net domestic product<sup>a</sup>

Period	Total	Agri- culture	Industry	Transp. & Comm.	Commerce	Others
I. Amount (NT\$ million)						
1952	14,657	5,233	2,623	500	2,742	3,499
1953	19,546	7,436	3,433	670	3,590	4,417
1956	28,086	8,759	6,219	1,096	4,757	7,255
1957	32,464	10,163	7,648	1,408	4,937	8,308
1958	35,947	11,127	8,573	1,478	5,516	9,253
1959	41,614	12,591	10,632	1,622	6,086	10,683
1960	50,833	16,528	12,562	2,074	7,332	12,337
1961	57,087	17,872	14,240	2,711	7,965	14,299
1962	61,646	17,891	15,857	2,833	8,918	16,147
1963	70,749	18,844	19,780	3,084	10,434	18,607
1964	84,722	23,509	23,856	3,672	12,657	21,028
1965	91,888	24,797	25,940	4,363	13,687	23,101
1966	102,296	26,326	29,256	5,501	14,686	26,527
1967	115,432	28,336	33,898	5,934	16,745	30,459
1968 <sup>b</sup>	133,694	31,748	40,545	7,396	18,624	35,381
1969 <sup>b</sup>	148,929	30,999	47,696	8,473	20,981	40,780
II. Percentage						
1952	100.0	35.7	17.9	3.8	18.7	23.9
1953	100.0	38.0	17.6	3.4	18.4	22.6
1956	100.0	31.2	22.2	3.9	16.9	25.8
1957	100.0	31.3	23.6	4.3	15.2	25.6
1958	100.0	31.0	23.8	4.1	15.4	25.7
1959	100.0	30.3	25.5	3.9	14.6	25.7
1960	100.0	32.5	24.7	4.1	14.4	24.3
1961	100.0	31.3	24.9	4.8	14.0	25.0
1962	100.0	29.0	25.7	4.6	14.5	26.2
1963	100.0	26.6	28.0	4.4	14.7	26.3
1964	100.0	27.7	28.2	4.3	15.0	24.8
1965	100.0	27.0	28.2	4.8	14.9	25.1
1966	100.0	25.7	28.6	5.4	14.4	25.9
1967	100.0	24.5	29.4	5.2	14.5	26.4
1968 <sup>b</sup>	100.0	23.8	30.3	5.5	13.9	26.5
1969 <sup>b</sup>	100.0	20.8	32.0	5.7	14.1	27.4

<sup>a</sup>Source: (92, p. 18).

<sup>b</sup>Estimate.

development plans carried out by the government in Taiwan as an integral part of the four-year economic development is of great economic significance. From this point of view, one of the major responsibilities of economic planners in Taiwan is to draw up a development plan in which agriculture is consistent with non-agricultural sector of the Taiwan's economy. Export of agricultural products provides exchange earnings needed for equipment and supplies of industries. Industries must also look to the rural population in the marketing of its products. Consequently, the government made clear, at the very beginning, its policy of "develop industry through agriculture and expand agriculture through industry". It proceeded with a well coordinated program with due emphasis on both agriculture and industry. For the past two decades, economic growth in Taiwan has never been retarded as the result of allocation of resources to the agricultural sector; on the contrary, it has gained remarkable support from agriculture.

The broad goals of each agricultural development plan as a part of the four-year economic development plan of Taiwan have increased food production for domestic consumption, provided for exports, and developed an agricultural processing industry to create employment and rural income. It has also been directed towards the improvement of agricultural institutions, such as re-organization and strengthening of farmers' associations to serve as a bridge between the government and farmers, improvement of farm credit system and marketing

facilities in the interest of farmers, expansion and strengthening of agricultural education, extension and rural public health, establishment of demonstration farm communities, and promoting agricultural research to increase agricultural production and step up agricultural exports so as to bring about modernization of Taiwan's agriculture at an early date (46, p. 35; 42, pp. 15-17; 91, pp. 5-9).

The average annual growth of agriculture during the first plan (1953-56) was 6.2 percent; the second plan (1957-60), 5 percent; the third plan (1961-64), 6.4 percent; and the fourth plan (1965-68), 6.5 percent. The planned annual growth rate for agriculture during the fifth plan (1969-72) is set 4.4 percent (46, p. 35 and 91, p. 6).

It should be noted that the Taiwan agricultural development plan has been underwritten by massive U.S. aid, partly in the form of food which represented one-quarter of all U.S. aid during 1952-69 (92, p. 146). Through the effective use of this aid the economy of Taiwan has been gradually transferred from predominantly agriculture to an agriculture-industry mixed economy. Presently, the successful development of agriculture and industry has resulted in a reduction of food imports and an expansion of agricultural exports.

It is also necessary to point out that the development of agricultural policy and programs based on technical feasibility economic priority and farmers' actual needs, has been conducted by JCRR. Thus, JCRR, as has been discussed earlier,

has played a leading role in the formulation of agricultural policy and planning, and in the economic development of Taiwan's agriculture.

#### E. Technological Innovations

A significant feature of the increase in agricultural productivity and output in Taiwan is the extent to which it resulted from technological innovations. With regard to this aspect, Christensen pointed out that:

It has long been recognized in Taiwan that technological innovations that increase production per hectare and per worker are essential for agricultural progress (22, p. 29).

The capital investment associated with these technical improvements was modest and mainly took the form of requirements for working capital that gave a quick payoff in increased agricultural output. Moreover, these technological innovations were adapted to the existing framework of small farm units in Taiwan. Such an approach facilitated full and productive utilization of the large farm labor force, and led to substantial increases in yield per hectare.

The nature of the important technological innovations and the factors that led to the development of improved production possibilities and their widespread adoption have varied considerably. As shown previously, increased use of modern farm inputs stand out as essential factors contributing most to high yields and increased farm productivity in Taiwan's

agriculture throughout the entire period under study.

### 1. Increased use of modern inputs

The available data on Table 27 shows the change of inputs by comparing 1951 with 1965. Land increased almost 10 percent. Working capital (including commercial fertilizer only) and fixed capital (including farm building, farm tools and equipment, farm animals, plants and trees, irrigation works, and country roads) registered a much higher increase, 130 and 132 percent, respectively, on the same comparative basis.

In term of individual inputs, Ho's study points out that average annual growth rates for land, labor, working capital, and fixed capital were 0.1, 0.5, 6.1, and 4.8 percent, respectively, from 1951-65, as indicated in Table 28. Shen's study, as indicated in Table 29 by comparison of growth pattern of Taiwan's agriculture in two periods, 1952-64 (Period I) and 1965-68 (Period II), indicates that farm output increased in period I by an annual growth rate of 4.19, whereas the rate of growth in period II was 3.01. But the annual growth rate of labor input between these two periods dropped significantly from 1.25 to 0.55. During the same periods, the annual growth rate of capital inputs including chemical fertilizer, feed inputs, and implement and depreciation on farm equipment and buildings, substantially increased. For example, implement and depreciation on farm equipment and buildings almost quadruples from 2.31 to 8.16. Similar increases in annual

Table 27. Indices of total farm input and output on Taiwan, 1951-65<sup>a</sup>

Year	Output <sup>b</sup> index (NT\$6,086 million =100)	Input indexes				Aggregate
		Land (874,000 hectares =100)	Labor (1,514,000 man equiv. =100)	Working <sup>c</sup> capital (345,000 M/T=100)	Fixed capital <sup>d</sup> (NT\$18,956 million =100)	
1951	100.0	100.0	100.0	100.0	100.0	100.0
1952	109.3	100.2	100.7	132.7	105.0	106.5
1953	122.9	99.9	101.8	145.5	110.0	109.5
1954	123.4	100.0	102.1	164.6	115.0	112.8
1955	122.9	99.9	101.1	162.9	119.0	112.5
1956	133.8	100.2	99.9	183.5	123.5	115.0
1957	145.7	99.9	99.7	192.2	128.6	116.4
1958	154.5	101.1	99.7	194.8	134.1	117.6
1959	153.3	100.4	101.8	196.8	141.6	119.4
1960	153.4	99.5	102.8	192.8	147.8	119.7
1961	169.0	99.8	104.4	184.3	155.4	120.3
1962	171.8	99.8	105.7	201.2	162.2	123.6
1963	169.6	99.8	107.6	215.6	169.3	127.0
1964	185.7	101.0	109.4	254.2	178.5	132.1
1965	198.0	101.0	109.7	230.4	191.7	131.8

<sup>a</sup>Source: (48, p. 212).

<sup>b</sup>The series covers a total of seventy-four major farm products, which are aggregated by using the 1952-56 average farm prices as weights.

<sup>c</sup>The series is represented by the quantity of commercial fertilizers consumed on farms.

<sup>d</sup>The series here consists of farm buildings, farm tools and equipment, farm animals, plants and trees, irrigation works, and country roads.

Table 28. Growth components of agricultural output<sup>a,b</sup>

Period	Output	Land	Labor	Working capital	Fixed capital	Technical change
1951-55	5.3	0.0(0.0)	0.1(0.3)	2.5(13.0)	0.5(4.4)	2.2
1956-60	3.5	0.0(-0.2)	0.3(0.7)	0.2(1.3)	0.5(4.6)	2.5
1961-65	4.0	0.1(0.3)	0.6(1.3)	1.1(5.7)	0.5(4.8)	1.7
1951-65	5.0	0.0(0.1)	0.2(0.5)	1.2(6.1)	0.5(4.8)	3.1

<sup>a</sup>Source: (48, p. 216).

<sup>b</sup>Figures in parentheses are growth rates of inputs.

Table 29. Average annual changes in output and input, and productivity of Taiwan's agriculture<sup>a</sup>

Items	Period I 1952-1964	Period II 1965-1968
Total output	4.19	3.01
Total input	1.74	4.18
Crop area	0.80	0.19
Labor input	1.25	0.55
Chemical fertilizer	5.84	9.70
Feed input	4.83	15.68
Implement and depreciation on farm equipment and buildings	2.31	8.16
Multiple cropping index	0.71	-0.20
Crop yield index	3.33	1.40
Land productivity per ha.	4.15	2.62

<sup>a</sup>Source: (107, p. 400).

growth rate in other capital inputs can be seen from Table 29. These figures indicate a significant shift in the pattern of farm input-use from the labor-intensive method of cultivation in period I to capital-intensive method after 1965. Thus, the relative importance of land and labor had been declined and capital inputs accounted for more contribution to the farm output for period II than period I.

## 2. Growth components of agricultural output

As has been indicated in Table 28, during the period 1951-65, the average annual output growth rate was 5 percent. Change in output in the period 1951-65 due to increases in productive factors in agriculture are working capital, 24 percent; labor, 4 percent; and fixed capital 10 percent while 62 percent of the increment in farm output in the same period was attributable to technological changes (percentage figures for working capital, labor, fixed capital and technological change are calculated from Table 28).

In essence, one valuable way of viewing progress in Taiwan agriculture is to survey the extent to which the new and improved cultural practices and innovations such as improved seeds, chemical fertilizers, plant protective inputs, etc. have been adopted since the war. Without doubt Taiwan's agriculture has made substantial progress in the adoption of modern inputs. Thus, the adoption of superior technology in

every field of activity is the surest test of enhancing the productive efficiency.

#### F. Agricultural Education, Research and Extension

Agricultural education, research and extension plays a crucial role in the development of Taiwan's agriculture. As discussed above, increased use of modern productive farm inputs has been an essential factor contributing to increased agricultural productivity in Taiwan since the end of the war. This stresses the significance of the successful development of innovations and techniques and their infusion through development of skills among farmers. The past growth of Taiwan agricultural output supports the view that the rate of return on investment in agricultural research, extension and education is high, according to Ho's study (48, pp. 161-180). He estimates that an investment of NT\$1.00 in agricultural research, extension and education could contribute a long run social return of NT\$14.00 of gross farm products (48, p. 188). Thus, it is clear that a significant part of the contribution in growth of Taiwan agricultural output during 1951-65 was due to technological change, which is shown in Table 28, infused through agricultural research, extension and education.

Taiwan has well-developed systems to carry out agricultural education, research and extension. Emphasis has been placed on the applications of scientific knowledge and techniques in the development of Taiwan's agriculture,

particularly, on finding practical solutions to problems of farm production and marketing that will increase agricultural productivity and output.

### 1. Agricultural education

An important aim of agricultural education programs is to meet the demand for skilled personnel created by agricultural development. Vocational education plays a major role by imparting practice and on-the-job training. At the high level, the educational program is aimed at training professional experts and technicians to meet the needs for improvement of agricultural development in various projects. At the secondary level, agricultural education is mainly implemented in a system of vocational schools. Its primary objectives are to develop rural leadership and foster the spirit of service; to train youth to be modern farmers and agricultural technicians; to improve the livelihood of farmers and to promote rural reconstruction; and to establish vocational agricultural school as center of education in the rural communities.

The ministry of education has a long-range education plan (1946-1982), which includes agricultural education and training program (94, p. 15). It is planned as an integral part of the general education which, in turn, is an integral part of the overall national development planning. As a result of a growing demand of farm education created by agricultural

development, agricultural education has been strengthened and numbers of student receiving high education and vocational school in agriculture have been increased considerably since 1952 school year. As indicated by Table 30, the number of students receiving vocational school in agriculture increased from 14,735 in 1952 to 21,101 in 1969. Students in high education in agriculture increased more astonishingly than those in agricultural vocational schools, an increase of more than four times during the same period. Enrollment and number of graduates in agricultural education institutions in 1967 school year is shown in Table 31.

## 2. Agricultural research and extension

It has been the government policy aimed to provide farmers greater knowledge and opportunity for more efficient farming by creating agricultural research units and farm extension system. Along with the development of Taiwan's agriculture, a number of research organizations for agriculture were established. These cover agriculture, livestock, animal health, fishery and forestry research. There are also seven distinct experiment stations and three special experiment stations, with branches and substations. Their primary function is to promote agricultural improvement. Other institutions responsible for agricultural research and experiments are the Sugar Research Institute of the Taiwan Sugar Corporation, the Tobacco Research Institute of the Taiwan

Table 30. Number of students receiving higher education and vocational school in agriculture, 1952-53 to 1969-70

	Higher education		Vocational school	
	Total	Agriculture	Total	Agriculture
1952-53	10,037	1,231	40,092	14,735
1953-54	11,943	1,396	45,601	17,582
1954-55	13,670	1,712	52,830	20,604
1955-56	18,174	2,038	60,397	23,206
1956-57	22,606	2,373	65,903	24,208
1957-58	25,619	2,504	69,823	23,624
1958-59	27,938	2,551	71,832	22,792
1959-60	29,770	2,731	77,800	22,983
1960-61	35,060	3,049	84,337	24,765
1961-62	38,423	3,364	88,335	25,350
1962-63	44,314	3,621	91,693	25,948
1963-64	51,707	4,068	96,888	26,163
1964-65	64,010	4,519	106,811	26,914
1965-66	85,346	5,447	117,246	26,671
1966-67	113,855	7,253	127,891	26,791
1967-68	138,613	8,429	143,296	26,844
1968-69	161,220	10,169	150,131	24,431
1969-70	184,215	5,072	155,870	21,101

<sup>a</sup>Source: (92, pp. 168-69, and computed from 92, pp. 168-69).

Table 31. Size and number of agricultural education institutions, 1967-68 academic year<sup>a</sup>

	Number	Enrollment	Number of graduate in June, 1967
<u>Higher level:</u>			
1. College of agriculture.			
a. With postgraduate.	2	123	37
b. Undergraduate only.	2	4,164	900
2. Junior colleges of agriculture. (3-year system)	1	1,158	165
3. Junior colleges of agriculture. (5-year system)	3	2,984	-
<u>Second level:</u>			
1. Vocational agricultural schools.	38	26,844	6,584

<sup>a</sup>Source: (94, pp. 11, 39 and 46).

Tobacco and Wine Monopoly Bureau and the Pineapple Experimental Station of the Taiwan Pineapple Corporation.

A network of agricultural research and improvement stations has conducted mainly applied research focusing on practical problems of farmers related to their locality. The major achievements of research institutes have been the successful adaptation to Taiwan of high-yielding crops varieties and seeds, greater resistance to disease, soil fertility improvement, effective irrigation methods, more receptivity to fertilizer and intensive care, improved implement and machine, and better quality farm products for exports as well as home use. It was through these research institutes that farm technology has been selectively introduced after controlled experimentation. During the period 1952-69, the substantial increase in Taiwan's agricultural production was due primarily to the increase in yield per hectare. The general increase in yield per hectare was, in turn, due largely to agricultural research work. Thus, the high level of farm technology has been attributed in large part to the effective work of agriculture and the seven district agricultural improvement stations.

Taiwan has a well-developed system of agricultural extension service which works in close association with farmers. Agricultural research in Taiwan was matched by effective and systematic organization of a farm extension

service closely linked with the experiment stations to disseminate their research results. Thus, the effective diffusion of knowledge about superior farming methods is a direct result of effective extension work of farmers' associations.

Agricultural extension programs in Taiwan are built on farmers' own organizations, aimed directly to increase agricultural production in line with government four-year plan for economic development, and employed educational methods to develop farmers' own initiative.

The farm extension program, under great assistance of JCRR, has been considerably strengthened since the creation of Agricultural Extension Office of the PDAF in 1964 and the promulgation of the "regulations for Agricultural Extension in Taiwan" in 1965, which completed the present pattern of agricultural extension in Taiwan (20, p. 278). Agricultural extension has three aspects, namely, farm extension work with adult farmers, 4-H club with rural youth and home economics extension work with farm women and girls, each serving one sector of the rural community.

Farm extension work aims at helping adult farmers adopt the improved agricultural technique to increase production. For attaining this goal, farm discussion groups have been organized in villages to carry out various training and educational activities. All of these activities are conducted by the farm advisors of township farmers' associations with the assistance of model farmers. 4-H club work helps rural youth

to acquire production technique, cultivate better citizenship and develop good leadership. With the guidance of township farmers' associations and the assistance of volunteer local leaders, 4-H clubs have been organized in villages to carry out various kinds of training and educational activities.

There are 1 to 3 farm advisors, 1 to 2 4-H advisors, and 1 to 2 home advisors in each township devoting themselves to the three phases of agricultural extension under the direct guidance of county supervisors. The township advisors are always encouraged to make their programs flexible and localized in order to meet local situation and needs. Table 32 shows the number of extension local leaders and basic extension organizations by December, 1967.

In addition, the training activities of farm extension for extension workers and farmers are available and developed in accordance with the advancement of agricultural research and local needs. Therefore, the training activities are varied from time to time. On the other hand, much efforts have been done by Provincial Department of Agriculture and Forestry, Provincial Farmers' Association and seven district agricultural improvement stations to supply audio-visual aids and extension publications for strengthening extension education.

All the three phases of the extension program have been carried out smoothly and effectively and rapid adoption of improved technology on Taiwan's farms has been achieved. There are a number of conditions which contributed to the successful

Table 32. The number of extension local leaders and basic extension organization, Dec., 1967<sup>a</sup>

	No. of local leaders	No. of group/clubs	No. of members
Farmer supervisors			34
Farmer advisors			584
4-H supervisors			32
4-H advisors			320
Home economics supervisors			241
Model farmers	4,062		
Farm discussion group		4,869	88,955
4-H volunteer leaders	4,744		
4-H project clubs		5,027	70,341
Home economics local leaders	3,900		
Home improvement club		2,452	44,005
<b>Total</b>	<b>12,706</b>	<b>12,348</b>	

<sup>a</sup>Source: (94, p. 53 and p. 59).

adoption of improved farm technology in Taiwan, according to Christensen. These are as follow:

1. Emphasis on applied research designed to provide findings that meet farmers' needs.
  2. The innovating attitude of most Taiwan farmers.
  3. Wide use of field demonstrations of integrated packages of improved practices.
  4. Provision of needed supplies and credit through farmers' associations and other organizations.
  5. A family system of farming that creates strong economic incentives for individual farmers to adopt improved practices that increase output.
  6. Readily available markets for farm products.
- (22, p. 37).

In short, the strategy for the development of human resources in Taiwan has been emphasized on: agricultural education to farmers; innovations and techniques compatible with existing framework of small farm size out of Taiwan's own agricultural research; and an extension system oriented to obtain voluntary acceptance of developmental programs provides useful guide-lines.

#### G. Farmer Service Organizations

The primary functions of agricultural organizations are: (1) to improve marketing facilities and marketing of farm products; (2) to provide farmers with production inputs and credit, technical guidance and farm insurance; and (3) to disseminate new knowledge about improved and new production and marketing methods. From the very beginning the government has recognized that well-organized farmer service organizations are essential instruments for carrying out rural reconstruction

program (106, p. 70). The government has taken a great interest in the promotion of farmer service organizations. The major farmer service organization in Taiwan include multiple-purpose farmers' organization, fruits marketing cooperatives and irrigation associations.

#### 1. Farmers' associations

Following the successful implementation of the land reform program in 1953, JCRR helped the government effect a fundamental reorganization of Taiwan's farmers' associations, which were established during Japanese administration and were not consistent with farmers interests and welfare (46, p. 330; 106, p. 71). The programs undertaken to improve the quality of farmers' associations personnel and to strengthen the financial structure of the associations have brought about considerable increase in membership, business volume, deposits and loans, and various services. The remarkable success achieved may be seen in fact that control of associations is now entirely in the hands of the farmers themselves and the services of the associations have been considerably expanded and improved, as indicated by Table 33.

Farmers' associations are federal system of multi-service cooperative organizations. They are organized on three levels: township, county and provincial. Altogether there are 364 farmers' associations: one provincial association, 22 county associations and 341 township associations with a total

Table 33. Growth of the farmers' associations in Taiwan, FY1961-FY1967<sup>a</sup>

	1961	1967
Number of FAs <sup>b</sup>	340	364
Membership	786,129	878,651
Employees	8,098	10,913
Capital and reserves	NT\$194,741,000	NT\$694,222,348
Total marketing and supply business revenue	NT\$683,295,000	NT\$1,120,342,249
Value of total agricultural production	NT\$24,427,000,000	NT\$42,896,000,000
Extension expenditures from:	NT\$81,782,000	NT\$96,651,554
members' contribution	NT\$9,987,000	NT\$10,072,880
transfers from credit and marketing business	NT\$12,733,000	NT\$19,918,140
government subsidy	NT\$22,042,000	NT\$27,521,741
incomes from assets and production services	NT\$38,536,000	NT\$39,138,892
Deposits	NT\$1,048,978,000	NT\$3,792,717,435
Loans	NT\$741,646,000	NT\$3,843,405,039
Hogs insured	190,719	369,887
Profits earned	NT\$20,244,000 (293 FAs)	NT\$60,814,357 (337 FAs)
Deficits incurred	NT\$8,947,000 (44 FAs)	NT\$2,296,937 (16 FAs)

<sup>a</sup>Source: (106, p. 76).

<sup>b</sup>The farmer's associations.

membership of 830,425 farm households in 1967 (106, p. 71). It is township farmers' association in each township that directly contacts the farmers and serves them with various activities. The services rendered by township farmers' associations are classified into four main departments: (1) economic services to purchase and market farm products and sell farm production inputs and consumption goods, (2) credit services to receive deposits of members and make loans to them for production uses and living, (3) extension services to educate farmers on new and improved farm technology to increase farm productivity and output, and (4) livestock insurance services to strengthen the livestock diseases control and protect the benefit of livestock industry and increase livestock production.

The most striking example is the one that Taiwan Food Bureau carries out its low rice price stabilization policy and its fertilizer-rice barter program through township farmers' associations. Township farmers' associations collect, mill and store rice on behalf of the government entrusted services and then delivered to Taiwan Food Bureau as payments of land tax, and under the programs of low compulsory purchasing prices of paddy rice and high government exchange price of fertilizer to rice. It would be very difficult for the government to push the individual farmer into carrying out its policies and programs without the farmers' association.

## 2. Farm irrigation associations

Farm irrigation systems in Taiwan are managed by the farm irrigation associations. Good irrigation management depends much on the proper operation of the associations themselves. Before the war members of irrigation associations organized during the Japanese administration were mainly land owners. Most of irrigation works had been constructed by the government. Members were required to pay membership dues, and fees in proportion to the number of hectares under irrigation. After the war, the reorganization of the original 39 irrigation associations into present 26 associations was completed and brought associations under direct control of farmer members in 1956 through JCRR; assistant in order to improve their management (106, p. 116). Following the reorganization, much efforts have been made to improve the financial operation and irrigation service, and strengthen the activities of irrigation association.

The 26 irrigation associations, which are scattered all over the island, are placed directly under supervision of the Provincial Water Conservancy Bureau. They collect regularly from the farmer member water fees to finance the maintenance and construction of irrigation facilities. They assist the planning and development of new irrigation projects. They are cooperatives which handle the utilization of water resources to promote agricultural production. Each association consist

of three programs divisions, in charge of engineering, management and finance. Technical and financial assistance is provided by JCRR to improve irrigation facilities, including planning, designing and construction of new systems as well as the extension and improvement of existing systems.

### 3. Fruits marketing cooperatives

Taiwan has six fruit marketing cooperatives. A provincial union of fruit marketing cooperative is organized by representatives from six fruit marketing cooperatives. A provincial union of fruit marketing cooperatives provides leadership and direction for them. These fruit marketing cooperatives are concerned mainly with the marketing and processing of fruits and vegetables, but they also provide technical services for improving the quality of fruits and vegetables through pest control and distribution of better varieties. They conduct some research and provide advisory services to fruit and vegetable growing farmers in producing and marketing fruits and vegetables. They help gear production and marketing of fruits and vegetable to prospective foreign export and domestic consumption. Presently there are 72,000 fruit growing farmers in these six fruit marketing cooperatives (53, p. 27).

Fruits marketing cooperatives as well as farmers' associations, and local governments have established the wholesale markets for vegetables and fruits to enable

centralized transaction by both selling and buying parties. Through this means, the farmers are able to obtain correct market information and do not suffer the consequences of delinquencies in payment for their products. It is likely that specialized farming in fruits and vegetables will become more commercialized and be expected to expand rapidly for both domestic and export markets in the future.

In essence, farmer organizations provide the means by which government programs are effectively implemented at the farm level, and they have greatly increased farmers' bargaining power to compete with private business concern. Thus, farmer organizations have played an active role in Taiwan's agricultural development.

#### H. Land and Water Resources Development

The greatest difficulty which still handicaps Taiwan's agricultural development and the raising of the farmers' living standard is the extreme scarcity of land resource and growing farm population, which enlarges the man-land ratio. Thus, it is necessary for Taiwan to utilize arable land for multiple cropping. Fortunately, Taiwan as a whole has abundant rainfall, which provides potentials for irrigation, but also requires flood control measures. The development of improved drainage, irrigation, and flood control facilities greatly influenced expansion of agricultural output in Taiwan.

Most of the growth in crop yields and much of the expansion of farm production took place on irrigated land. Therefore, land and water resources in Taiwan must be used more intensively by bringing additional land under cultivation, expanding and improving irrigated area, and increasing the area under multiple cropping.

#### 1. Irrigation development and intensive land use

Historically, irrigation has been one of important sources of increased agricultural output in Taiwan. Japanese colonial policy was oriented primarily toward developing Taiwan as a major supply of rice for the Japanese domestic market through rapid development of irrigation system during her occupation (78, p. 8). The irrigated area increased rapidly from 332,000 hectares in 1910 to 529,000 hectares in 1940, but decreased greatly to 505,000 hectares due to destruction of irrigation facilities and lack of maintenance (22, p. 49). The rehabilitation of irrigation systems caused by wartime damages as well as by floods was completed by 1955 through government and JCRR. Since then much emphasis has been given to the development of potential water resources and soil conservation, and better utilization of available water. Development work covers basin-wide water resources planning, construction of reservoirs, underground water development and improvement of existing irrigation facilities. To achieve more effective use of available water, irrigation projects

have been implemented for canal lining to cut down percolation losses, and rotational irrigation has been promoted to expanded irrigated areas, and the improvement of the effective distribution system in canal development and maintenance, local storage and pumping facilities, land leveling and development (23, p. 6; 52, pp. 32-33; and 106, p. 11).

During the period 1955-1969, over 120,000 hectares of dry farm land had been changed into irrigated fields, including transformation of single-crop paddy land into double-crop paddy fields. The total area of paddy field had expanded from 533,600 hectares in 1952 to only 537,000 hectares in 1969 (92, p. 27). Some of the paddy fields have been gradually shifted to the production of more profitable crops and for non-agricultural use. This has been offset by bringing additional land under irrigation and by increased use of dry land for crops in sloping land areas. As mentioned before, most of arable land was brought under cultivation by 1945. Thus, the possibility of increasing agricultural production by expanding crop area has been extremely limited. Consequently, the only way left for increasing the major crops is to increase yield per hectare through technological innovations and intensification of cultivation, particularly the traditional practice of multiple cropping. Earlier, it was shown in Tables 10 and 11 that all the growth of crops has resulted from high yields and multiple cropping.

The regression analysis between increase in irrigated acreage and increase in multiple cropping index, as quoted by Lee (74, p. 95) indicates that one percent increase in the irrigated area would result in 1.164 percent increase in the multiple cropping index. This shows the importance of irrigation investment in increasing productivity in Taiwan's agriculture.

Closely related to irrigation development is a ground water development program. Ground water development program was started in 1958, and by 1966, 731 deep wells had been drilled. They provided irrigation for 140,665 hectares of paddy fields from which 187,500 metric tons of rice could be produced annually (106, pp. 124-125).

In essence, irrigation and drainage facilities are basic to an increase in agricultural production. The main objectives for improvement and development of these facilities are to develop new water resources, expand irrigated area, increase land productivity, and the economical use of the available water.

## 2. Land development and improvement

To meet the urgent need for increasing agricultural production, the government has reclaimed tidal land, developed hill land, consolidated farm land and implemented soil conservation (22, p. 53 and 91, pp. 96-101). To help accomplish these programs, government agencies and banking institutions have extended a large amount of agricultural credit.

a. Land reclamation      The importance of the tidal land reclamation program cannot be ignored because land for agricultural development is limited in Taiwan and tidal land development is one of the positive measures for providing more food and more land for the growing population.

Along the west coast of Taiwan, there are tidal land which may be reclaimed for potential farming. Following investigation, experimentation and planning, about 2,890 hectares had developed by 1968. It is expected that a total of 2,499 hectares of tidal lands will be reclaimed by the end of the fifth four-year agricultural development plan (1969-1972) (91, p. 97). About 10,000 hectares of waste land is to be reclaimed in east Taiwan. Approximately 3,360 hectares have already been reclaimed and are being used for agricultural purposes (91, p. 27).

b. Land consolidation      Taiwan has many small farms without adequate irrigation, drainage and farm roads. The fragmentation of farm lands, caused by the increase in the number of farm families, limits the use of modern farm machine and causes waste of labor resources. A land consolidation program, supported by government financial and technical assistance to farmers, was initiated in 1961 to direct farmers to work together with their neighbors in consolidating their many small plots into suitable farming unit in order to save border lands as well as labor, and also to improve irrigation,

drainage and transportation systems. Approximately 161,269 hectares were consolidated by the end of 1968. It is expected that a total of 700,000 hectares will be consolidated by 1980 (22, p. 53).

c. Soil conservation      The soil conservation program, which is aimed at conserving the national resources of soil and water for permanent agriculture and sustaining farm production, was initiated in 1961 with the establishment of the Mountain Agricultural Resource Development Bureau (105, pp. 111-114). The Bureau is responsible for the development of grassland and other agricultural resources in the mountain areas.

Sedimentation and flood damages are severe in Taiwan. Opening up mountainous country due to population has impaired many good water sheds. The soil conservation program has been carried out on 75,000 hectares of slope farm land. On the other hand, to promote the development of slope land and to strengthen the effectiveness of soil conservation, JCRR launched an integrated soil conservation and land use program in 1964 (49; 60, pp. 14-15). This program has been promoted to include livestock raising in the existing hillside farm system. This program combines farm roads improvement, water system development, soil conservation, crop improvement, irrigation and raising of dairy cows and forage cover crops on the slope lands. Since 1950 a total of 515 projects has been

supported by JCRR, including 245 on irrigation and reclamation, 19 on drainage 31 on flood control, and 220 on investigation, planning and experimentations. For these projects JCRR extended about NT\$964.4 million and U.S.\$2.5 million of grants, and NT\$738.5 million of loans. It is estimated that through JCRR assistance about 45,152 hectares of land have been newly irrigated; 478,567 hectares have been provided with irrigation improvement and supplementary water supply; and 203,265 hectares damaged by floods have been rehabilitated. The annual increase of production is estimated about 445,200 metric tons of paddy. Under flood control program, 113,058 meters of new dikes and 4,480 meters of sea walls have been built, and 180,931 meters of old dikes have been repaired (60, p. 10; 106).

In essence, government has played a major role in facilitating agricultural development. Irrigation and related land improvement and development programs planned and carried out by governmental agencies provided the basic support for achieving rapid growth in Taiwan's agricultural output.

#### I. Agricultural Credit

Agriculture has continued to play a major role in the Taiwan's economy, as is evidenced by the discussion in Chapter IV. Agricultural credit is essential to agricultural development for the reasons such as providing agriculture with working capital, effective use of land resources, stepping up

production of crops, and the improving the life of the farmers. Therefore, the establishment of well-developed agricultural credit system to facilitate the use of capital inputs has been the major goal in implementing agricultural credit programs in Taiwan (106, pp. 207-212).

Prior to 1950, private money lenders played an important role in financing Taiwan's agriculture. Approximately 82 percent of the credit needed by farmers in 1949 was provided by private money lenders, particularly landlords (22, p. 57). However, the implementation of the Land-to-the-Tiller Program in 1953 has brought about a drastic change to the whole structure of Taiwan's agricultural financing. In 1960, private money lenders provided only 43 percent of the credit used by farmers, while the credit institutions and government agencies and enterprises provided the remaining 57 percent (80, p. 19). In 1965, the credit institutions, government agencies and enterprises supplied about 65 percent of all farm credit used by the farmers (22, p. 57). This fact points out a diminishing importance of private money lending as well as a change in the pattern of agricultural financing where private money lending has been gradually replaced by the institutional credit.

### 1. Supply of agricultural credit

The institutional credit is made available through agricultural institutions, and government agencies and enterprises. The former includes the Farmers Bank of China, the Land Bank of Taiwan, the Cooperative Bank of Taiwan, and credit departments of township farmers' associations, while the latter includes the Provincial Food Bureau, the Provincial Tobacco and Wine Monopoly Bureau, the Provincial Supply Bureau, the Taiwan Sugar Corporation and JCRR. At the end of 1969, the amount of outstanding agricultural loans provided by these institutions and organizations for Taiwan's farmers as a whole was NT\$17,491 million, as shown in Table 34.

The agricultural credit from government sources since 1952 increased by only 6 times during 1953-1969, while that from agricultural institutions sources increased more than 40 times during the same period as indicated in Table 35. The loan-to-value ratio (the last column of Table 35), the ratio of all outstanding agricultural loans by all organizations to the total value of agricultural production, increased from 7 percent in 1953 to 37 percent in 1969, an increase about more than 5 times. All agricultural loans are used mainly to finance crop production, marketing and processing.

In the field of farm credit, the government agencies and enterprises are also important financial sources to Taiwan farmers, as shown in Tables 34 and 35. They particularly

Table 34. Agricultural loans of agricultural credit institutions and government agencies and enterprises, December 31, 1969<sup>a</sup>

	Amount in NT\$ million	%
<b>Agricultural credit institutions</b>		
Farmers Bank	1,327	7.59
Land Bank	4,852	27.74
Cooperative Bank	4,495	25.70
FA Credit Sections	3,737	21.36
Sub-total	14,411	82.39
<b>Government agencies and enterprises</b>		
Food Bureau	1,167	6.67
Monopoly Bureau	213	1.23
Supply Bureau	0.6	--
Taiwan Sugar Corp.	550	3.14
JCRR	1,150	6.57
Sub-total	3,080	17.61
Grand-total <sup>b</sup>	17,491	100.00

<sup>a</sup>Source: (61, p. 2).

<sup>b</sup>Duplications are not eliminated.

extend substantial amount of farm credit to farmers for the crop production required in formulating national economic policies relative to rationing, export, price stabilization and other measures. Such credit is extended both cash and in form of production materials and equipment, notably fertilizers through township farmers' associations, or sometimes to

Table 35. Agricultural loans of agricultural institutions and government agencies and enterprises, Taiwan, 1953-1969<sup>a</sup>

Year	Loan outstanding at end of year			Gross value of agricultural production	Loan-to-value ratio
	Government agencies and enterprises	Credit institutions	Total		
	Million NT\$				Percent
1953	495	224	716	10,390	6.9
1954	651	281	932	9,429	9.9
1955	457	371	828	11,664	7.1
1956	502	567	1,069	13,019	8.2
1957	479	667	1,146	15,432	7.4
1958	617	1,112	1,719	17,326	9.9
1959	763	1,548	2,311	20,145	11.5
1960	1,088	1,573	2,661	25,755	10.1
1961	1,050	2,686	3,716	28,383	13.1
1962	1,459	4,460	5,919	28,500	20.8
1963	1,486	4,305	6,791	30,065	22.6
1964	1,746	5,807	6,553	35,888	18.3
1965	1,669	7,208	8,877	37,474	23.7
1966	1,774	8,875	10,649	40,046	26.6
1967	2,022	9,169	11,191	43,799	25.6
1968	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	48,869	NA <sup>b</sup>
1969	3,080	14,411	17,491	47,679	36.7

<sup>a</sup>Source: (Compiled and computed from 11, p. 2; 22, p. 59; 65, p. 24; and 80, p. 23).

<sup>b</sup>NA refers to not available.

farmers directly. Most of loans are required to be repaid in kind, such as rice, at a reasonable interest rate. Among them, the Taiwan Sugar Corporation and the Provincial Food Bureau play a leading role in financing the production of rice and sugar, the most important crops in Taiwan (22, p. 58).

## 2. Unified agricultural credit program

To help bring about a better farm credit system in Taiwan JCRR launched six demonstration programs involving more than half of the township farmers' associations between 1955 and 1960. The demonstration programs covered three phases: (1) to improve lending, servicing, and collecting procedures; (2) to build up reserves by requiring all profits from those demonstration programs to remain with the credit department; and (3) to make use of a loan of NT\$112 million provided through the United States aid counterpart funds (15, p. 18; and 22, p. 60).

Based on experience gained from these demonstration programs, the Unified Agricultural Credit Program for Taiwan was launched in 1961. The purposes of this program are: (1) to provide Taiwan agriculture with a permanent and dependable source of lending funds to finance farm production at reasonable rates and on terms consistent with farmers' requirements; (2) to improve financial resources and service of agricultural institutions, i.e., to eliminate the uncertainty of and negotiations for annual or periodic

financial aid from the government, and to enable agricultural credit institutions to achieve a self-sustaining status, operating with a minimum of duplication. Under this program, the farmers' association should mobilize all its available funds for agricultural financing and should supervise all uses of loans by the farmers. To implement the program, an agricultural credit fund of NT\$300 million from the U.S. aid counterpart funds was established and used to make loans to participating farmers' associations over a five-year period. The fund provides each participating farmers' association with two kinds of loans, namely, direct and indirect. Direct loans, about two-thirds of the fund, are given to the farmers' association without interest rate to match its landing capacity. When the farmers' association has fully utilized all its lending resources and still needs additional funds for making more loans to farmers, it can borrow from the fund with interest rate through the Land Bank and the Cooperative Bank. An agricultural credit planning board was set up to make policy and administer the fund (15, pp. 18-19; 22, pp. 60-61; and 106, pp. 209). Of the 295 township farmers' associations that have credit department to provide credit facilities to their members, 259 township farmers' associations, representing 88 percent of all associations with credit departments, were enrolled in the Unified Agricultural Credit Program in 1968, compared with only 63 associations in the beginning year of 1961 (20, p. 283; 106, p. 209).

With the termination of U.S. aid to Taiwan at the end of fiscal year of 1965, the appropriations from the counterpart fund were discontinued, but the 63 farmers' associations which took part in the program in 1961 began to make their first installment repayments at the end of 1965. Since then, the capital repayments from the direct loans and the interest payments from the indirect loans have been used as a revolving fund to finance loans to newly participating farmers' associations. The aggregate loans made by the Agricultural Credit Fund from 1961 to 1968 to the farmers' associations directly and indirectly reached to NT\$275 million. Up to the end of 1968, participating farmers' associations had made agricultural loans totaling NT\$5,040 million to 319,879 farmers, more than one-thirds of farm families in Taiwan benefited from the program during the period 1961-68 (106, pp. 209-210).

Thus, credit departments of farmers' associations have been strengthened and improved in recent years through the Unified Agricultural Credit Program. Farm loans have been increased and earnings of credit departments of farmers' associations have also accumulated. Furthermore, government has provided the association with funds for extension work to substitute for fund formerly provided by the credit department. Therefore, the capital accumulation of the farmers' associations has been greatly enhanced.

## J. Economic Incentives

During the early stage of development, economic incentives associated with land ownership resulting from successful land reform program were a powerful stimulus to increased agricultural output and productivity in Taiwan, especially for rice farmers to increase rice production. Economic incentives were further strengthened by supported and guaranteed prices of one kind or another for some crops such as sugar, pineapples, jute, mushroom and banana, improvement of marketing systems of agricultural exports, adequate supply of productive production inputs through farmers' association; and the well-developed agricultural financing system.

### 1. Marketing facilities

Facilities for transportation, storing, and processing for farm products are highly developed in Taiwan. Taiwan's present marketing system has been built up over a long period. During Japanese occupation, large investments were made for constructing transport facilities, irrigation facilities, and farm marketing facilities as a basis for agricultural development; many local farm cooperative organizations were established for marketing farm products and distributing farm production requisites, and selling consumer goods (22, p. 23). However, marketing facilities have been improved greatly since the end of the war. Township farmers' associations provide warehousing, processing and storage facilities to the farmers

for their marketable grains such as rice, wheat and peanuts as well as the grains for home consumption. In recent years, cooperative marketing activities of the associations include hogs, mushrooms, asparagus, onion, jute, fruits and vegetables. Fruits and vegetable marketing cooperatives provide collecting, packing and packing stations, inspection, grading, transportation, and processing and selling services and facilities to the farmers who are the members of cooperatives. They are also directly engaged in exporting fruits and vegetables. Taiwan Sugar Corporation transports sugarcane from farms and processes it in several refineries that are located around the island. In addition, many merchant factories and private companies provide services and facilities to the farmers. Important marketing facilities in Taiwan are presented by Table 36.

## 2. Streamlining of marketing systems

The second important aspect of increasing economic incentives for the farmers is the streamlining of the marketing system. It calls for the rearrangement of the marketing channels to bring farm products to the consumers by the shortest possible route; elimination of the profits made by middleman, reducing the cost of production and improving the producers' share of the consumers dollars. By establishing direct contact between producers and consumers, cooperative marketing is an important measure to help eliminate excess profits made by middleman. For this reason, public program

Table 36. Important marketing facilities of Taiwan<sup>a</sup>

Item	Number	Capacity
Rice warehouses (FA)	1,183	493,125 m/t
Rice warehouses (merchant)	209	150,909 m/t
Seed & other warehouses (FA)	762	150,000 m/t
Rice mill (FA)	429	9,296 m/t
Rice mill (merchant)	209	4,047 m/t
Peanut husking mills of FA	7	300 m/t
		of brown rice per 10 hour day
Asparagus collecting stations (FA)	150	18,350 m/t
Mushroom collecting stations (FA)	501	30,462 m/t
Onion packing stations (FA)	8	400 m/t per day
Banana packing houses	368	300,000 m/t a day
Orange packing houses	26	100 m/t a day
Cold storage of PFA	1	300 m/t
Sugar mill (Centrifugal)	25	57,200 m/t per day
Vegetable markets	53	
Livestock markets	15	

Note: FA refers to farmers' association; m/t refers to metric tons.

<sup>a</sup>Source: (13, p. 44).

has been centered around the promotion of cooperative marketing. As is discussed above, both farmers' associations and fruit marketing cooperatives engage in the cooperative marketing of farm products. It is obvious that cooperative marketing of farm products is an important way to improve farmers' economic welfare by means of collective bargaining and effort. This is especially important in providing economic incentives to farmers.

### 3. Growth in market demand

Economic growth of non-farm sectors results in growth in demand for farm products and was a major factor affecting agricultural output and growth rate in many countries. Population and income growth in urban areas has been essential in providing larger commercial markets for farm products in most countries. In Taiwan, growth in market demand for farm products has been attributed to growing population, urbanization, income growth, and well-developed agricultural export markets (22, p. 66; and 106, p. 193). The population in Taiwan has been increasing rapidly since 1950, from 7.6 million to 14 million (9, p. 17). The population approximately doubled between 1950 and 1969. In view of the population growth, the government's primary agricultural policy has been to direct and encourage increases in staple food crops in order to keep pace with population growth. Taiwan's domestic demand for food has been increasing at a yearly rate of 5 percent or more

since 1945 (22, p. 67). On the other hand, per capital real income has been increasing at a yearly rate of 4.7 percent since 1952 (92, p. 16).

Export markets for agricultural products also have affected agricultural output growth rates. As an island with limited natural resources and a small domestic market, the Taiwan economy has to depend heavily on agricultural exports to earn foreign exchange. Taiwan exported over half its rice and sugar production in the 1930's (129, p. 40), but in recent years, the share of exports has been smaller, as indicated in Table 18. However, agricultural policy to diversify agricultural production and exports of the banana, canned pineapple, asparagus and mushrooms, fruits and vegetables have provided farmers with new market outlets in recent years. Exports of these diversified agricultural products have been increased considerably since early 1960's. Even though industrial products have been exported in increasing quantities, agricultural commodities have remained essential component of the export trade.

While a part of agricultural production is mainly for domestic consumption, a large part of it, about 73 percent in 1966, is marketed off the farms (13, p. 10). The percentage of farm's production marketed off the farm varied widely from a high of 100 percent for cotton and citronella to a low of 55 percent for rice, as indicated by Table 37.

Table 37. Percentage of farm production marketed off farm in Taiwan<sup>a</sup>

Product	Percent
Rice	55.4
Sweet potato	55.5
Wheat	97.3
Corn	90.1
Soy bean	91.7
Other beans	91.7
Sugarcane	98.5
Tea	99.8
Peanut	86.9
Cassava	92.1
Jute	99.4
Cotton	100.0
Citronella	100.0
Banana	99.3
Pineapples	96.6
Citrus fruits	93.2
Other fruits	97.7
Mushroom	97.5
Radish	92.6
Irish potato	95.1
Green onion	93.8
Cabbage	89.2
Watermelon	95.8
Tomato	94.4
Other vegetables	57.9

<sup>a</sup>Source: (13, p. 10).

#### 4. Price incentives

Favorable input-product price ratios may be one of the important factors inducing farmers to increase capital inputs and to apply advanced and improved agricultural technology to expand agricultural production. However, after reviewing the farm prices situation in Taiwan as indicated in Tables 38 and 39, it is clear that the prices farmers receive for their farm products relative to prices they pay for fertilizer and other capital inputs in the period of 1953-1959 was not favorable for the farmers. Therefore, it was not a responsible factor for the increase of farm production in this period. But it was a contributory factor for expansion of farm production during the period of 1960-1969, because the input-product price ratios were favorable to farmers. In general, prices received by farmers relative to prices paid by farmers have averaged relatively low in Taiwan, mainly because of the fact that the average price of fertilizer paid by farmers to government is higher than in most countries (22, p. 71).

As indicated in Chapter IV, the farmers receive fertilizers through government compulsory rice-fertilizer barter system which is usually at unfavorable ratio to farmers. Although fertilizer prices have been reduced by government in recent years, but fertilizer prices to farmers still are high.

Table 38. Index of prices received and paid by farmers in Taiwan, 1952-1964<sup>a</sup>  
(Base: 1952-100)

Year	Index of prices received by farmers (A)	Index of prices paid by farmers (B)	A/B x 100 parity ratio
1952	100	100	100
1953	134.75	137.09	98.29
1954	124.08	128.14	96.83
1955	137.20	144.85	94.71
1956	148.15	155.51	95.26
1957	164.14	164.40	99.84
1958	164.90	170.91	96.48
1959	182.97	186.24	98.24
1960	254.93	241.19	105.69
1961	262.84	258.94	101.50
1962	249.38	260.21	95.83
1963	271.81	262.31	103.62
1964	282.25	266.53	105.89

<sup>a</sup>Source: (62, p. 239).

Table 39. Index of prices received and paid by farmers in Taiwan, 1965-69<sup>a</sup>  
 (Base: 1961-1963=100)

Year	Index of prices received by farmers (A)	Index of prices paid by farmers (B)	A/B x 100 parity ratio
1965	107.47	105.04	102.31
1966	109.79	105.31	104.25
1967	112.56	105.96	106.22
1968	118.26	109.64	107.86
1969	115.19	107.73	106.92

<sup>a</sup>Source: (92, p. 122).

Shen has pointed out an advantage of rice-fertilizer barter system:

Under the rice-fertilizer barter system.... This barter system benefits rice farmers by assuring them of a reliable supply of fertilizers at stable prices and of a stable and certain paddy price after harvest. It has undoubtedly encouraged rice production since its introduction in 1948. The barter ratio has, however, been gradually adjusted in favor of the farmers (106, p. 89).

In general, farmers are more concerned with farm prices after harvest than that of the planting season. To facilitate farmers' decision-making concerning farm production investments, it is necessary to eliminate the extreme instability of prices of farm products over time and insure a stable supply of farm products. Contract pricing systems of one kind or another have been introduced in Taiwan, with considerable success, for important farm export products such as mushrooms, asparagus, jute, pineapple, and sugarcane (13, pp. 64-65). Under this system, the contract is signed between individual farmers and canneries in advance of the planting season and the contract price is applied when the farm products under contract are ready for the market.

In short, prices of farm products need to be high enough to provide economic incentives for farmers to apply superior farm technology and purchase needed capital inputs if farm production is to increase at high rate. The maintenance of farm prices at high level depends on an effective farm organizations for marketing farm products and government policy

programs.

#### K. External Assistance and Investment

External assistance and investments have contributed greatly to the social and economic development on Taiwan (129, p. 86). Of course, Taiwan cannot have achieved rapid economic growth without external assistance and investment. Until its discontinuation in 1965, U.S. economic assistance has been the major source of foreign economic aid to, and a major factor influencing economic conditions and development of Taiwan since early 1950's. U.S. economic assistance allocated to Taiwan has been essentially of three kinds: (1) general economic aid for defense and direct force support in the form of project and non-project assistance, and technical cooperation; (2) development loan funds for a variety of purposes, including construction of dams, shipbuilding, and railroad and fishing fleet modernization; and (3) surplus agricultural commodities under Public Law 480 (PL 480). In spite of the phasing out of American economic aid in Taiwan in 1965, PL 480 program has been continued since then.

The major purposes of American economic assistance to Taiwan are: (1) to stabilize the country's economy so as to attain internal equilibrium; (2) to cut down Taiwan's foreign exchange expenditures so as to balance its international payments and receipts; and (3) to promote Taiwan's industrial

and agricultural development so as to pave the way for economic reconstruction (19, p. 367).

U.S. economic aid to Taiwan can be conceived as various forms of resources inputs into Taiwan economy. These inputs may be classified into consumers' goods, industrial and agricultural raw materials, and capital goods. During 1952-1969, U.S. aid commodities delivered to Taiwan totaled \$1,260 million, accounting for 19 percent of the total commodities imports of \$7,635 million (92, p. 137 and p. 152). The breakdown of this aid commodities in terms of inputs during the same period was as follow: (1) industrial and agricultural raw materials for domestic processing accounted for \$910.2 million, or 72.2 percent of the total; (2) capital goods, \$271.3 million, or 21.5 percent; and (3) consumer goods, \$78.9 million, or 6.3 percent (92, p. 137). This aid permitted Taiwan to maintain consistently large excess of imports of goods and services, which contributed greatly to the much needed capital investment and raw materials required for the initiation and continuation of massive economic plans. Imports of raw materials and capital goods directly contributed to Taiwan's industrial development. Wheat, feed grains and soybean among consumption goods were also a major source of raw material flour and oil extracting industries, and were essential to the development of livestock and poultry industries.

The allocation of U.S. aid to developmental project among different sectors of the economy of Taiwan during the aid period 1951-1965 is shown in Table 40. Of the \$1,092 million in total aid allocations to sectors of Taiwan's economy, \$235.1 million or 22 percent of the total was to agricultural sector, accounting for the third largest amount of the total aid.

Table 40. Taiwan: allocations of U.S. economic aid by sectors of the economy, 1951-65<sup>a</sup>

Sector	U.S. dollars	NT dollars	Total dollars	Distribution of total
	-----Million-----			--Percent--
Infrastructure	235.9	171.1	407.0	37
Agriculture	56.1	179.0	235.1	22
Human resources	140.7	142.5	283.2	26
Industry	100.1	66.2	166.3	15
Total	532.8	558.8	1,091.6	100

<sup>a</sup>Source: (129, p. 87).

From 1951 to 1968, the arrival amount of U.S. aid received by Taiwan was \$1,481 million. This included \$1,028.4 million or 69 percent of the total, \$65.1 million in development loan fund or 5 percent, and \$386.8 million or 26 percent in surplus agricultural commodities under PL 480 program, averaging approximately \$82.3 million a year during aid period

of 1951-1969, as presented in Table 41.

Taiwan has made effective utilization of agricultural commodity aid in its agricultural and economic development programs. Agricultural commodity aid (or food aid) was used in a manner that did not interfere with farmers' incentive to increase agricultural productivity and output (22, pp. 83-84). More details about the role of American food aid in Taiwan's agricultural and economic development will be presented in the next chapter.

#### L. Concluding Remarks

Improvement of agricultural output and productivity requires a package of improved inputs rather than a single input. The strategy adopted by Taiwan for increased agricultural productivity and output can best be described as an integrated package approach, which is a correct combination of all factors (or inputs) described previously. It has long been realized that inputs needed to improve Taiwan's agriculture are highly complementary. High yielding seeds, to be effective, need fertilizer as well as irrigation, whose effectiveness, in turn, depends upon the existing stock of knowledge, research and extension work. The lack of even one of these factors would make the others substantially less productive. Taiwan's agriculture has been able to grow rapidly, precisely because all of the necessary inputs, as

Table 41. Arrival amount of U.S. aid as of December 31, 1969<sup>a</sup>  
 Unit: \$ million

Period	Grand total	General economic aid			Direct force support	Development loan fund	Agricultural commodities under PL 480
		Total	Defense support	Technical cooperation			
FY 1951-54	375.2	374.3	289.1	4.1	81.1	-	0.9
1955	132.0	129.4	97.5	2.4	29.5	-	2.6
1956	101.6	92.0	78.7	3.3	10.0	-	9.6
1957	108.1	87.0	77.0	3.4	6.7	-	21.0
1958	81.6	64.7	53.3	3.5	7.8	-	17.0
1959	128.9	71.2	62.2	2.6	6.4	30.6	27.1
1960	101.1	74.4	68.2	2.4	3.8	19.1	7.6
1961	94.2	50.1	45.7	2.0	2.4	16.1	28.0
1962	65.9	6.6	3.9	2.7	-	-	59.3
1963	115.3	21.6	19.8	1.8	-	-	93.7
1964	82.9	56.7	55.2	1.5	-	-	26.2
1965	56.5	0.4	-	0.4	-	-	56.1
1966	4.2	-	-	-	-	-	4.2
1967	4.4	-	-	-	-	-	4.4
1968	29.1	-	-	-	-	-	29.1
Total	1,481.0	1,028.4	850.6	30.1	147.7	65.1	386.8
Average							
1951-68	82.3	57.1	47.3	1.7	8.2	3.6	21.5

<sup>a</sup>Source: (compiled and computed from 92, p. 146 and p. 149).

identified and explained earlier, were available to the farmers as a package.

Another way of characterizing the development process for Taiwan's agriculture is to describe it as technological, and institutional as well as organizational. The technological factors include modern farm inputs, such as improved varieties of seed, chemical fertilizer, multiple cropping, pesticides, etc. Land reform, agricultural research, education and extension are included in institutional category while organizational category includes farm service organizations, land and water resources development, economic incentives, agricultural credit, U.S. aid, JCRR, and national agricultural planning and policy. Superior and improved technology which could increase agricultural output and productivity was developed, and new and improved organizational and institutional systems for obtaining improved and superior technology applied on farms were put into effect. Through modern farm technology the farmers received improved inputs and advanced techniques. It was the new and improved farmers' institutions and organizations that made modern and scientific farming an effective agent of growth. These institutional and organizational systems ensured that superior and improved technology was properly introduced, widely disseminated, extensively adopted, and correctly applied. It is particularly to be noted that throughout the period of economic development of Taiwan's

agriculture, the role of government has remained positive and encouraging in all aspects on the one hand, while the substantial increases in agricultural productivity and output was achieved by the introduction of technological, institutional and economic factors through American food aid as a source of capital on the other.

VI. THE ROLE OF FOOD AID IN AGRICULTURAL AND  
ECONOMIC DEVELOPMENT OF TAIWAN

A. The Public Law 480 Commodity  
Program in Taiwan

The United States has provided economic assistance in the form of agricultural commodities to Taiwan since 1953 under Section 550 of the Mutual Security Act of 1953 (superseded by Section 402 of the Mutual Security Act of 1954); and under the Agricultural Trade Development and Assistance Act (PL 480) of 1954.

PL 480 provides for overseas shipments of U.S. surplus agricultural commodities under four titles. Title I provides for the sale of surplus agricultural commodities to friendly countries for payment in local currency of the recipients. The sale proceeds are deposited in the U.S. Government account in a financial institution of the recipient country. These funds are to be used by the U.S. authorities in the recipient countries for meeting their needs, for loans to the recipient governments and private enterprises operating within the country, and for grants to the recipient governments. Title II authorizes donations of surplus agricultural products for famine and emergency relief, school-feeding, community development, and other development purposes overseas. Title IV authorizes two types of programs: (1) surplus food may be used for domestic distribution to eligible people in U.S.,

(2) and for distribution to needy people overseas through non-profit American voluntary, charitable, and relief agencies and international organizations. The use of such food is also authorized for barter to obtain certain strategic materials, and for the procurement of off-shore goods and services. Title IV provides for long term credit sales of surplus agricultural commodities in dollars at relatively modest interest rates. The purpose of this title is to assist developing nations which have reached an appropriate stage in the evolution of their economies to become dollars customers of the U.S., while at the same time conserving their financial resources for use in the development process. Title I has been the most important source of agricultural commodity aid to Taiwan during the last one and one half decades.

#### B. Scope of PL 480 Programs in Taiwan

Taiwan did not receive food aid under PL 480 program until 1957 because food aid was being received under Section 402 of the Mutual Security Act. Since 1957 food aid under PL 480 has become an integral part of U.S. economic assistance to Taiwan. Ten agricultural commodity agreements between Taiwan and the U.S. were signed during the period July 1, 1956 through December 31, 1969. As shown by Table 42, these commodities were estimated to have a market value of \$380 million. As indicated by Table 43, PL 480 aid represented 35 percent of

Table 42. Value of U.S. PL 480 surplus agricultural commodities under agreements signed July 1, 1956 through December 31, 1969<sup>a</sup>

PL 480 programs	Unit: U.S.\$ million	% of total PL 480
Title I: Sales for foreign currency	232.1	61.0
Title II: Government-to-government donation for disaster relief and economic development	17.6	4.6
Title III: (1) Donation through voluntary relief agencies	64.4	
(2) Barter	16.1	
Total	80.5	21.2
Title IV: Long-term dollar and convertible foreign currency sales	49.9	13.2
Total PL 480	380.1	100.0

<sup>a</sup>Source: (119, p. 97).

total U.S. agricultural export to Taiwan during the period. Table 42 shows the title-wise distribution of total commodity aid under PL 480 programs. Shipments under Title I constituted 61 percent of the total PL 480 aid during the period 1956-1969. It is evident that food donations under Title III have also been of importance to Taiwan. According to the data in Table 42, food aid under Titles I and III form the most important food source for economic development in Taiwan.

Table 43. Value of total agricultural imports from U.S.,  
fiscal year 1954-55 through 1968-69<sup>a</sup>

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<u>Value (\$ million)</u>	
(1) Under specified U.S. government program	
(a) Total PL	380.1
(b) Mutual security	267.4
Total	647.5
(2) Outside specified government programs	
Total	442.3
(3) Total agricultural imports	1,089.8
 <u>Percentage distribution (%)</u>	
Percentage share of (1) in (3)	59.4
Percentage share of (2) in (3)	40.6
Percentage share of (a) in (3)	34.9
Percentage share of (b) in (3)	24.5

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<sup>a</sup>Source: (computed and derived from 119, p. 97).

The value of PL 480 commodities, by date of arrival in Taiwan, is presented in Table 44. The difference between estimated value under the agreements and the actual value is due to the time lag between the signing of the agreements and their actual execution.

Table 44. Arrival amount of surplus agricultural commodities under PL 480 in Taiwan<sup>a</sup>

	Value (\$ million)					Percentage distribution				
	Total	Title I	Title II	Title III	Title IV	Total	Title I	Title II	Title III	Title IV
1951.										
to										
1954	0.9	-	-	0.9	-	100.0	0	0	100.0	0
1955	2.6	-	-	2.6	-	100.0	0	0	100.0	0
1956	9.6	-	-	9.6	-	100.0	0	0	100.0	0
1957	21.0	9.3	-	11.7	-	100.0	44.2	0	55.8	0
1958	17.0	11.8	-	5.2	-	100.0	69.5	0	30.5	0
1959	27.1	18.6	-	8.5	-	100.0	68.8	0	31.2	0
1960	7.6	-	2.6	5.0	-	100.0	0	34.5	65.5	0
1961	28.0	19.7	-	8.3	-	100.0	70.3	0	29.7	0
1962	59.3	46.4	4.3	8.6	-	100.0	78.3	7.2	14.5	0
1963	93.7	68.8	2.6	7.9	14.4	100.0	73.4	2.8	8.4	15.4
1964	26.2	12.0	8.1	6.1	-	100.0	45.7	30.8	23.5	0
1965	56.1	17.4	5.6	3.9	29.2	100.0	31.0	10.0	7.0	52.0
1966	4.2	-	-	4.2	-	100.0	0	0	100.0	0
1967	4.4	-	-	3.6	0.8	100.0	0	82.7	17.3	0
1968	29.3	26.6	1.8	0.9	-	100.0	90.6	6.2	3.2	0
Total										
1957-										
68	373.9	230.6	28.6	71.1	43.6	100.0	61.7	7.7	19.0	11.6
Total										
1951-										
68	387.0	230.6	28.6	84.2	43.6	100.0	59.6	7.4	21.7	11.3

<sup>a</sup>Source: (computed from 92, p. 149).

<sup>b</sup>From 1951 through 1954 are referred to fiscal years.

### 1. Title I program

Table 45 indicates the types of commodities, in value terms, provided under the various agreements. The ten agreements signed through December 31, 1969 represented \$270.6 million at market value and \$285.5 million at market value plus ocean transportation. The commodities consisted of wheat and flour (41.5 percent); cotton, textiles and yarn (35.9 percent); fats and oils (11 percent); tobacco (9.7 percent); feed grains (1.3 percent); and dairy products (0.6 percent). Thus, wheat, flour and cotton have been of primary importance, approximately 45.6 percent of total market value of the PL 480 commodities during the period 1956-69 was in cotton, textiles, yarn, and tobacco. Food items accounted for the next of the aid. The quantities of commodities programmed under agreements over the entire period is shown in Table 46.

### 2. Title II program

Title II agreements for agricultural commodities valued at \$31.2 million, including cost of transportation, were signed with Taiwan during the period 1957-69, as indicated in Table 47. The value and quantity of commodities involved during the period 1957-69 is presented in Table 48. The data in Table 49 shows commodity arrivals under Title II during the period 1960-68. The commodities were valued at \$31 million. Wheat accounted for nearly 58 percent of total value. Cottonseed oil and milk products constituted 19.3 percent and 11.4

Table 45. Title I, PL 480 - value of commodities programmed under agreements signed July 1, 1956, through December 31, 1969<sup>a</sup> Unit: U.S. \$ Million

The type of commodity	Market value	% of total market value
Wheat and flour	112.2	41.5
Feed grains	3.6	1.3
Cotton, textiles, and yarn	97.2	35.9
Tobacco	26.1	9.7
Fats and oils <sup>b</sup>	29.8	11.0
Dairy products	1.7	0.6
Total market value	270.6	100.0
Total market value including ocean transportation	285.5	
Total estimated CCC cost including ocean transportation	363.0	

<sup>a</sup>Source: (119, pp. 104-105).

<sup>b</sup>Include cottonseed oil, soybean oil, tallow, lard, linseed oil, soybeans and soybean meal.

Table 46. Title I, PL 480 - quantities of commodities programmed under agreements signed July 1, 1956, through December 31, 1969<sup>a</sup>

Commodity	Quantity	
	Unit	Amount
Wheat and flour	1,000 bushels	66,309
Feed grains	1,000 bushels	2,625
Cotton	1,000 bushels	850
Tobacco	1,000 bushels	30,132
Fats and oils <sup>b</sup>	1,000 bushels	271,751
Dairy products	1,000 bushels	4,566
Soybean and soybean meal	1,000 bushels	190,260

<sup>a</sup>Source: (119, p. 107).

<sup>b</sup>Include soybean oil, cottonseed oil, tallow, lard and linseed oil.

Table 47. Title II, PL 480 - government-to-government and world food program, value of commodities, July 1, 1956 to December 1969<sup>a</sup>, Taiwan<sup>b</sup>

Commodities	Value (in \$1,000)
Bread grains	19,729
Fats and oil <sup>c</sup>	2,545
Milk and milk products	2,986
Rice	1,448
Raw cotton	297
Total value	27,005
Ocean transportation	4,230
Total	31,235

<sup>a</sup>Transfer authorizations issued at CCC cost and ocean transportation financed under Title II, PL 480.

<sup>b</sup>Source: (119, p. 129).

<sup>c</sup>Includes butter and butter oil.

Table 48. Title II, PL 480 - government-to-government and world food programs, value and quantities of commodities classified by purpose of programs, July 1, 1956, to December 31, 1969<sup>a</sup>, Taiwan<sup>b</sup>

Classifications	Value (in \$1,000)	Quantities (in metric tons)
Disaster	3,997	22,447
Child feeding	11,061	53,195
Voluntary agency	321	490
Economic development	15,856	92,560
Total	31,235	168,692

<sup>a</sup>Transfer authorizations issued at CCC cost and ocean transportation financed under Title II, PL 480.

<sup>b</sup>Source: (119, p. 133 and p. 136).

Table 49. Arrival quantity and value of commodities under PL 480 Title II<sup>a</sup>

	Arrival amount	Estimated value
	(metric tons)	(\$1,000)
1. Work relief program (Jan. 1962-Dec. 1966)		
Wheat	81,742	7,481
Soybean oil	1,365	571
Milk powder	225,000	62
Cotton seed	766	379
Butter oil	114,908	110
Cottonseed slid oil	975	5,993
Total	424,756	14,596
2. Frost relief (1963)		
Wheat	9,000	720
3. Flood relief (1960)		
Rice	5,700	911
Wheat	7,474	577
Total	13,174	1,488
4. School lunch program (Sept. 1964-June 1968)		
Wheat	29,112	5,461
Milk powder	5,954	3,489
Vegetable oil	2,572	1,664
Bulgur wheat	12,722	3,597
Total	50,410	14,211
Grand total	497,339	31,015

<sup>a</sup>Source: (89, pp. 7-8).

percent, respectively, of the total. The value of commodities classified by purpose of programs were as follow: \$14.6 million or 47.1 percent of the total for work relief programs (i.e. for economic development); \$14.2 million or 45.8 percent for school lunch programs; \$1.5 million or 48 percent for flood relief programs; and \$0.7 million or 2.3 percent for frost relief programs.

### 3. Title III program

Donations through the American voluntary relief agencies and the barter contract program of Title II have been the second most important aspect of PL 480 programs, as shown in Table 42. Quantity and value of relief commodities imported under Title III by American voluntary agencies is presented in Table 50. Agricultural commodities worth \$71.2 million were received under Title III (excluding barter contract program) during the period 1957-68. The commodity composition of this program was broadened with the imports of beans, soybeans, milk, cornmeal, wheat flour, butter oil, raw cotton, milled rice, bulgur wheat, edible oil, and CSM mix. The shipments of agricultural commodities under barter contract programs during the period totaled \$16 million, as indicated in Table 42.

Table 50. Quantity and value of relief commodities imported under PL 480 Title III by American voluntary agencies<sup>a</sup>

Period (Fiscal year)	Arrival amount (metric tons)	Estimated value (\$1,000)
1957	47,416 <sup>b</sup>	11,741
1958	24,843 <sup>c</sup>	5,170
1959	45,303 <sup>d</sup>	8,475
1960	27,267 <sup>e</sup>	4,958
1961	47,314 <sup>f</sup>	8,304
1962	44,511 <sup>g</sup>	8,616
1963	55,958 <sup>h</sup>	7,860
1964	46,294 <sup>i</sup>	6,152
1965	26,890 <sup>j</sup>	3,894
1966	22,306 <sup>j</sup>	3,946
1967	4,325 <sup>k</sup>	705
1968	7,156 <sup>k</sup>	1,395
<b>Total</b>	<b>399,583</b>	<b>71,216</b>

<sup>a</sup>Source: (89, p. 9).

<sup>b</sup>Including beans, milk, cornmeal, and flour.

<sup>c</sup>Including beans, milk, cornmeal, flour, butter oil, and raw cotton.

<sup>d</sup>Including milk, cornmeal, flour, raw cotton.

<sup>e</sup>Including milk, cornmeal, flour, milled rice, and raw cotton.

<sup>f</sup>Including milk, cornmeal, flour, milled rice, oil and cotton.

<sup>g</sup>Including beans, milk, cornmeal, and oil.

<sup>h</sup>Including beans, milk, bulgur wheat, flour, and oil.

<sup>i</sup>Including soybean, milk, bulgur wheat, flour, and butter oil.

<sup>j</sup>Including edible oil, beans, milk, bulgur wheat, and wheat flour.

<sup>k</sup>Including edible oil, beans, milk, CSM mix, bulgur wheat, and wheat flour.

#### 4. Title IV program

Commercial agricultural imports from the U.S. have increased steadily in recent years in spite of PL 480 shipments. As shown by Tables 43 and 63, PL 480 shipments increased from 1957 through 1965 but have decreased sharply since 1965. This encouraging expansion of commercial imports to Taiwan indicates that the country considerably improved economic conditions. Taiwan has made significant gains in economic growth and has substantially increased its foreign exchange reserves since the early 1960's. Only three agreements have been signed since July 1961 under the Title IV long-term dollar credit program.

The data in Table 51 shows quantity and value of commodities received under PL 480 Title IV during the period 1961-68. The three principal commodities were: cotton, \$51.3 million or 51.3 percent of total market value; soybean, \$8.5 million or 19.1 percent of the total, and tallow, \$8.4 million or 18.9 percent of the total. The value and quantity of commodities under Title IV program under agreements signed July 1, 1961 through December 31, 1969 is shown by Table 52.

#### C. Size and Importance of the PL 480 Programs

Tables 53 and 54 show the magnitude and the relative importance of PL 480 programs relative to total American economic aid and Taiwan's total agricultural production. It

Table 51. Arrival quantity and value of commodities under PL 480 Title IV, 1961-1968<sup>a</sup>

	Quantity (Metric tons)	Value (\$1,000)	Percentage in value (%)
Soybean	86,250	8,550	19.1
Soybean oil	3,500	868	1.9
Corn	37,000	2,098	4.7
Dairy products	310	231	0.5
Tobacco leaf	816	1,601	3.6
Tallow	40,000	8,444	18.9
Cotton	37,091	22,976	51.3
Total market value		44,768	100.0
Total ocean transportation		5,840	

<sup>a</sup>Source: (compiled and computed from 89, p. 10).

Table 52. Title IV, PL 480: Value and quantity of commodities programmed under agreements signed July 1, 1961, through December 31, 1966<sup>a</sup>

Commodity	Quantity	Value (\$ million)
Wheat and flour	8,267,000 bushels	15.3
Feed grains	1,424,000 bushels	2.1
Cotton	200,000 bales	23.0
Tobacco	1,883,000 pounds	1.6
Dairy products	90,000 pounds	0.1
Fats and oils	272,506,000 pounds	17.8
Total market value		59.6
Total ocean transportation <sup>b</sup>		5.8

<sup>a</sup>Source: (119, pp. 78-83).

<sup>b</sup>Includes ocean transportation to be financed by CCC.

is evident from Table 53 PL 480 aid became the dominant component of the total American economic aid after 1962, with the exception of 1964. It represented nearly 43 percent of total U.S. economic aid during the period 1957-68, ranging from 19.4 percent of the total in 1957 to 100 percent in 1968. For the period 1951-1968, PL 480 programs accounted for 26.1 percent of total U.S. economic assistance, ranging from 0.2 percent of the total in the period 1951-54 to 100 percent in 1968. The size and importance of PL 480 Title I program in total U.S. economic aid can also be seen from Table 53. The percentage share of the Title I program in total U.S. aid ranged from 8.6 percent in 1957 to 90.4 percent in 1968 and accounted for 26.4 percent of total American economic aid during the period. In absolute terms, total PL 480 assistance amounted to \$373.9 million and \$387.0 million during the periods 1957-68 and 1951-68, respectively. Furthermore, amount received under Title I is shown to have constituted 61.7 percent or \$230.6 million of the total PL 480 assistance during the period 1957-68. As indicated by Table 54, the total value of surplus agricultural commodities imported under PL 480 assistance programs was relatively large compared with domestic agricultural production in Taiwan. For example, in 1962 and 1963 the assistance was equivalent to 10 percent and 14.4 percent, respectively, of domestic production. Percentages for most other years were smaller, ranging from 0.1 percent in 1951-54 to 7 percent in 1965. For the periods

Table 53. Arrival amount of U.S. aid in Taiwan, 1951-68, as of December 31, 1969<sup>a</sup>

Period	Value (\$ million)			Percentage share of (2) in (1)	Percentage share of (3) in (1)	Percentage share of (3) in (2)
	(1) Total U.S. aid	(2) Total PL 480	(3) PL 480 Title I			
FY1951-54	375.2	0.9	0	0.2	0	0
1955	132.0	2.6	0	2.0	0	0
1956 <sup>b</sup>	101.6	9.6	0	9.4	0	0
1957 <sup>b</sup>	108.1	21.0	9.3	19.4	8.6	44.2
1958	81.6	17.0	11.8	20.8	14.5	69.5
1959	128.9	27.1	18.7	21.0	14.5	68.8
1960	101.1	7.6	-	7.5	0	0
1961	94.2	28.0	19.7	29.7	20.9	70.3
1962	65.9	59.3	46.4	90.0	70.4	78.3
1963	115.3	93.7	68.8	81.3	59.7	73.4
1964	82.9	26.2	12.0	31.6	14.5	45.7
1965	56.5	56.1	17.4	99.3	30.8	31.0
1966	4.2	4.2	-	100.0	0	0
1967	4.4	4.4	-	100.0	0	0
1968	29.3	29.3	26.5	100.0	90.4	90.6
Total 1957-68	872.4	373.9	230.6	42.9	26.4	61.7
Total 1951-68	1,481.2	387.0	230.6	26.1	15.6	59.6

<sup>a</sup>Source: (computed and compiled from 92, p. 146 and p. 149).

<sup>b</sup>Agricultural commodity aid to Taiwan under PL 480 programs did not arrive until 1957.

Table 54. Contribution of PL 480 programs to total agricultural production of Taiwan, 1951-1968<sup>a</sup>

	(1) Value of agricultural production <sup>b</sup>	(2) Value of PL 480 programs <sup>c</sup>	(3) Value of PL 480 Title I <sup>c</sup>	Percentage share of (2) in (1)	Percentage share of (3) in (1)
	\$ million	\$ million	\$ million	%	%
1951-54	679.1	0.9	-	0.1	0
1955	250.1	2.6	-	1.0	0
1956	279.0	9.6	-	3.4	0
1957	328.4	21.0	9.3	6.4	1.9
1958	363.4	17.0	11.8	4.7	1.3
1959	415.5	27.1	18.6	6.5	1.6
1960	546.7	7.6	-	1.4	0.3
1961	610.7	28.0	19.7	4.6	0.8
1962	620.8	59.3	46.4	9.6	1.5
1963	651.4	93.7	68.8	14.4	2.2
1964	780.1	26.2	12.0	3.4	0.4
1965	803.9	56.1	17.4	7.0	0.9
1966	849.3	4.2	-	0.5	0.05
1967	930.2	4.4	-	0.5	0.05
1968	1,015.8	29.3	26.8	2.9	0.3
Total					
1957-68	7,916.2	373.9	230.6	5.0	3.0
Total					
1951-68	9,124.4	387.0	230.6	4.2	2.5

<sup>a</sup>Source: (92, p. 149, and computed from Table 16).

<sup>b</sup>Includes crops and livestock production.

<sup>c</sup>Based on arrival amount of commodities imported.

1951-68 and 1957-68, PL 480 assistance accounted for 4.2 percent and 5 percent, respectively of domestic agricultural production. For the Title I program the respective figures were 2.5 percent and 3 percent.

D. Economic Effects of Agricultural Commodity  
Aid Under Title I Imports

In this chapter, we attempt to determine the economic effects of the PL 480 Title I program on the Taiwan's economy and the relationship of the aid to total U.S. economic assistance. Particular emphasis is to appraisal and analysis of the economic effects of the imports upon the development of Taiwan's agriculture as well as upon the economy as a whole. Special attention is focused on agricultural production, prices, foreign trade, balance of payments, capital formation, economic development and growth, and on the impact from the use of sales proceeds. Primary attention is given to the impact on agricultural production. The welfare implications of PL 480 assistance will also be discussed.

1. Impacts of use of local currency sales proceeds

As mentioned earlier, U.S. agricultural commodity assistance programs have been operated in Taiwan under two separated laws. Section 402 of the Mutual Security Act of 1954 and the PL 480 of 1954. Local currency funds are also derived from the sale of U.S. surplus agricultural commodities

in Taiwan under the two laws. Although these two programs are operated under different regulations, their objectives are similar.

U.S. surplus agricultural commodities provided under Mutual Security Act represent sale by the U.S. government to Taiwan for local currency. The local currency realized is deposited in a special account of the U.S. government. Section 505 of the same Act provides that the local currency derived from Section 402 commodity sales shall be used in the form of loans, rather than grants, whenever possible. The most recent period for which data is available is from 1956 to 1960. From 1956 to 1960, appropriations from this local currency fund totaled NT\$5,045 million (18, p. 353). Table 55 summarizes the specific projects or uses of these funds.

The direct forces support was to enable Taiwan to maintain the military forces necessary to carry out mutual Taiwanese-U.S. objectives. The support was used for military construction for purchasing commodities and materials that were directly consumed by the military. Funds allocated under this program were used for two types of aid: project assistance and non-project assistance. Project assistance referred to financial aid provided to initiate and carry to conclusion a specific project or course of action within a given period of time. Non-project assistance referred to financial aid provided for the procurement of supplies which were for general

Table 55. Distribution of local currency funds generated from Section of 402 (505) of Mutual Security Act of 1954, 1956-1960<sup>a</sup>

Unit: NT\$ million

	Total		1956	1957	1958	1959	1960 <sup>b</sup>
	Amount	%					
Total	5,045	100	722	971	766	1,218	1,366
Agriculture & natural resources	201	4.0	97	92	11	-	-
Industry & mining	1,808	35.8	266	425	431	210	473
Transportation & communications	170	3.4	50	57	59	-	2
Labor	-	0	-	-	-	-	-
Public health	135	2.7	30	32	-	22	49
Education	46	0.9	43	2	-	-	-
Public administration	-	0	-	-	-	-	-
Social welfare	118	2.4	36	52	-	30	-
Miscellaneous	223	4.4	0	0	-	21	201
Direct forces support	2,343	46.4	196	308	264	935	638

<sup>a</sup>Source: (compiled from 18, p. 353).

<sup>b</sup>Program amount.

sale and use within the country. Wheat, soybeans, raw cotton, beef tallow, machinery and equipment, were among the products imported under the program. All such supplies were sold for local currency. The proceeds were used to pay for labor and services or for locally produced materials used on local projects.

Imported commodities under Title I, PL 480 are sold in Taiwan's domestic market. These local currencies are deposited in the Bank of Taiwan to the account of the U.S. government. The use of Taiwan currency deposited to the U.S. government's account is based on agreement between the two governments. The uses of Taiwan currency as provided in the agreements over the entire period under review are presented in Table 56. Table 56 shows uses of the currency under Title I sales as provided in the agreements through December 31, 1969. Taiwan deposited to the account of the United States new Taiwan dollars valued at U.S.\$238.4 million during the period 1956-69. Of this amount, U.S.\$106.8 million or 44.8 percent was disbursed for common defense under Section 104(c); U.S.\$87.5 million or 36.7 percent was allocated for U.S. uses under Section 104 (a,b,d,g,i,j); U.S.\$33.2 million or 13.9 percent was authorized as loans to Taiwan for economic development under Section 104(f); and U.S.\$10.8 million or 4.6 percent was authorized as loans to private enterprise under Section 104(e). It should be noted that the percentage for the U.S. uses would increase to 41.3 percent if the loans to private enterprises

Table 56. Title I, PL 480 - uses of local currency as provided in agreements signed July 1, 1956 through December 31, 1969<sup>a</sup>

Item	In U.S.\$1,000 equivalents	Percentage allocation
104(c) common defense	106,788	44.8
104(e) loans to private enterprise	10,852	4.6
104(f) loans to Taiwan for economic development	33,260	13.9
U.S. uses	87,539	36.7
Total amount in agreement	238,439	100.0

<sup>a</sup>Source: (119, p. 111).

of the United States were included. The availability of Title I local currency funds for U.S. uses in Taiwan probably has led to an expansion of U.S. activities. It seems reasonable to believe that it is doubtful whether a sufficient amount of dollar appropriations would have been forthcoming to undertake operation of all U.S. programs on the same scale as was possible with the availability of Title I local currency funds.

Loans were made to U.S. private firms or their subsidiaries for business development and trade expansion in Taiwan. This included the expansion of markets for U.S. agricultural products. Title I local currency funds may not be used for the manufacture of products to be marketed in

competition with U.S. products.

One of the goals of American economic assistance in Taiwan has been to stimulate the development of private industry. The important role of U.S. aid in fostering the rapid growth of Taiwan's private sector was observed by Li who stated:

U.S. aid has played an important role in the development of private industry, not only because it has served as a major source of investment funds, but because it has encouraged and helped to induce the flow of private capital into the channels of production (77, p. 24).

It is clear that U.S. aid in the form of local currency funds loaned to private enterprises under Section 104(e) has also contributed to the development of Taiwan's private enterprises, some of which represent American interests. Many established private industries, such as textiles, paper and cement, were rehabilitated during the early years of aid and have been expanded since then with aid from America. Particularly, American aid was the catalytic financial element for new private industries in Taiwan such as synthetic fiber, polyvinyl plastics, glass, cast iron pipe, hardboard, and soda ash (54, p. 138). American aid in the form of local currency funds has also played a vital role in the development of Taiwan's agricultural processing industry. This is now the fourth largest industry, accounting for 16.4 percent of total export value in 1969, as indicated by Table 17. The development of the agricultural processing industry will be discussed later.

As a result of the combined effect of U.S. aid (including local currency funds) and the public policy of promoting and improving the investment climate and stimulating private industry (54, pp. 138-140), the private sector in Taiwan is an expanding and important part of the economy. This is indicated by Table 57.

Common defense assisted in providing the supplemental resources necessary for carrying out a defense program. This aid is generally provided in the form of indirect assistance for the military effort through development projects benefiting the economy and providing economic welfare to civilians. It includes construction of roads, bridges, dams, and electric power plants; development of natural resources; importation of raw materials for the support of established industry and agriculture; and the provision of raw and finished materials to develop and maintain additional industry and expand and improve agricultural production (17, p. 337). Economic development loans to Taiwan, in the amount of U.S.\$33.2 million or 13.9 percent of the total local currency funds during the period 1956-69, were used to improve agriculture and promote economic development. Particular emphasis was placed on food production, processing, and distribution. 140 million dollars equivalent or about 58.7 percent of the total local currencies during the period was to be available for purpose of common defense and as loans for Taiwan's economic

Table 57. Private and public industrial production in Taiwan<sup>a</sup>  
1952-1969

Period	Annual growth rate		Index numbers	
	Unit: %		(Base: 1952=100)	
	General index		General index	
	Private	Public	Private	Public
1953	28.9	25.0	128.9	125.0
1954	15.0	-1.0	148.2	126.2
1955	17.5	10.3	174.2	139.2
1956	5.9	5.5	184.4	146.9
1957	11.1	12.3	204.8	165.0
1958	9.4	4.1	224.0	171.8
1959	14.6	8.5	256.7	186.4
1960	12.5	9.2	288.9	203.5
1961	30.4	10.7	376.6	225.2
1962	11.9	10.2	421.3	248.2
1963	12.7	4.9	474.8	260.3
1964	22.0	16.1	579.1	302.2
1965	22.9	11.1	711.6	335.8
1966	22.1	8.1	868.9	363.0
1967	21.1	8.8	1,052.3	394.9
1968	26.8	10.5	1,334.4	436.3
1969	17.8	15.6	1,572.1	504.4
1953-69 average	17.6	10.0		

<sup>a</sup>Source: (92, pp. 49-50).

development. A large part of this amount was used for development projects aimed at raising agricultural productivity and production (22, p. 24). These Title I local currency balances provided supplementary funds for agricultural development projects which probably would have been delayed in the absence of the program.

In short, local currencies generated by Title I sales have enabled Taiwan to undertake and complete special projects and

promote overall economic development programs in Taiwan. This would not always have been possible in the absence of these proceeds.

## 2. Impacts on agricultural production

The impact of food aid on agricultural production in recipient countries has been of much concern to economic development economists. They fear that food aid may have an adverse effect on the economic development of agriculture in the receiving nations. This fear stems from the possibility that agricultural commodities made available on a concessional basis may significantly depress prices of farm products and cause a decline in farm incomes. The availability of food may lead to government policies that would lower the priority for public investment in agriculture and reduce economic incentives for increasing agricultural productivity.

In analyzing the impacts of food aid on agricultural production in Taiwan, our attention will focus primarily on the effects of food aid upon the development of farm production and prices, especially of similar or related farm products, supplies in the domestic market of the same products, farm income, and the use of agricultural resources.

The major U.S. agricultural commodities imported by Taiwan have been wheat, soybeans, corn, tobacco and cotton. Since the demand for these five crops in Taiwan has increased rapidly, domestic production, with the exception of tobacco,

is insufficient to meet the requirements of home consumption, as shown in Table 58. Therefore, imports inevitably are the principal source. Taiwan's imports of these crops were in two categories: U.S. aid imports (Section 402 of Mutual Security Act and PL 480 program) and commercial import. These five commodities imported to Taiwan are largely from the United States. It can be seen from Table 58 that U.S. aid imports were a very important part of Taiwan's total imports of these five commodities during the period 1952-1969. The percentage shares of U.S. aid imports to total import for each of these commodities ranged from 0.1 percent for corn, 29 percent for tobacco, 33.8 percent for soybean, 45.4 percent for cotton, to 60 percent for wheat. These imports have been the principal element of total supply for each of these commodities except tobacco.

The data in Table 59 indicates that Taiwan's domestic production of these crops, except wheat, did not decline during the period of U.S. food aid studied here. Table 59 clearly shows that the percentage increase in output and planted area over the period were significant for all crops except for wheat and were particularly significant for corn and soybeans. It also can be seen that there had been an increase in yield per hectare for all crops during the period 1952-69. The declining trend in wheat production and in area indicated by Table 59 was probably due to a greater profitability of growing other competing crops. While wheat is

Table 58. Production and imports of wheat, soybean, corn, tobacco, and cotton, cumulative, 1952-1969, Taiwan<sup>a</sup>

Crop	Domestic production		U.S. aid imports		Total imports		Total supply
	M.T.	% of total supply	M.T.	% of total supply	M.T.	% of total supply	
Wheat	485,097	9.2	2,952,654	60.0	4,921,063 <sup>b</sup>	90.8	5,281,025
Soybean	849,693	21.6	1,042,016	33.8	3,083,687	78.4	3,933,380
Corn	658,667	38.5	66,818	0.1	1,052,740	61.5	1,711,407
Tobacco	282,613	90.8	8,308	29.0	28,675	9.2	311,288
Cotton	12,741	1.5	395,753	45.4	877,959	98.5	890,700

<sup>a</sup>Source: (compiled and computed from 9, pp. 104, 106, 124, 206, 238, 240 and 252; 72, p. 6).

<sup>b</sup>Total imports of wheat includes wheat and flour.

Table 59. Indices of planted area, per hectare yield and total production for wheat, soybean, corn, tobacco, and cotton, 1952-1969, Taiwan<sup>a</sup>

Crop	1952	1955	1960	1965	1966	1967	1968	1969
<u>Planted area</u>								
Wheat	100	88	173	76	99	82	53	32
Soybean	100	142	246	219	211	215	203	186
Corn	100	163	271	366	437	469	418	377
Tobacco <sup>b</sup>	100	113	144	145	138	181	201	216
Cotton	100	133	246	96	71	72	73	104
<u>Per hectare yield</u>								
Wheat	100	132	195	186	173	176	195	187
Soybean	100	116	147	205	205	239	245	246
Corn	100	82	110	162	170	196	176	172
Tobacco	100	115	123	126	122	109	114	106
Cotton	100	146	88	240	253	247	289	160
<u>Total production</u>								
Wheat	100	116	274	141	172	144	103	60
Soybean	100	165	360	449	433	514	499	459
Corn	100	134	297	588	740	918	738	642
Tobacco	100	130	178	182	168	198	230	229
Cotton	100	146	88	240	253	247	289	160

<sup>a</sup>Source: (9, pp. 206, 123, 237-239; and computed from 92, pp. 33-34).

<sup>b</sup>Total harvested area.

considered a substitute for rice. There has been no decline in rice production, nor in its acreage. The production of rice has actually increased considerably since 1952 as indicated by Table 9.

a. Effects on wheat production      Following the end of World War II and the implementation of U.S. agricultural commodities aid programs in Taiwan in 1950, there has been a much greater need of wheat flour because of the influx of a large number of Chinese mainlanders. To meet this urgent need, measures have been taken to encourage domestic wheat production, in addition to the imports of large quantities of wheat. As a result, wheat production had increased from 16,604 metric tons in 1952 to a peak of 45,574 metric tons in 1960, for an increase of more than 270 percent. Since 1961 wheat production has declined markedly to only 9,950 metric tons in 1969 (92, p. 33). This was due to the effects of falling wheat prices which were, in turn, caused by: (1) large quantities of cheap wheat imported from U.S., particularly food aid import; (2) the price of rice in world market was much higher than that of wheat flour, the government has deemed it advisable to encourage the people to eat more wheat flour so that rice saved thereby may be exported to obtain more foreign exchange; (3) the area available for wheat production is limited and the crop competes with other winter crops, which are usually more profitable; (4) wheat is not an important source of income for most producers in Taiwan, since few of them depend exclusively upon this crop; (5) it has been government policy to import more wheat than flour to supply sufficient raw materials to the rapidly expanded milling

industry and to utilize the by-products for livestock feed; and (6) the competition of crops, in terms of costs and returns, is a serious factor affecting wheat production. The per hectare earnings from wheat are somewhat lower than those of most its competing crops, as shown in Table 60. Because of these factors, Taiwan prefers to rely on imported wheat and concentrate on producing more profitable crops. It can be expected that Taiwan will have to depend increasingly upon imports of wheat.

Wheat is one of the least profitable and the least desirable crop among competing winter crops in Taiwan. Increased U.S. aid imports of wheat, coupled with relaxed governmental extension drives, has brought about a considerable diminution of the wheat crop area. Since most winter competing crops are more profitable than wheat, a shift of land from wheat to other competing crops is expected. This means more returns to the farmers.

It is interesting to note the impact of wheat importation on rice production and exports, as shown by Table 61. The continued decline in wheat flour prices relative to rice prices over the entire period of study produced conditions to encouraging people to consume more flour than rice so as to increase rice export. The total export value of rice during 1953-1969 amounted to \$413.4 million while the total import value of wheat and flour was 275.8 million. Some wheat flour

Table 60. Production costs and returns of various winter crops<sup>a</sup>  
(1967/68 crop year) Unit: NT\$/Ha.

Crop	Production value	Production costs	Net returns <sup>b</sup>	Farm earnings <sup>c</sup>
Fall sweet potato	15,101	11,522	3,579	5,709
Hu-tzu sweet potato	8,736	9,317	- 581	1,614
Wheat	8,196	9,299	-1,103	558
Corn	14,464	11,422	3,042	4,406
Soybean	9,591	9,160	431	1,146
Rapeseed	10,534	11,425	- 891	2,957
Flax	8,162	9,342	-1,180	647
Tobacco	51,908	49,677	2,231	15,485
Cabbage	23,036	21,403	1,633	3,207
Headed Chinese cabbage	29,094	21,322	7,772	13,616
Onion	78,412	38,551	39,861	45,720
Garlic	27,858	24,903	2,955	7,224
Tomato	82,132	47,987	34,145	50,973
Potato	22,977	26,059	-3,082	3,049
Radish	16,183	13,341	2,842	7,316

<sup>a</sup>Source: (132, p. 111).

<sup>b</sup>Net returns = production value - production cost.

<sup>c</sup>Farm earnings = net returns + wages of family labor.

Table 61. Prices of wheat flour and paddy rice for years 1951-1969<sup>a</sup>

Year	Retail price of flour in Taipei City (NT\$/kg)	Retail flour price index 1951=100	Retail price of rice in Taipei City (NT\$/kg)	Retail rice price index 1951=100 <sup>b</sup>	Retail price ratio of rice and flour ( $\frac{\text{rice price}}{\text{flour price}} \times 100$ )
1951	8.43	100	3.68	100	43.7
1952	7.61	90	4.64	126	61.0
1953	7.83	93	6.87	187	87.7
1954	7.41	88	5.99	163	80.8
1955	6.92	82	5.58	152	80.6
1956	6.58	78	5.36	146	81.5
1957	6.77	80	5.31	144	78.4
1958	7.16	85	5.39	146	75.3
1959	6.73	80	5.11	139	75.9
1960	6.64	79	6.39	174	96.2
1961	6.56	78	6.83	186	104.1
1962	6.48	77	6.29	171	97.1
1963	6.15	73	6.00	163	97.6
1964	6.20	73	5.97	162	96.3
1965	6.91	82	6.29	171	91.0
1966	6.34	75	6.32	172	99.7
1967	6.05	72	6.59	180	108.9
1968	5.88	70	6.75	183	114.8
1969	5.81	69	6.81	186	117.2

Note: All prices are adjusted with the general wholesale price index in Taipei City (1964=100).

<sup>a</sup>Source: (9, p. 111).

<sup>b</sup>Derived from the fourth column of Table.

has been exported since 1959 from Taiwan to nearby countries. The total export value of wheat flour during 1959-1969 was \$10.1 million (9, p. 107; 92, p. 136). Over 30 percent of imported wheat and flour came under U.S. food aid programs, as indicated by Table 58. Thus the total net export earnings as a result of trade in wheat and rice was \$128 million. This points out that if there were no imported wheat and flour to substitute for rice for domestic consumption, there would be little rice surplus for exports. The trend of rice exports for the period of study is given by Table 18. This, however, reflects government policy in favoring imports of low-priced wheat and exporting high-priced rice. It is important to note that the potential rice export for Taiwan in the years ahead will largely depend on the rate of growth of population, the quantity of wheat import, the price of wheat relative to rice, domestic production of rice, and the degree of shifts in dietary habits.

b. Effects on soybean production Soybeans have been one of the important food and feed crops in Taiwan for many years. Soybean imports under food aid program had the effect of expanding soybean production and planted area, as shown by Table 59, even though prices of soybeans imported under food aid program were lower than that of local soybean prices (72, p. 9). Soybean imports under food aid program were not terminated until 1963 (72, p. 6). Production statistics in

Table 59 show that soybean production increased from 14,627 metric tons to the peak of 75,226 metric tons in 1967, then declined to 67,111 metric tons in 1969. On the other hand, the planted area increased from 24,300 hectares in 1952 to a peak of 59,700 hectares in 1960, then dropped steadily to 45,300 hectares in 1969. There was a little effect on change in the planted area of soybean during the food aid period. Relatively speaking, the price of soybean has been quite stable. But with anticipated increasing imports of soybean, domestic expansion of soybean acreage may be halted due to the limited land resource available. By comparing soybean with competing winter crops, as indicated by Table 62, it is clear that the production of soybeans is less profitable. Diminution of soybean acreage may increase profit and bring about more efficient use of farm resources.

Vegetable oilseeds produced and consumed in Taiwan consist of peanuts, soybean and rapeseed. Of these three oilseeds, peanuts and soybeans are commonly used both for processing into oils for cooking and industrial uses, and for direct food consumption. Over 92 percent of all vegetable oil consumed in Taiwan is extracted from soybeans and peanuts. Soybean oil is considered a substitute for peanut oil. We shall trace the effects of wheat imports under food aid programs upon the development of peanut production. According to the data in Table 9, growth in peanut production over the

food aid period 1952-1963 was substantial. The planted area for peanut also increased steadily. The data in Table 9 convincingly shows that increases in both yield per hectare and planted area contributed to increased production of peanuts. Thus we may conclude that soybean imports resulted neither in a decline in production of peanuts, nor a significant shift of acreage from peanut to the production of soybean. Moreover, both the planted area and production of peanut did increase during the food aid period for soybean imports.

Since the termination of soybean imports under food aid program in 1963, soybean imports have been on a commercial basis. Particularly since the relaxation of soybean import controls in 1966 (9, p. 206), imports of soybean have dramatically increased.

c. Effects on corn production      Corn is used both for human food consumption and for animal feed in Taiwan. The production of corn is relatively small compared with other crops such as rice, sweet potatoes, and soybean. Prior to 1960, domestic production was nearly adequate to satisfy home consumption, and only a very small amount was occasionally imported. Corn imports under U.S. food aid did not start until 1961 and were terminated in 1964 (89, pp. 3-4). The data in Tables 58 and 45 indicates that the total market value of feed grains (mainly corn) in PL 480 Title I program was only 1.3 percent of the total market value of all commodities

programmed under agreements signed July 1, 1956 through December 31, 1969; corn imported under food aid programs was less than 0.1 percent of total corn imports.

Since 1963, the increase in demand for corn in Taiwan has been greater than the increase in domestic production. This is due to government's positive promotion and encouragement of modern techniques used in raising hogs and chickens. As indicated in Chapter IV, the government launched integrated hog-raising and chicken raising programs in 1963. As a result, the production of hogs and chickens and the consumption structure of corn have changed considerably. Significant corn imports started in 1963. Approximately 19,000 metric tons were imported, accounting for 35 percent of total supply of corn in Taiwan. Since then, corn imports quadrupled from 33,000 metric tons in 1964 to 133,600 metric tons in 1967. With the advent of liberalized corn import policy in 1967, corn imports increased rapidly from 133,600 metric tons in 1967, to 388,400 metric tons in 1969, accounting for 90 percent of total supply in Taiwan (9, p. 124). Most of the imported corn is used for meeting increasing requirements of the livestock and poultry industries. Furthermore, since 1967, the yearly planted area, yield per hectare, and production of corn has been decreasing sharply as a result of the policy of import liberalization, as indicated in Table 59. The cost of corn production in Taiwan is higher than in other countries.

Consequently, domestic producers of corn are unable to compete with foreign producers. The policy of free import of corn has had a major impact in the form of decreased planted area and production in Taiwan. Land is expected to shift from corn to more profitable crops.

d. Effects on tobacco production      The production, marketing, and manufacturing of tobacco in Taiwan is under strict control of the Provincial Tobacco and Wine Monopoly Bureau, a provincial government agency. The agency fixes the number of hectares to be devoted to tobacco production, and requires growers to sell their entire crop to the agency at fixed prices. The agency also has monopoly over all imports of tobacco. As indicated by Table 58, the shares of U.S. aided imports of tobacco accounted for 29 percent of total tobacco imports for the period 1952-1969. During the period, tobacco imports accounted for only 9.2 percent of total domestic supply. Hence, U.S. aided imports of tobacco consisted of a relatively small percentage of total domestic production. The upward trend both in production and in planted area of tobacco, as indicated by Table 59, is probably due to higher profits and favorable prices of growing tobacco rather than to U.S. aided imports of tobacco. Observing the data in Tables 60 and 62, we find that the tobacco price is the highest one among the farm prices of winter crops.

Table 62. Farm prices of winter crops, 1963-1968, Taiwan<sup>a</sup>  
 Unit: NT\$/kg

Year	Sweet potato	Corn	Wheat	Soybean	Flax	Rapeseed	Tobacco leaf	Vegetables <sup>b</sup>
1963	0.96	3.05	4.24	7.06	0.75	6.68	21.20	0.78
1964	0.69	3.34	3.84	7.01	0.75	6.18	21.20	0.76
1965	0.89	4.11	4.07	6.52	0.80	5.34	20.70	1.00
1966	0.82	4.01	4.07	7.14	0.85	5.47	20.90	1.28
1967	0.91	3.60	4.22	6.23	0.95	6.91	20.90	1.40
1968	0.90	3.17	3.81	6.04	0.95	5.63	21.10	1.07

<sup>a</sup>Source: (132, p. 110).

<sup>b</sup>Price of vegetables is the weighted average of the prices of eight main winter vegetables.

As indicated by Table 59 tobacco production has increased greatly since 1952. This may be attributed to the joint efforts of the agency and the Taiwan Tobacco Research Institute. They have provided growers with technical assistance and economic incentives, such as new seeds with superior quality, high yielding varieties for commercial growing, improved methods of topping tobacco, favorable domestic prices, expanded marketing facilities, and adequate loans both in cash and in kind for fertilizer, pesticides, implements and materials for production and curing of tobacco leaves (1, p. 20; 22, p. 58). Tobacco production was only 8,972 metric tons in 1952. It increased to 15,937 metric tons in 1960, and to 20,509 metric tons in 1969, for an increase of 230 percent during the period 1952-1969 (9, p. 238).

e. Effects on cotton production Climatic conditions, such as typhoons and continuous rain, are not favorable to growing cotton in Taiwan. Cotton production is very unstable and yield per hectare usually varies considerably from year to year. These uncertainties and risks in cotton farming are the major obstacle to the development of cotton production in Taiwan. As indicated by Table 58, domestic production of cotton accounted for only 1.5 percent of domestic supply for the period of study. Thus the textile industry in Taiwan depends almost entirely on imported raw cotton. At least 95 percent of the annual total supply of raw cotton is imported.

The proportion of imported raw cotton has been increasing with rapid development of Taiwan's textile industry. In the early stage of the development of the textile industry in Taiwan, cotton imports under food aid programs played a very important role. Prior to 1960, the cotton imports through food aid programs accounted for nearly 90 percent of total raw cotton imports. The percentage decreased to 43 percent in 1965, and finally declined markedly to only 9.4 percent in 1969 (9, p. 252). For the past ten years, 1960 through 1969, Taiwan's textile industry had expanded considerably. The cotton imported under food aid programs has been far short of meeting increasing demand. Therefore, commercial cotton imports have risen significantly since 1960. In 1960, commercial imports of cotton were only 13,528 metric tons. They have increased substantially to 92,206 metric tons in 1969.

Imports of raw cotton under food aid programs facilitated recovery and development of Taiwan's textile industry. The expansion of exports of cotton goods was felt to be a desirable development. Thus, one of the features of Taiwan's textile industry is that it imports almost all raw cotton required for supporting the rapidly expanding manufacturing production, and then exports a considerable portion of its textile products to foreign countries. Exports of textile products first occurred in 1956. From the initial level of only \$3.1 million, exports increased very rapidly to \$21 million in 1960, \$65

million in 1965, and 266 million in 1969. The 1969 exports accounted for 24 percent of the value of total exports (92, p. 136). Textile products are now Taiwan's number one export commodity. This contributes significantly to increased foreign exchange earnings.

Planted area of cotton has declined sharply since 1960, as shown in Table 58, due to unfavorable weather conditions, great variation in yield and uncertainty of farmers' income from growing cotton, and because a very significant quantity of raw cotton was imported at favorable prices. However, remarkable yield increases of cotton have stabilized production. It is, therefore, unlikely that the area and production of cotton can be expanded significantly in the future as long as substantial quantities of cotton are imported from foreign countries at a reasonable price.

f. Impacts on livestock and poultry production      The raising of livestock and poultry has been a secondary but significant aspect of Taiwan's agriculture since the early 1950's, as shown in Table 6. In recent years, the livestock and poultry industry has gradually developed into a full-fledged modern industry instead of being a side-line production activity of farmers. This development was made possible by government's implementing an integrated improvement program in the production of hogs and chickens. Consequently, the output growth of livestock and poultry has increased far more rapidly than that of crops, as indicated by Tables 4 and 5.

Increased production of feed grains and soybeans has been inadequate since the early 1950's to enable the rapid development of Taiwan's livestock and poultry industry. A significant portion of the expanded output of livestock and poultry has been based on ever-increasing importation of feed grains and soybeans. Prior to imports of feed grains and soybeans under the food aid program, the prices of feed grains and soybeans were often too high and too unstable to allow the expansion of commercial livestock and poultry industries. Furthermore, technical, economical and structural factors limited production of feed grains and soybean and discouraged shifts of farm land resources to feed grains and soybean cultivation from other crops. Consequently, continuous expansion of production of these crops to meet the rapid increase in demand was difficult. Food aid imports filled a large part of the gap between domestic demand for, and supply of, feed grains and soybeans. By making an adequate quantity of high quality livestock and poultry feeds available at reasonable and stable prices, the food aid program also made aided improvement in Taiwan's livestock and poultry industries. Food aid imports of feed grains and soybean were particularly important in the early stage of development of Taiwan's economy. These imports, which could not have been purchased commercially on the same scale, were a motivating factor in the development of livestock and poultry industries and the stimulation of increased

commercial long-run demand for imports of feed grains and soybean.

Soybean-cake, the by-product of oil processing, has been used widely as a high protein feed for raising livestock and poultry, especially, hogs. Hogs are a major component of Taiwan's livestock industry. As pork is one of the most important animal protein foods, total consumption of pork in Taiwan had increased very rapidly from 94,000 metric tons in 1952 to 348,000 metric tons in 1969 (9, p. 133). The increase in pork production inevitably requires more soybean-cake as concentrated feeds. The total number of hogs was only 2.71 million in 1952, but increased to 3.05 million in 1969 (9, p. 133). Along with the increase of hog population, total requirements for soybean-cake have also increased.

Rapidly increasing corn imports and consumption during the period 1952-1969 was due mainly to the rapid increase in poultry numbers, from 5.59 million in 1952 to 14.44 million in 1969. This was an increase of almost three times (9, p. 146). High egg prices, increasing real per capita income, and high elasticity of consumption for eggs have stimulated the raising of poultry since 1952 (9, p. 151; 92, p. 16). Corn imports will eventually be affected by further development of poultry industry. Given the higher elasticity of demand for eggs and chicken, the poultry industry will be a promising industry for Taiwan in the years ahead. So far as production is concerned, poultry raising is second only to hog raising. The increase

in the production of hogs and poultry has significantly contributed to additional income to farmers, better nutrition to the people, increased use of surplus farm labor and greater rural prosperity.

g. Contribution of Title I imports on Taiwan's

agricultural production

The contribution of U.S. PL 480 Title I program to Taiwan's total agricultural production during the aid period 1957-68 can be seen from Table 63. Arrival amount of agricultural commodities under Title I imports were valued at \$230 million while the total value of Taiwan's agricultural production was \$8,576.2 million during the aid period. On the average U.S. farm product imports under Title I contributed \$19.2 million to Taiwan each year during the aid period. The average value of Taiwan's agricultural production was \$714.2 million. The percentage share of agricultural commodities imports under Title I amounted to 3 percent of domestic agricultural production.

3. Impacts on domestic prices

Earlier in Chapter II, it was pointed out that food aid might have a depressing effect on agricultural prices in recipient countries. This could dampen agricultural development. However, it might help moderate the inflationary pressures on farm prices resulting from increasing food and fiber needs, inadequate domestic supply, and insufficient foreign exchanges for purchasing commercial agricultural

Table 63. Values of PL 480, Title I and agricultural production in Taiwan

	Cumulative value for 1957-1968 (\$ million)	Averaged value in 1957-1968 (\$ million)	Percentage share of (1) in (2) (Percent)
(1) PL 480 <sup>b</sup> Title I	230.5	19.2	3
(2) Agricultural production <sup>c</sup>	8,576.2	714.2	

<sup>a</sup>Source: (compiled and computed from Table 16; and 92, p. 149).

<sup>b</sup>Value of PL 480, Title I is based on arrival amount of commodities imported.

<sup>c</sup>Agricultural production includes crops and livestock productions.

imports.

During the period 1952-1969, aid imports of U.S. agricultural commodities to Taiwan did not result in a visible fall in farm prices, as might have been expected under equilibrium conditions in a free market. The imports come at a time when the economy of Taiwan was experiencing a substantial rise in the general price level. The relative movements of farm and non-farm prices of the last 15 years (1953-1968) are compared by means of the price index numbers in Table 64. Taking 1952 as the base, wholesale prices in Taipei City increased by 131 percent in 1968 while agricultural prices

Table 64. Index numbers of general and agricultural prices<sup>a</sup>  
(Base: 1952=100)

Year	Wholesale price index in Taipei	Agricultural price index <sup>b</sup>	Crops					
			Group index	Rice	Other food crops <sup>c</sup>	Special crops <sup>d</sup>	Vegetables	Fruits
1952	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1953	108.8	117.4	116.8	126.3	118.6	130.6	111.7	99.4
1954	111.3	123.4	120.8	119.7	120.1	122.7	129.8	112.6
1955	127.0	147.1	146.9	131.9	147.9	164.2	157.5	135.8
1956	143.2	165.7	151.9	138.4	160.1	153.6	160.7	148.2
1957	153.5	172.6	162.5	149.7	168.6	163.8	166.2	164.9
1958	155.6	183.3	179.4	153.6	184.4	158.0	233.9	177.6
1959	172.5	211.0	208.1	183.0	203.4	186.2	263.0	214.3
1960	196.9	241.7	240.0	236.6	246.9	217.3	286.7	219.3
1961	203.2	239.0	248.8	245.5	251.3	233.6	299.8	220.9
1962	209.4	239.3	257.9	241.0	257.3	252.0	304.5	239.9
1963	223.0	254.8	276.7	252.6	276.2	266.3	295.4	296.0
1964	228.5	268.1	291.0	256.0	287.8	327.0	299.9	288.9
1965	217.9	270.5	283.2	259.5	313.7	279.3	349.3	240.0
1966	221.1	280.1	287.1	263.1	314.2	285.1	373.7	226.3
1967	446.6	282.6	287.8	281.3	319.4	267.0	386.8	217.9
1968	231.2	300.0	302.3	295.4	312.7	282.5	388.3	258.3

<sup>a</sup>Source: (13, p. 69).

<sup>b</sup>Agricultural price index includes crops, livestock products, forest products, and fishery products.

<sup>c</sup>Other food crops include sweet potatoes, corn, wheat, barley and soybean.

<sup>d</sup>Special crops consist of tobacco, cotton, tea, sugarcane, peanuts, jute, rapeseed, etc.

rose by 200 percent in the same year. Furthermore, crops price (including rice, other food crops, special crops, vegetables and fruits) increased by 202.3 percent while rice price, price of other food crops (including soybean, corn, wheat, barley and sweet potatoes), price of special crops (including tobacco, cotton, peanuts, sugarcane, jute, etc.), price of vegetables, and price of fruits increased, respectively, by 195.4 percent, 212.7 percent, 182.5 percent, 288.3 percent, and 158.3 percent. During this period, agricultural prices increased more rapidly than most non-agricultural prices. In fact, prices of all crops, particularly, price of other food crops, were increasing more rapidly than that of general wholesale prices during the same period. It can be observed from Table 64 that agricultural prices were the major factor in the inflationary movement of prices during the past 15-year period. Thus, we might conclude that in the absence of U.S. food aid commodity imports the increase in the level of farm prices, particularly food prices and prices of special crops, would have been more pronounced. Food aid programs did help moderate the inflationary pressures on farm prices, including food prices and prices of special crops.

It has been the policy of the government in Taiwan to stabilize food prices. In the absence of Title I imports, Taiwan would have relied more on consumer rationing and price controls to moderate increasing prices of agricultural

products. However, prices of feed grains, soybeans, wheat, cotton and other commodities in Taiwan would have been higher and more unstable without Title I imports because of inflationary pressures of increasing demand, serious shortage of domestic supplies, and lack of foreign exchanges to import those commodities on commercial basis.

#### 4. Impacts on U.S. agricultural markets and foreign trade

A number of research studies have indicated that PL 480 programs have helped bring about agricultural and economic development in many recipient countries and have also helped develop potential commercial markets for U.S. farm products (3; 4; 11, pp. 2-4; 34, pp. 3-6; 125; and 126). A good test of economic development is a country's improving ability to import commodities and services on a commercial basis. For example, Japan, a recipient of PL 480 Title I commodities during the mid-1950's, is now the number one commercial customer for U.S. farm products. Japan now receives no commodities under PL 480 programs. Italy and Spain were also principal early recipients of American food aid. These countries are no longer qualified under the PL 480 Title I program due to their improving economic conditions and level of foreign exchange reserves. The point has been well stated by Freeman:

These countries (Japan, Italy and Spain), at a critical times in their economic developments, were aided by Public Law 480. They were ready to carry out their own self-help programs, but they needed

some help in getting started. Once started, they have moved forward of their own momentum (33, p. 3).

Taiwan is now in the take-off stage of economic growth and development. Taiwan has made significant gains in economic growth and has increased substantially her foreign exchange reserves. U.S. commercial sales of farm products, particularly wheat, soybean and feed grains, have increased significantly in Taiwan in recent years (9, p. 106, 124, 206). The availability of Title I commodity imports during the 1952-1959 period of extreme inflation and critical shortages of foreign exchange reserves in Taiwan was a major factor in helping to develop this expanding commercial market (78, pp pp. 13-14). Title I imports of low-priced farm products enabled Taiwan to meet the increasing domestic demand for both human and animal consumption and allowed the development of the livestock, poultry, and textile industries. As a result, Taiwan was able to build its foreign exchange reserves by increasing its exports of wheat flour, pork, and cotton products. These earnings have helped to finance the commercial purchase of low-priced wheat which has substituted for rice in domestic use and thus made possible increased exports of high-priced rice.

Furthermore, the Title I program has enabled Taiwan to use its scarce foreign exchange reserves to import capital inputs essential for continued industrial and economic development. Taiwan is now in an improved position to increase its

commercial purchases of U.S. farm products. It is an example of transition from aid to trade. As an indication of this, the U.S. signed a Title IV long-term dollar credit agreement with Taiwan in 1962 (4, p. 11). The Title IV program facilitates the expansion of U.S. dollar market by helping countries in the transition from paying for commodities with their own currencies under Title I program to paying for them with dollars on a commercial credit basis.

Taiwan's commercial purchases of U.S. farm products have increased considerably in recent years while PL 480 shipments have gradually declined, as indicated by Table 65. U.S. commercial sales of farm products increased from an average of \$4.1 million in the period 1955-1959 to \$90.4 million in 1969, an increase of 22 times. PL 480 shipments dropped from \$48.5 million on the average during 1955-59 to \$22.7 million in 1969, an decrease of more than 50 percent during the period. These impressive figures illustrate the story of Taiwan in a dramatic transition from food aid to commercial trade.

The economy of Taiwan depends heavily on foreign trade because of limited natural resources and small domestic markets. Taiwan's economy is largely dependent on agricultural exports, as indicated by Table 17. The value of total agricultural exports has substantially increased from \$114 million in 1952 to \$305 million in 1969. With the foreign exchange made available, it has been possible to import capital goods

Table 65. U.S. agricultural exports to Taiwan, average 1955-59, annual from 1961 through 1969<sup>a</sup>  
Unit: \$ million

Period	Total agricultural exports	Under specified government financed programs <sup>b</sup>	Outside specified government financed programs <sup>c</sup>
Average			
1955-59	52.6	48.5	4.1
1961	72.6	59.0	13.6
1962	75.6	53.8	21.8
1963	67.9	42.0	25.9
1964	84.6	48.6	36.0
1965	84.6	53.1	31.5
1966	65.1	34.8	30.3
1967	103.2	44.6	58.6
1968	121.5	25.8	95.7
1969	113.1	22.7	90.4

<sup>a</sup>Source: (120, p. 599; 121, p. 604; 122, p. 598; and 123, p. 593).

<sup>b</sup>Includes PL 480 Titles I, II, III and IV, and other legislations. Also includes economic aid under PL 87-195 (the Act of International Development of 1961, as amended) and development loans (1965-69) under PL 87-195.

<sup>c</sup>Agricultural exports specified government-financed programs (sales for dollars) include, in addition to unassisted commercial transactions, shipments of some commodities with governmental assistance.

required for overall economic development. Before 1963 there was a persistent deficit in foreign trade every year. The deficient would have been greater in the absence of foreign exchange earnings generated by increased agricultural exports. Thus, agriculture has not only contributed to Taiwan's overall economic development, but has also helped to improve its

balance of payments position.

Rapid expansion in domestic consumption of rice caused by high population growth, higher per capita income, and hence higher per capita food consumption has tended to decrease the quantity of rice available for export. As indicated by Table 18, about 20 percent of total foreign exchange earnings in 1952 was due to rice exports. The share of earnings from rice sales declined markedly to about 10 percent in 1956, to about 6 percent in 1966, and finally to less than one-half percent in 1969.

Because prices of rice averaged higher than those for wheat in world market, as indicated by Table 61, larger imports of wheat and larger exports of rice were economically advantageous for Taiwan's foreign exchanges. However, it should be noted that, in the absence of larger wheat imports, Taiwan might have required imports of rice or would have had to shift more land to rice production because of growing population pressures.

Taiwan's agricultural exports, with recent diversification, have played a more important role in foreign exchange earnings. The major agricultural products for export now include: canned asparagus, mushrooms, forestry products in addition to rice, sugar, bananas, tea, and pineapples (34, p. 4). Less emphasis is now placed on sugar exports because of low and unstable world sugar prices. Therefore, increasing acreage of cultivated land is gradually converted from production of sugarcane

to high value, relatively price-stable export crops such as those new crops mentioned above.

A large part of local currency funds generated from sales of Title I commodity imports to Taiwan has been used to finance the improvement of agricultural production, particularly the production of diversified crops (22, p. 24). These new diversified agricultural crops which are processed in Taiwan for exports have rapidly grown in importance since they were developed to export. For example, exports of canned mushrooms and asparagus did not start until 1961 and 1963, respectively, but by 1968 their combined export value had reached \$54.4 million (34, p. 4). Taiwan is secondarily to the U.S. as a mushroom producer, producing one-quarter of the world's output. Exports of bananas and canned pineapples have also shown remarkable growth, as indicated by Table 18.

##### 5. Impacts on the balance of payments

The importation of farm products under PL 480 Title I has had several important effects on Taiwan's trade patterns and balance of payments. First, the import of these farm products on concessionary terms under Title I does not require payment in foreign exchange. This may imply net foreign exchange saving to Taiwan. Therefore, Title I shipments have enabled Taiwan to increase imports of these agricultural products without using scarce foreign exchange reserves. The reserves were needed to purchase capital inputs essential to overall economic

development. In the absence of farm product imports under Title I, it is likely that commercial farm imports probably would not have increased a comparable amount due to the higher priority given to capital imports required for overall economic development. Title I imports have largely been a supplement to, rather than a substitute for, commercial imports of these farm products. As indicated by Table 66, during the period 1957-68 the total payments to Taiwan under PL 480 Title I amounted to \$230.9 million. This would have been paid on a dollar basis in the absence of Title I imports, assuming that the same value of farm products was imported on a commercial basis. The Title I imports accounted for only 4.3 percent of total import payment. Thus, \$230.9 million to Taiwan could be considered as foreign exchange savings.

Second, local currencies generated by Title I sales in Taiwan are allocated among common defense, loans for Taiwan's economic development, U.S. uses, and loans for private enterprises. In fact, the first two uses can be considered as an elimination of foreign exchange payments. The last two uses should, in terms of foreign exchange, be considered as constituting cash sales. Thus, the use of local currency funds for various U.S. expenditures has, to some extent, resulted in a loss of dollars to the economy of Taiwan. However, the positive contribution of the PL 480 Title I program has more than offset the dollar loss resulting from the last two uses

Table 66. PL 480 Title I imports in total payment for imports of commodities in Taiwan, 1957-1968<sup>a</sup>

Period	Total payments imports of commodities (\$ million)	PL 480 Title I imports (\$ million)	Percentage of total payments (%)
1957	252.2	9.3	3.7
1958	232.8	11.8	5.1
1959	244.5	18.6	7.6
1960	252.2	-	0
1961	324.1	19.7	6.1
1962	327.5	46.4	14.2
1963	336.8	68.8	20.4
1964	410.4	12.0	2.9
1965	555.3	17.4	31.9
1966	601.1	-	0
1967	847.5	-	0
1968	1,025.9	26.6	2.6
Total	5,410.3	230.6	4.3

<sup>a</sup>Source: (compiled and computed from 92, p. 132 and 149).

of local currency generated. Overall economic development has been hastened by meeting Taiwan's needs for agricultural imports and by facilitating the financing of agricultural development projects.

Third, in spite of the continuous expansion of Taiwan's foreign trade, there was still a substantial trade deficit each year. A large part of Taiwan's imports from 1952 to 1969 was financed with U.S. aid, as indicated by Table 66. The aid contributed significantly to the lessening of inflationary

pressures, to the balancing of international payments and to stabilization of the economy of Taiwan. It can be seen from Table 66 that 93.5 percent of the total payments deficit of \$1,348.7 million during 1952-1969 was made up by U.S. aid financing, in the amount of \$1,260.5 million. PL 480 Title I payments were 19.7 percent of total U.S. aid and covered 18.5 percent of Taiwan's payments deficit during the period. In this respect, Title I imports under the PL 480 program contributed favorably to Taiwan's balance of payments position. Table 68 presents financial sources for Taiwan's total imports. U.S. aid accounted for 16.5 percent of total import value for the period 1952-69.

In short, without U.S. aid the budget deficit would have been larger, the inflationary pressure stronger, and Taiwan's economic development would have been adversely affected.

#### 6. Impacts on capital formation

The key factor governing rapid economic growth in Taiwan is the capital formation that was supported by American economic aid, including food aid programs (129, pp. 86-87).

Kawano asserted that

In theory a high rate of economic growth in brought about by no other means than an efficient utilization of limited resources. There are, however, two aspects of this question. The first is the supply of capital, and the second is its investment. It is desirable that as large a sum of capital as possible should be procured, and that investment should be carried out with maximum efficiency.

Table 67. Cumulative values of total imports and exports from 1952 through 1969 in Taiwan<sup>a</sup>

<u>I. Total value (\$ million)</u>				
<u>Imports</u>	<u>Exports</u>	<u>Deficit</u>	<u>U.S. aid</u>	<u>PL 480 Title I<sup>b</sup></u>
7,634.4	6,285.7	1,348.7	1,260.5	248.8
<u>II. Percentage share of cumulative total</u>				
<u>U.S. aid in total deficit</u>	<u>PL 480 Title I in total U.S. aid</u>	<u>PL 480 Title I in total deficit</u>		
93.5	19.7	18.5		

<sup>a</sup>Source: (computed and derived from 92, pp. 130, 132 and 149).

<sup>b</sup>PL 480 Title I commodities did not arrive in Taiwan until 1957. The arrival amount of Title I commodities valued at \$230.5 million during the period from 1957 through 1968. Since the date of arrival value for Title I imports in 1969 is not available, hence we use the value of Title I commodities programmed signed December 12, 1967 in which \$18.3 million of Title I commodities was scheduled to ship in 1969.

Table 68. Financial sources for imports<sup>a</sup>

<u>I. Cumulative value (\$ million)</u>				
<u>Period</u>	<u>Total</u>	<u>Bank's exchange settlements</u>	<u>U.S. aid</u>	<u>Other</u>
1952-69	7,635.4	5,602.4	1,260.5	772.5
<u>II. Percentage distribution (%)</u>				
1952-69	100.0	73.4	16.5	10.1

<sup>a</sup>Source: (computed from 92, p. 132).

In regard to the supply of capital there are two aspects--foreign aid and inflow of foreign capital on the one hand, and saving out of domestic product on the other (67, p. 140).

Capital is available both from within the agricultural sector and from the non-agricultural sector of the economy. The formation of capital in agriculture is generated from savings, which are the excess of net production over consumption. Consumption in developing nations is already very low. Hence, it is difficult to see how consumption could be further reduced as a source of savings and hence capital formation. This is particularly true when growing population pressures are considered. Therefore, agriculture must rely on increased productivity and on the inflow of foreign capital and foreign aid for capital formation.

The agricultural sector in Taiwan achieved remarkable growth rates with American economic assistance and food aid during the period 1952-1969. This growth was discussed in Chapter IV. Total agricultural output almost doubled during the period. As was discussed in Chapter V, most of the large increases in agricultural output were attributed to three major factors: (1) increasing use of modern capital inputs; (2) increased farm productivity of labor resulting from application of improved farm technology; and (3) institutional and organizational factors. Of those three factors, the second was the most important element. The large increases in agricultural output have not only adequately met the needs of

a growing population at home, but have also furnished the raw materials for industry and made possible an expansion of agricultural exports to earn foreign exchange. These increases were achieved through increases in yield per hectare with virtually no increase in acreage.

The available evidence indicates that American economic aid during 1951-1965 provided a large amount of the capital required for industrial development. The industrial development indirectly supported the development of Taiwan's agriculture. Food aid program under PL 480 helped Taiwan to save foreign exchange and provided for investment in land and water resource development, crop and livestock development, and rural institutional and organizational improvement. Technical assistance in the form of American agricultural advisors and the training of agricultural technicians and specialists in U.S. and other countries contributed significantly to the needed technical competence for the development of Taiwan's agricultural programs. Moreover, JCRR has sponsored more than 6,500 projects for rural and agricultural development in Taiwan since the early 1950's. These projects were financed by American economic assistance and food aid programs.

The analysis of Chapter IV indicated that Taiwan's agriculture has played an important role in contributing capital to the overall development of Taiwan economy. The analysis also illustrated the fact that the agricultural sector

must depend upon foreign capital and upon capital formation through increased productivity. American food aid can be considered as a source of the capital required for increasing yield per hectare. As mentioned previously, American food aid, rather than being used for consumption only, has been directed toward increased capital investment in the agricultural sector.

It is clear that the U.S. capital assistance played an important role in the economic development of Taiwan's agriculture. Jacoby, commenting on a study of Taiwan's economy covering the 1951-1965 period, stated that:

U.S. capital assistance to agriculture was \$213 million during 1951-65. This was 22.5 percent of total capital assistance to Taiwan, but it financed nearly 59 percent of net domestic capital formation in agriculture. (This figures exclude the multipurpose Shihmen Dam, which served agriculture, and aid investment to expand agricultural processing industries). The preponderance of all assistance was aid-generated local currency, expended through the program of the Joint Commission (54, p. 180).

American aid has long played an important role in the economic development plans of Taiwan. Successive 4-year development programs were initiated in 1953. The fifth economic plan, covering 1969-1972, is currently in operation. The remarkable success of the first three plans was underwritten by massive U.S. aid. The contribution of American aid and surplus farm product imports under food aid programs to Taiwan's total gross capital formation may be seen from Table 69. In the first 4-year economic plan, 40 percent of total

Table 69. Percentage of total gross capital formation financed by total U.S. economic and PL 480 Title I imports, during the four consecutive 4-year economic development plans, 1953-1968, in Taiwan<sup>a</sup>

	First plan (1953-1956)	Second plan (1957-1960)	Third plan (1961-1964)	Fourth plan (1965-1968)
(1) Total U.S. aid in \$ million	608.8	419.7	358.3	94.4
(2) Total PL 480 Title I in \$ million	0	39.8	146.9	43.9
(3) Percentage share of (2) in (1) in %	0	9.5	41	46
(4) Percentage of total gross capital formation contributed by (1)	40	37	30	9 <sup>b</sup>
(5) Percentage of total gross capital formation contributed by (2)	0	3.5	12.7	4.1

<sup>a</sup>Source: (computed and compiled from 90, p. 15; 91, p. 2; 92, pp. 146, 149; 93, pp. 46-47).

<sup>b</sup>Inflow of foreign capital since U.S. aid was terminated in mid-1965.

gross capital formation came from U.S. aid, and none came from PL 480 Title I because Title I imports did not arrive in Taiwan until 1957. During the second 4-year plan, U.S. aid accounted for 37 percent of total gross capital formation while Title I imports accounted for only 3.5 percent. In the third plan, 30 percent of total gross capital formation was financed with external resources. These resources were mainly from the U.S. and included the 12.7 percent contribution of Title I imports. During the period of the fourth 4-year plan, only 9 percent of total gross capital formation was created by the inflow of foreign capital. Only 4.1 percent was financed with Title I imports. On the average, Title I imports contributed about 5.1 percent of total gross capital formation in Taiwan during each of the four 4-year economic development plans.

Taiwan's agricultural sector made many types of contributions to capital formation through increasing productivity and output during the period 1952-1969. These types of capital contribution are: (1) agricultural savings used for the non-farm sector; (2) net transfer of capital; (3) agricultural export earnings; (4) human capital transfer; and (5) a compulsory transfer of capital as a result of government taxation and regulation, including the collection of land taxes, low compulsory purchasing prices of paddy rice, and high fertilizer to rice government exchange prices.

Recently, a comprehensive study of capital contribution of the agricultural sector to the non-agricultural sector in Taiwan, in terms of visible capital transfer, was completed by Pein (86, pp. 26-49). Pein's estimates for the years 1952-1969 are presented in Table 70. Visible capital transfers from agriculture in the form of agricultural savings used for the non-farm sector, agricultural exports earning, and the earnings resulting from governmental compulsory transfer totaled NT\$93,342 million from 1952-1969. This is equivalent to \$2,342.1 million. For each year of the 18-year period, Taiwan's agricultural sector contributed to the non-farm sector of the economy an average of about NT\$5,204 million, which is equivalent \$130 million. It also can be seen from Table 70 that during the 1950's the largest proportion of capital contribution among various sources was from agricultural export earnings. But starting in 1960 the most important source of capital contribution has been from agricultural savings used for the non-agricultural sector. Since 1965, earnings from the fertilizer-rice barter system have been more important as a source of capital transfer from agriculture than agricultural exports. Moreover, Taiwan's domestic capital formation during the period 1952-1969 averaged NT\$1,718 million annually at 1964 constant prices (86, p. 36). In the same period, the capital contribution of the agricultural sector to the non-agricultural sector averaged NT\$520

Table 70. Capital contribution of agricultural sector to non-agricultural sector,  
Taiwan, 1952-69<sup>a</sup>  
Unit: NT\$ million

Period	Agricultural savings	Earnings from land tax, compulsory rice purchase, and rent of public land <sup>b</sup>	Earnings from fertilizer-rice barter system <sup>b</sup>	Earnings from agricultural exports	Total earnings
1952	-645	269	126	2,060	1,810
1953	308	508	419	2,553	3,768
1954	-1,077	282	299	2,027	1,531
1955	173	245	318	3,170	3,906
1956	633	249	-150	2,579	3,311
1957	1,138	250	17	3,236	4,641
1958	1,022	253	-34	1,865	3,106
1959	1,293	225	-33	1,489	2,974
1960	2,048	414	628	711	3,861
1961	2,787	386	654	565	4,392
1962	2,201	264	610	922	3,997
1963	2,900	253	951	379	4,483
1964	4,351	329	800	2,550	8,030
1965	5,601	344	1,070	597	7,612
1966	5,815	237	1,160	285	7,497
1967	6,733	215	1,182	418	8,548
1968	7,610	500	1,902	211	10,223
1969	7,795	151	1,652	375	9,973
Total					
1952-69	50,686	5,374	11,571	26,052	93,683
Average					
1952-69	2,816	298	643	1,447	5,204

<sup>a</sup>Source: (86, p. 37).

<sup>b</sup>Based on 1964 constant prices.

million annually, as indicated by Table 70, which represented 33 percent of the total domestic capital formation. Thus, the capital contribution of the agricultural sector played a significant role in the development of the non-agricultural sector of the economy in Taiwan.

#### 7. Impacts on economic development and growth

U.S. economic aid did not only produce a corresponding furtherance of capital formation in terms of scale, it also made possible a selective and thoroughly planned investment in important industries in Taiwan. American economic aid was granted and loans were made with the understanding that the funds would be invested in specific projects which were considered likely to contribute to agricultural and general economic development in Taiwan. Moreover, American economic aid did not only create an addition to the purchasing power of Taiwan, but it also made possible the direct purchase of capital goods and raw materials required for overall economic development. This is the significance of U.S. aid for economic development of Taiwan.

A study by Jacoby of U.S. aid to Taiwan during the period 1951-1965 indicated that:

Aid more than doubled the annual rate of growth of Taiwan's GNP, quadrupled the annual growth of per capita GNP, and cut thirty years from the time needed to attain 1964 living standard (9, p. 152).

He also estimated that GNP in Taiwan would have grown only 3.5 percent a year until 1983 in the absence of U.S. aid. In per capita terms, Taiwan is one of the Asian nations which received the largest amounts of U.S. aid in the period 1952-1967.

Taiwan ranked the highest on a per capita basis, receiving nearly \$8 a year per capita (129, p. 44). Since the value of PL 480 Title I imports constituted 14.1 percent of total American economic aid during the period 1951-1965 (92, pp. 146 and 149), we may conclude that Title I imports at least played a significant, but not major role in Taiwan's economic growth and development. However, for the period 1957-1968, it appears more reasonable to compare total U.S. aid and Title I imports because Title I imports did not commence until 1957. Table 53 shows the importance of PL 480 Title I imports to the economy of Taiwan in terms of arrival value. The imports accounted for 26.4 percent of total U.S. economic aid during the period 1957-1968.

The shortage of foreign exchange reserves in Taiwan during the 1950's and early 1960's imposed severe limitations upon the import of essential agricultural commodities such as wheat, feed grains, soybean, fats and oils, raw cotton, etc. that could be purchased on the commercial basis. During this period, domestic production of these farm commodities was insufficient to meet the needs of domestic consumption. The development of the livestock and poultry industries, the textile industry and

the flour milling industry was limited by serious shortages of animal feeds, wheat, soybeans, and raw cotton. Furthermore, the balance of payments situation in Taiwan was such that any diversion of foreign exchange reserves toward the imports of these commodities would have impaired Taiwan's industrialization by affecting the import possibilities for capital inputs. The additional resources provided by PL 480 Title I commodity imports have helped sustain a faster rate of economic growth than would have been possible without these commodities imports.

A stable economy is a prerequisite for a country's economic growth. In the early post-war period when Taiwan's agricultural and industrial production had not yet been restored, there was a serious shortage of food and fiber, and inflation was rampant. In the face of this threatening situation, the government placed top priority on price stabilization to combat inflation. By 1952, both agricultural and industrial production were restored to peak prewar levels. In the meantime, American food aid began to arrive in large quantities, thereby bringing relief to the pressure of excessive demand. This dampened inflationary tendencies. Therefore, food aid imports had the effect of stabilizing prices for those commodities imported as well as for their close substitutes.

The impact of wheat importation under food aid programs on rice production and exports was discussed earlier. Wheat is considered a substitute for rice so that rice exports hence added foreign exchange earnings were made possible. Rice farmers not only made a significant capital contribution, as discussed in Chapter IV, to the non-farm sector, but they also contributed to the sustained growth of Taiwan's economy.

As was shown earlier in the analysis, the importation of feed grains, and soybeans under food aid programs has been instrumental in the development of the livestock and poultry industries. Hence it has promoted private investment in agriculture and increased employment and income, given the existence of complementary relationship between animal feeds as input and fixed investment in livestock breeding. It should be emphasized that without Title I imports it is doubtful that the government in Taiwan would have allocated the equivalent amount of foreign exchange to import animal feeds or the internal funds to finance livestock and poultry enterprises. The importation of animal feeds through food aid programs forced the government, to a certain extent, to direct resources to the livestock and poultry industries in the form of operating capital (21, p. 216). This enabled farmers to direct savings toward fixed capital formation in the form of producing stock.

The importation of raw cotton on concessional terms has greatly facilitated the development and expansion of Taiwan's textile industry. It has contributed to better utilization of the industry's capacity and to the continuation and expansion of exports of textile goods. This has also contributed to increased domestic employment, increased foreign exchange earnings, and to more rapid industrial growth. In 1966, textiles replaced sugar as the single most important exchange earner in Taiwan (92, p. 136).

Taiwan's the fourth largest industry, that of food processing, accounted for 16.4 percent of total export value in 1969, as indicated by Table 17. The industry has increased its efficiency and grown rapidly since the early 1960's through JCRR's financial and technical assistance (106, pp. 193-195). Food processing is concentrated primarily in sugar refining, pineapples, mushroom, asparagus, and tea processing. As indicated earlier, of the processed foods, mushrooms, asparagus, and pineapples have shown the most substantial growth as export items. The export of processed agricultural products led to increased cash income of farmers, and thus provided more incentive to farmers to improve their farms. The production of those crops to be processed for export gave the farm families additional income by employing much surplus labor which otherwise would have not been utilized.

Earlier, it was pointed out that U.S. aid, including food aid, in the form of loans to private enterprise from local currency funds has played an important role in fostering the growth of the private sector in Taiwan. Public industry in 1952 accounted for 56.6 percent and private industry 43.4 percent of total industrial output. As a result of U.S. aid and the public policy of promoting private industry (26, pp. 9-22), the relative positions reversed by 1969 so that private industry accounted for 70.5 percent and public industry 29.5 percent of total industrial output (92, p. 52; 54, pp. 138-140). It is clear that in the absence of the aid program private industry would not have become, by 1965, the mainspring of the economy of Taiwan. The utilization of the loans has had the effect of increasing industrial output, income, and employment in the private sector.

Since a large part of local currency funds generated from the sale of Title I commodity imports has been used for development projects in Taiwan's agriculture (22, p. 24), the capital investments are likely to have the effect of increasing employment and output in the rural areas. The development projects financed by the Title I program were already in the government investment budget and were chosen for their compatibility with U.S. legislative criteria. The projects would probably have been financed in the absence of Title I sales proceeds, but the resulting deficit in the government

budget would have had to be covered by other sources. In other words, the entire pattern of government spending might have been changed without these local currency funds obtained from Title I sales.

Since 1952, Taiwan's economy has grown from a war-torn, deteriorating state to a progressive, and fully self-sufficient one. Outstanding achievements have been made in all sectors of the economy. American economic aid and technical assistance were important factors contributing to high economic growth in Taiwan. Table 71 may be used in judging Taiwan's economic progress. In the 18 years from 1952-69, Taiwan's real national income increased by 264.7 percent for an average annual rate of 7.9 percent. Real per capita income increased by 116.8 percent or at an average annual rate of 4.7 percent. These growth rates have been achieved in spite of limited natural resources, high population growth rates, and large expenditures for defense.

Industrial development has been the most striking economic phenomenon since 1952. The economy of Taiwan prior to 1962 was based primarily on agriculture. Industry has since toppled agriculture as a contributor to net domestic product and has also earned more foreign exchange (92, pp. 18, 134). Industrial output increased by nearly 840 percent for a yearly rate of 14.1 percent, while agricultural production grew at a yearly rate of 4.9 percent during the period 1952-69.

Table 71. Indicators of Taiwan economy<sup>a</sup>

Items	Index numbers			Annual average growth rate
	1952	1965	1969	1953-1969
Population	100.0	155.4	176.1	3.3
Growth national product <sup>b</sup>	100.0	282.0	406.4	8.6
Real national income	100.0	246.5	364.7	7.9
Real per capita income	100.0	173.8	216.8	4.7
Agricultural production	100.0	191.2	223.7	4.9
Industrial production	100.0	487.0	939.7	14.1
Exports	100.0	414.8	929.2	14.0
Imports	100.0	268.3	582.1	10.9

<sup>a</sup>Source: (compiled from 92, pp. 1-2, and p. 14).

<sup>b</sup>Real growth national product at constant prices of 1964.

A significant feature of Taiwan's economy is its increasing dependence on foreign trade. Total exports, which were 13.7 percent and 21.6 percent of GNP in 1960 and 1965 respectively, increased to approximately 30 percent of GNP in 1969 (92, p. 18 and 134). Total exports increased by 829.2 percent or at an annual rate of 14.0 percent while imports increased at a yearly rate of 10.9 percent. Taiwan's capacity to pay for needed imports has showed corresponding improvement.

### E. Welfare Effects of PL 480 Programs

Rapidly increasing demands for wheat and flour, soybeans, feed grains, cotton, and dairy products have resulted in a situation in which domestic production of these farm products is insufficient to meet the requirements of home consumption. Therefore, imports are the principal sources of these farm products. The products have been imported largely from U.S., both under food aid programs and on a commercial basis. As indicated by Tables 45, 46, 49, 51 and 52, these farm products were the five major agricultural commodities imported to Taiwan under American food aid programs (i.e. PL 480 Title I through Title IV) during 1957-69.

The shipments of these five and other commodities under food aid programs totaled \$380.1 million, accounting for 35 percent of total U.S. agricultural exports to Taiwan during the period 1956-69, as indicated by Tables 42 and 43. It seems reasonable to say that imports of these and other commodities under food aid programs have been very important in raising the per capita consumption level in Taiwan. Food and animal feed shortages have been relieved and resources have been provided for the development of the livestock and poultry, textiles, and flour milling industries. These industries have become a viable part of Taiwan's economy. For example, rapid expansion of livestock and poultry production has been encouraged to provide additional animal protein food. However,

shortages of protein feeds, such as feed grains and soybeans, would limit production of these products.

Increasing productivity and output in Taiwan agriculture together with larger imports of commodities from U.S., under both food aid programs and commercial basis, have been sufficient to meet the increasing demands for food and fiber resulting from rapid population growth and rising per capita income.

#### 1. Relationships among food consumption, income and population

Rapid agricultural and economic development, together with structural changes in the economy, have markedly changed the pattern of food consumption in Taiwan. Rising per capita income and rapid population growth have resulted in increased total food consumption since 1951. The changing patterns of food consumption, income, population, and expenditures can be observed from Tables 72, 73 and 74. According to the data in Table 72, yearly food consumption expenditures per capita as a percentage of total per capita expenditures have gradually decreased, as would be expected with increasing per capita income. Per capita expenditures for food consumption accounted for 56 percent and 50 percent of total expenditures in 1951 and 1961, respectively, compared with 40 percent in 1969. It also can be seen from Table 73 that the percentage share of food consumption expenditures in national income decreased considerably from 46 percent in 1951 to 35 percent in 1961,

Table 72. Percentage share of per capita yearly food consumption expenditures in per capita yearly total expenditure in Taiwan<sup>a</sup>

Period	(1) Per capita yearly total expenditures NT\$	(2) Per capita yearly food consumption expenditures NT\$	Percentage share of (2) in (1) (%)
1951			56
1961	4,399	2,213	50
1965	5,524	2,677	48
1966	5,641	2,250	40
1967	5,984	2,625	44
1968	6,382	2,652	41
1969	6,459	2,576	40

<sup>a</sup>Source: (compiled and computed from 8, p. 3; 22, p. 22; 92, p. 14).

Table 73. Percentage share of food consumption expenditures in national income in Taiwan<sup>a</sup>  
Unit: NT\$ million

Period	National income (at current price) NT\$ million	Food consumption expenditures (at current price) NT\$ million	Percentage share of (2) in (1) (%)
1951			46
1961	69,792	24,205	35
1965	112,867	34,487	31
1966	125,554	35,891	29
1967	143,045	38,877	27
1968	167,975	43,160	26
1969	190,421	46,013	24

<sup>a</sup>Source: (compiled and computed from 8, p. 5; 22, p. 22; 92, p. 4).

and to 24 percent in 1969. From Table 74 it can be seen that during the period 1953-69 per capita income increased 110 percent while the average daily per capita supply of calories increased only 16 percent. Much of the reason may be found in total population, which went up 70 percent. The percentage increases in per capita income and per capita daily food consumption during this period suggest that income elasticity of demand for food (i.e. percentage increase in food consumption, 16 percent, divided by percentage increase in per capita

Table 74. Per capita income, per capita daily calories of average food supplies, and population in Taiwan<sup>a</sup>

Period	Per capita yearly real income		Per capita daily calories of average food supply		Population	
	NT\$	Index	Calories	Index	1,000 persons	Index
1953	4,146	100	2,283	100	8,438	100
1960	5,033	121	2,361	103	10,792	128
1965	6,981	168	2,412	106	12,628	150
1969	8,709	210	2,656	116	14,312	170

<sup>a</sup>Source: (compiled and computed from 10, p. 32; 13, p. 12; 59, p. 4; 92, pp. 4 and 16; 112, pp. 35-36).

income, 116 percent) was only about 0.15. This extremely low income elasticity of demand for food can be interpreted by the fact that the people in Taiwan generally consumed fairly adequate diets from nutrition standpoint during this period. They chose to use their additional income to increase their consumption of non-food items such as housing, clothing, recreation, appliances and other items with which they were inadequately supplied.

## 2. Impacts on per capita food consumption

Since the early 1950's the food consumption pattern in Taiwan has altered significantly. In urban areas the food consumption pattern has changed even more quickly than in rural communities. The urban people are now substituting more wheat flour and animal protein food for rice. Thus, per capita consumption of rice has decreased steadily, as shown by Table 75. From Table 75, a trend can be observed that the per capita yearly consumption of basic foodstuff (rice, sweet potato and wheat flour) was rather stable, with only a slight decline from 217 kilograms in 1952-55 to 206.5 kilograms in 1966-69. The stable situation was due to the substitution among kinds of cereals. For example, the consumption of rice and sweet potatoes declined but that of wheat flour increased. However, because of the definite decline in human consumption of sweet potatoes, which was in turn due to the increase of per capita income, the total consumption of basic foodstuff

Table 75. Food consumption in Taiwan<sup>a</sup>  
(Average kilogram per capita per annum)

Items	1952-55	1956-60	1961-65	1966-69
Rice <sup>b</sup>	141.77	143.00	140.50	139.20
Wheat flour	11.98	18.32	19.44	23.85
Sweet potato	63.51	65.98	50.38	43.47
Sugar	11.68 <sup>c</sup>	10.89	9.28	11.84
Corn <sup>d</sup>	0.63	0.86	1.48	1.91
Soybean <sup>e</sup>	1.01	1.80	2.21	2.68
Peanut <sup>f</sup>	4.11	5.54	5.43	5.04
Pork	13.39	17.28	18.27	23.15
Chicken egg	0.68	0.83	1.03	1.35
Chicken meat	2.15	2.16	2.29	3.09
Milk products <sup>g</sup>	1.80	1.64	3.73	6.74
Fish	18.60 <sup>h</sup>	21.70	27.78	30.90 <sup>i</sup>
Total	271.21	290.00	281.82	292.95

<sup>a</sup>Source: (compiled and computed from 9, pp. 74,93,110, 126,137,150,151,161,208, 213; 13, p. 11; 132, pp. 194,196).

<sup>b</sup>Polished rice.

<sup>c</sup>Average 1953-55.

<sup>d</sup>For human food consumption only.

<sup>e</sup>For direct food consumption only.

<sup>f</sup>Includes direct food consumption per capita, and consumption of processed peanut oil and other food products per capita.

<sup>g</sup>Includes fresh milk, butter, condensed and evaporated milk, cheese, and powdered milk.

<sup>h</sup>Average 1953-55.

<sup>i</sup>Average 1966-68.

decreased.

In general, per capita yearly food consumption of various items presented in Table 75 had the upward trend. The per capita consumption in total increased from 271.21 kilograms to 292.95 kilograms in the period 1952-55 to 1966-69.

### 3. Impacts on national diet

The pattern of national diet, though largely a matter of tradition, is limited by the availability of food supply for consumption. Food available for consumption is primarily determined by the food produced domestically and imported from abroad. The per capita consumption of food will be taken as a basis for investigation of the national diet in Taiwan.

The national diet in Taiwan has improved significantly since 1953. As shown by Table 76, the per capita total food energy per day was 2,283 calories in 1953. It increased to 2,361 calories in 1961 and to 2,412 calories in 1965. It increased again to 2,656 calories in 1969. Over the entire period, the rate of increase was 19 percent. Per capita total daily protein consumption increased from 53.4 grams in 1953 to 68.3 grams in 1969, for an increase of 28 percent for the same period. Per capita daily animal protein consumption increased from 12.5 grams in 1953 to 20.9 grams in 1969. This represented an impressive 67 percent increase.

Substantial increases in per capita daily protein consumption, especially in animal protein consumption, in a

Table 76. Per capita daily food energy, protein content, and starchy ratio of the national diet in Taiwan<sup>a</sup>

Period	Food energy (calories per day)	Protein content (grams per day)			Starchy ratio (%)
		Vegetable	Animal	Total	
1953	2,283	40.9	12.5	53.4	76.6
1960	2,361	43.2	13.9	57.1	75.7
1965	2,412	43.6	17.6	61.2	71.2
1969	2,656	47.4	20.9	68.3	67.3
Index (Base: 1953=100)					
1953	100	100	100	100	100
1960	103	106	111	107	99
1965	108	107	141	115	93
1969	119	116	167	128	88

<sup>a</sup>Source: (compiled and computed from 8, p. 13; 10, p. 32; 59, p. 4; 112, p. 35).

national diet means that the diet of the country has been improved and that the level of food consumption has been increased. Moreover, as a result of the increase in per capita daily protein consumption of products, such as meat, fish, fruits and vegetables, means that the proportion of calories derived from starchy food declines. The starchy ratio declined from 76.6 percent in 1953 to 67.3 percent in 1969 for a decrease of 12 percent. All these changes over the period 1953-69 indicate that the diet in Taiwan was significantly

improved by such factors as increasing agricultural productivity and output, rising per capita income, and large imports of agricultural commodities under food aid programs. However, in spite of this improvement, the quality of national diet in Taiwan is still lower than that of developed countries. The protein intake is far from adequate and the starchy ratio remains quite high.

#### F. Concluding Remarks

During the post-war period, the U.S. has been the principal source of economic aid and technical assistance to Taiwan. American economic aid and technical assistance has been a significant factor in promoting internal stability and economic progress in Taiwan. Economic growth in Taiwan has relied heavily on increased productivity of agriculture since early 1950's. U.S. economic aid in the form of food aid accounting for one-fourth of the total American aid, has been a major factor contributing to the expanded productive capacity of Taiwan's agriculture, and also has played a vital role in the country's economic growth. The growth has benefited practically all sectors of the economy.

During the period of food aid imports under the Title I program, 1957-1969, Taiwan made considerable progress in increasing agricultural output. Output increases averaged 4.9 percent annually. The rate of progress in expanding

agricultural output over the period in Taiwan was greater than in many other developing nations. The substantial increases in agricultural production for Taiwan exceeded the growth rate of population, which averaged 3.3 percent annually during the same period. Despite the rapid growth of Taiwan's population, the country experienced per capita gains in agricultural output of 1.6 percent yearly.

Regarding the welfare effects of imports under food aid programs, our analysis indicated that in Taiwan the propensity to consume staple foodstuffs has tended to decline, and it is expected to decline further as income continues to rise. Per capita consumption of food energy, in terms of calories per day, was adequate, although the composition of the diet may not have been ideal. Particularly, protein intake is inadequate and the starchy ratio remains much too high.

In short, from the analysis of this chapter, we may conclude that the impacts of Title I commodity imports under food aid programs on the agricultural sector was highly productive and also had a positive effect on the overall economic development and growth of Taiwan.

## VII. AGRICULTURAL DEVELOPMENT PROBLEMS AND POLICY RECOMMENDATIONS

### A. Agricultural Development Problems

Despite Taiwan's success in achieving a high rate of agricultural growth averaging 4.9 percent annually for the period 1952-69, many problems affecting the development of agriculture, particularly food crops exist. Prior to 1965, the economy of Taiwan was preponderantly agricultural. Since 1965, industry has surpassed agriculture as a contributor to net domestic product and to generation of foreign exchange. With rapid growth in industrialization, the structure of Taiwan's agriculture has also changed. Family farms began to encounter a number of new problems such as shortage of farm labor, rising production costs, low rates of return to capital and inadequate supply of credit together with high interest rates. These factors coupled with small scales of farm operation resulted in a relative decline of farm income.

#### 1. Shortage of labor

From 1952 to 1964, farm labor was considered as surplus resource in agriculture. Increased farm productivity was chiefly achieved by the adoption of labor-intensive technology, as indicated by Table 29. However, as a consequence of rapid industrial development and the accompanying absorption of labor into the industrial sector since 1965, for the first

time in Taiwan's history the farmers have been faced with the problems of labor shortage and rising labor cost. The daily farm wage rate during rice transplanting and harvesting periods has increased substantially from the equivalent of \$1 in 1965 to \$3 in 1969, an increase of 200 percent. This wage increase largely reflects the fact that farm labor is no longer surplus in Taiwan.

## 2. Rising costs of farm production inputs

The costs of chemical fertilizers, pesticides, feeds, farm machinery and other materials are high relative to prices farmers receive for their products. The price for chemical fertilizer in Taiwan is the highest in the world (132, p. 113). Moreover, prices of farm products, especially rice, have long been kept at a low level. The resulting unfavorable ratio of prices received to paid, has discouraged farmers from increasing agricultural production.

## 3. Small scales of farms

Average farm size in Taiwan has steadily declined from 1.4 hectares in 1948 to 1.03 hectares in 1969. At the same time and with an almost fixed amount of farm land, the number of farm families has steadily increased from 597,333 in 1948 to 887,112 in 1969 (62, p. 8; 92, p. 30). The diminution in the scale of farm operation has resulted from increase in farm population with the area of cultivated land essentially

unchanged and expansion of the number of owner-cultivators, i.e., farm families, as a direct result of the land reform program. This unfavorable change in land-man ratio has created a basic handicap to the development of Taiwan's agriculture. While expansion of owner-cultivators has facilitated capital formation by farmers, the diminution in the scale of farm operation has made such capital formation more difficult.

In short, the average farm size of 1.03 hectares is far from an efficient size. Inefficient farms are often associated with high costs, low profits and low incomes. Therefore, the problems faced by farmers in how to utilize efficiently the small-scale farms so as to remain economically viable in the years to come.

#### 4. Relative decline of farm income

Due to a cost-price squeeze, average real incomes of farmers have become much less than those for non-farmers, as shown by Table 77. The national agricultural policy of holding down food prices at the consumer level has lessened economic incentives to farmers for increasing agricultural output and productivity. Furthermore, the stagnation of farm exports since 1967, in term of export value, is mainly due to the restriction of farm imports of developed countries and the urgent need to increase the efficiency of Taiwan's marketing systems (92, p. 134; 105, pp. 339 and 403; and 106, pp. 193-194). As a result, the farm income declined relative

Table 77. Yearly per capita income of farm and non-farm families  
Unit: NT\$

Year	Farm families (1)	Non-farm families (2)	$\frac{(1)}{(2)} \cdot 100$
1954	1,661	2,216	75
1959	2,500	2,985	84
1964	3,845	6,277	61
1966	3,857	5,928	65

<sup>a</sup>Source: (105, p. 405).

to non-farm income.

##### 5. Weaknesses of agricultural credit systems

Although the farm credit system has a record of successful achievements in financing development of Taiwan's agriculture, it also faces problems. First, agricultural credit institutions depend largely on deposits as the source of lending funds and, consequently, are unable to meet the demands of farmers. Second, credit departments of township farmers' associations are the basic constituents of Taiwan's agricultural credit system. The most notable weakness of the system is that they have no capital of their own. They have accumulated some capital from business profits, but the amount accumulated to date is inadequate to meet increasing demand for loans by farmers. Consequently, credit departments must obtain funds

from farmers' deposits and borrowing from agricultural banks. Since all assets and liabilities are combined with all departments in the same associations, credit departments' accounting systems are not independent. This lack of rigid physical control by credit departments limits their growth and effectiveness and exposes their funds to risks for other departments that credit institutions should not assume. The funds of credit departments are usually used by other departments. If the interest is not properly paid by the using departments, then it becomes a serious burden to the credit department. Third, agricultural financing institutions in Taiwan have selected several quick return projects for financing, but have been unable to finance all the desirable long-term projects. Finally, credit at reasonable terms must be made available for farmers for purchase of capital inputs. In Taiwan, adequate credit has been available to finance capital inputs, but interest rates have been relatively high, compared to those in developed nations.

In addition to above mentioned current problems, Taiwan's agriculture has to deal with future population growth and extremely limited natural resources. Other factors to be considered are sources of increased farm output, particularly food crops, capital requirements for capital-intensive projects, labor productivity, agricultural exports opportunities, and the role of agriculture in future economic

development.

### B. Policy Recommendations

In light of the current agricultural development problems the agricultural sector cannot continue to provide resources for rapid industrialization. In addition, capital needed for the continued expansion in industrial sector should be from the industrial sector rather than from the agricultural sector. Consequently, in order to find the solution to current farm problems and to achieve the objectives of continued increased agricultural productivity and output and higher farm incomes, a new agricultural policy has to be formulated. The following measures are recommended for improving future agricultural policy: (1) abolition of the rice-fertilizer barter system, (2) promotion of farm service organizations, (3) farm price support programs, (4) improvement in agricultural marketing systems, (5) increased capital investment, (6) furthering development and improvement of land and water resources, (7) strengthening of agricultural research, education and extension, (8) acceleration of farm mechanization and (9) encouraging the establishment of new rural communities. In addition, policy recommendations for improving future utilization of food aid are also discussed.

### 1. Abolition of the rice-fertilizer barter system

The application of commercial fertilizers has played a very important part in raising agricultural productivity and output. The per hectare level of fertilizer consumption in Taiwan is the third highest in the world, exceeded only by Japan and the Netherlands. Before 1970, cost of fertilizers used by Taiwan farmers represented over 30 percent of the costs of crop production (105, p. 407).

As discussed in Chapter IV, the exchange rates of chemical fertilizers and paddy rice have been extremely unfavorable to rice farmers. The barter ratio has been continuously lowered by the Government during the past years. However, fertilizer prices in relation to rice prices have shown an upward trend (133, pp. 24 and 26). The barter ratio has been determined by the sole decision of government to maximize profits rather than to reflect domestic production costs and international prices for fertilizer.

A recent study of the rice-fertilizer barter system in Taiwan by Lewis (76, pp. 127-179) indicated that the system of compulsory collection of rice through the rice-fertilizer exchange program has gradually generated disincentives for increasing agricultural production. The disincentive arises as a result of low prices for rice and high prices for fertilizers, thereby creating an inefficient resource allocation in rice farming. In addition, the diminution of the

scale of farm operation, as indicated previously, has made capital formation more difficult in the agricultural sector. Consequently, as the result of the combined effect of these two obstacles, the agricultural sector in Taiwan has remained poor, especially since 1965. The agricultural development problems mentioned earlier seem to bear this out. Based on the above analysis, the government in Taiwan should abolish this peculiar system of squeezing agriculture through the rice-fertilizer barter program. With the abolition of this program, the production of food and other crops should be stimulated. Moreover, the reduction of fertilizer prices to reasonable levels should be carried out in order to help farmers bring down their production costs.

## 2. Promotion of farm service organizations

In order to create agricultural surpluses so as to put agricultural production on a commercial basis, organized efforts are needed to take care of production, marketing, distribution, financing and other related matters. Taiwan has a well-developed system of farmers' associations and fruit cooperatives. In order to meet the new challenges of our rapidly changing world, new markets for farm products need to be developed through organized research and export promotional efforts. On the other hand, farmers' associations should be encouraged to develop a program of direct importation of chemical fertilizers so as to provide adequate supply

of, and to bring down the prices of fertilizers to farmers. Measures should also be taken to provide a sufficient supply of seeds, seedlings, breeding animals and farm machinery and implements. Much needs to be done to lower the prices of all these production inputs in order to provide more economic incentives for farmers in their farming. Moreover, financial system in credit departments should be legally made independent. The credit departments' personnel should be given special training so as to enhance their effectiveness in absorbing agricultural savings, further expanding farm credit and increasing loans for promotion of special crops for exports as well as for financing the distribution and marketing of farm products.

### 3. Farm support price programs

It would be worthwhile to mention here that, as a national agricultural policy since 1961, Japan has been continuously increasing the price of rice and decreasing the cost of chemical fertilizers and other production inputs so as to provide farmers economic incentives to expand rice production. Thus, rice production in Japan is highly profitable. In Taiwan, however, rice production is not as profitable as in Japan because of the high cost of production inputs, particularly fertilizer, and the low price of rice. Although prices of chemical fertilizer has been reduced continuously since 1969, its price is still high compared with world

market prices. Prices of other production inputs are also relatively higher than those of other nations. The following measures should be taken in order to provide farmers with more economic incentives to expand farm production.

First, Taiwan should follow more or less the same agricultural policy adopted by Japan, and agriculture should be supported by industry in terms of reduction in prices of farm inputs. Government effort should be made to provide farmers with sufficient farm productive inputs at reasonable prices. Second, the government should also take some action to keep farm prices at a certain level to create more incentives for farmers to produce and to expand them. Farm price support programs of one kind or another should be implemented for some crops. The Japanese government has adopted a policy of high price supports for rice in order to encourage expansion of rice production. This involves paying an artificially high price to farmers for rice, and reselling it to consumers at a comparatively low price independent of the supply-demand situation, this being done to stabilize general commodity prices and the farm labor wage. The national policy of Taiwan has been to keep the price of rice at a low level as a means of stabilizing the general price level. Japanese rice price support policy should also be adopted, once Taiwan's economy has become highly developed. Meanwhile, a minimum guarantee price program should be for purchasing some crops by

government, in case their market prices are too low. Moreover, larger imports of the U.S. wheat, soybeans and corn put downward pressure on their prices and, thereby, on their production. However, the comparative disadvantage of these crops is greater than other winter crops, and the land on which they are grown could be more profitably used for other crops. Therefore, price supports are not necessary for wheat, soybeans and corn. Third, supported price of sugar and guaranteed or negotiated prices of tobacco, pineapples, jute and banana have been implemented for many years in Taiwan with favorable results. Hence support price programs of one kind or another should be improved and expanded to cover more crops.

#### 4. Improvement in agricultural marketing systems

To improve farmers' income and consumers' supply, rationalized marketing is at least as important as increased agricultural production. Thus, an effective way to stimulate agricultural production is to create new markets, both at home and abroad. Supplies of farm products to the domestic and foreign markets should be effectively regulated in order that price stability may be maintained while farmers' income will be increased. Major measures should be adopted as follows. First, in order to facilitate the sale of farm products to domestic markets, modern markets with refrigeration and processing facilities should be established in major cities. This will lead to a general efficient system of marketing

operations, which also will be to the advantage of consumers. Second, exports of bananas and canned mushrooms have repeatedly encountered difficulties. Therefore, it is necessary that government assistance should be stepped up and cooperation between producers and traders should be further strengthened. Meanwhile, measures should be taken to ensure a fair distribution of profits from production and trade. All-round farmers' associations probably offer the most economical solution. Third, as a consequence of the government policy of diversification of agricultural production in Taiwan, efforts should be directed to the development of new farm products to be exported and the promotion of frozen products to be sold in domestic and foreign markets. Meanwhile, the establishment of a centralized storage system should be promoted to facilitate joint efforts at boosting export sales and to obtain credit facilities. For the mutual benefit of farmers, processors and exporters, crop production should be undertaken by farmers under contract, and a unified system of procurement and distribution of the farm products should be put into effect. Four, public assistance should be provided to farm service organizations at all levels for the training of technicians, establishment of modern facilities for storing, forwarding and other marketing purposes, improvement of marketing management, transportation of farm products to urban areas and distribution of production requisites. Other export promotion

activities such as marketing research and dissemination of market information should also be actively promoted.

#### 5. Increased capital investment

The labor-intensive method of cultivation in Taiwan's agriculture has gradually shifted toward capital-intensive methods since 1965, as shown by Table 29. The further development of Taiwan's agriculture should call for, among other things, mass capital investment in the development and improvement of irrigation facilities, development of marginal lands, improvement of farm land and structure, and strengthening present marketing systems. Under the system of small farms in Taiwan, the capacity of individual farmers for investment is limited. There should be an effective and extensive agricultural financing system to provide the necessary credit facilities for farmers. Thus, the efforts to be made by the agencies concerned should provide more capital for investment in the agricultural sector and for financing long-range efforts for increasing agricultural productivity and output. The major measures which should be adopted are as follows.

First, to effectively encourage the mobilization and utilization of agricultural capital and strengthen cooperation among all agricultural financing institutions, consideration should be given to the establishment of a central planning and coordinating machinery for agricultural financing. This will

ensure effective utilization of agricultural capital. Second, it is necessary to attract more deposits from farmers, more investment from commercial banks, and more loans from foreign sources. Agencies concerned should effectively encourage, mobilize and channel government and commercial bank's investments and private savings to agriculture. Third, interest rates for rural loans will be a crucial determinant of farmer investment in production, capital equipment and land improvement. Efforts should be made by government agencies and agricultural credit institutions to provide farm credit at reasonable terms to encourage farmers to invest more in their farming. Four, loans for long-term agricultural development projects should be sought from international financial organizations such as the World Bank and the Asian Development Bank.

#### 6. Furthering development and improvement of land and water resources

Agriculture depends heavily on land and water resources. Land resources are extremely limited in Taiwan. Land and water resources must be used more intensively and efficiently by bringing additional land under cultivation, expanding and improving irrigated areas, and increasing the area through multiple cropping. On the other hand, a high level of technical competence will be needed to plan and effectively

carry out projects to develop irrigated areas and to improve existing irrigated areas. The following measures should be employed:

First, since land resources are limited, an efficient distribution of land utilization in agriculture, industry and commerce is necessary. In principal, fertile land should continue to be used as farm land, and its use for industrial purposes should be avoided as far as possible. Needs of water supply for agriculture and industrial use should be considered carefully in the light of the overall requirements of the economy so as to achieve proper distribution and effective utilization. Second, in recent years, the average farm size for each farm household has declined to less than one hectare. The scale of farming operation has thus been steadily on the decrease. Therefore, the justifications for maintaining the traditional tiny farm system should be reexamined, and proper measures for the prevention of further fragmentation of farmland should be taken. Meanwhile, joint or cooperative farming should be encouraged so as to effectively promote farm mechanization. Third, the cultivation of small parcels of land has been a limiting factor in crop production in Taiwan. Arable lands on the plains are intensively cultivated by way of crop-rotation, inter-cropping and multiple cropping, and the high mountains are covered with forests. It is the zone in between that has provided potentials in bringing additional

land under cultivation. Particularly, there are vast areas of slopeland that could be developed. Over the past years, some hundreds of hectares of newly developed land were brought into cultivation under the land reclamation program. This was done through the development of slopeland in the mountainous areas and seaside or riverside tidal land. Therefore, government agencies concerned should place more emphasis on development projects for reclaiming new farm land and further emphasize soil conservation on slopeland areas so as to bring more land under cultivation to achieve better use of land resources. Four, additional water resources should be developed and more irrigation facilities should be constructed to achieve greater expansion of acreage. Drainage facilities should be improved for re-using the drained off surface water for irrigation, thus increasing the irrigated area. Efforts also should be made to extend the practice of rotational irrigation to save water and at the same time to expand crop acreage.

#### 7. Strengthening of agricultural research, education and extension

In Taiwan, development of improved crop varieties and pest control methods through the process of agricultural research work has contributed greatly to improved crop yields. Thus, the high level of farm technology has been attributed in large part to the effective research work of agricultural research institute and the seven district agricultural

improvement stations. These research programs should be expanded and improved. On the other hand, such expansion and improvement requires adequate funds and facilities. Agricultural research and experimentation agencies should be efficiently organized and must have sound operation. Furthermore, they must cooperate with each other and be ready to tackle any problem that may rise from daily extension work. Active contacts should also be maintained with agricultural research agencies of foreign nations, inasmuch as closer international technical cooperation will aid efforts to foster more agricultural technicians, improve productive technology and increase agricultural productivity and output.

In order to cope with the needs of agricultural development, agricultural education programs should be greatly expanded to provide large numbers of trained staff for agricultural experiment stations, extension services, agricultural agencies, and agriculturally related industries. University (or college) education in agriculture should emphasize the raising of scholastic standards. Quantity and quality should be equally stressed in expansion of graduate school of agriculture for turning out more masters and Ph.D. candidates. Thereby, the requirements for the national agricultural development and economic growth and for the university research and teaching may be met. Taiwan has a highly developed system of vocational agricultural training for rural youths.

Agricultural vocational schools should adjust their courses to meet local demands. Basic education should be improved to raise the literacy levels of farm people. This will not only speed the adoption of improved and better farming practices, but will also better equip those who migrate from rural areas to compete for urban jobs.

The introduction of new farm technology does not only mean more crop production, but a new way of life for farmers. In order to assist farmers in the changeover, increased and improved farm extension services are needed. The results of agricultural research can be communicated to farmers for rapid application in their farming only through effective and expanded extension services. Agencies concerned with agricultural development should, in conjunction with farmers' organizations, intensify extension service, carry out experiments on agronomical methods and hold special demonstrations in less developed areas for the benefit of needy farmers. They should also be adequately staffed with competent extension workers and make full use of mass communications media.

#### 8. Acceleration of farm mechanization

In view of the change of the agricultural structure and pattern of agricultural development since 1965, the new government agricultural policy should emphasize the development of capital intensive farming to meet the problems of labor shortage, rising farm labor cost and a gradual decline in

draft cattle population. Therefore, farm mechanization in conjunction with farmland consolidation programs should be given highest priority as Taiwan launches its agricultural development policy.

Over the past few years, the progress of farm mechanization in Taiwan has been very slow due to the small size of farms, farmers' weak purchasing power restricting the use of machines, along with the poor quality of farm machinery. Because the small size of farms tends to make their farm operation uneconomical, the government agencies concerned will need to adopt various measures, such as joint farming, subsidization for the purchase of farm machinery and extension of low-interest loans, establishment of extension service station and promotion of research work on farm machinery, to encourage and accelerate farm mechanization.

Government agencies concerned and farm extension workers should organize groups of 40 to 50 farm families into cooperative unit to make joint use of machinery and equipment to promote farm mechanization, marketing and purchasing economies, while continuing the system of individual ownership of land. The purchasing of machines by farmers should be subsidized with low interest long-term loans. Farm extension service stations should be set up at suitable locations in rural areas for promotion of farm mechanization, and centers for maintenance and repair of farm machines should be established.

The local manufacturing firms of farm machinery should be assisted through government encouragement. Further, research work on farm machinery to improve the quality and to lower the cost of the machines, should be stepped up. Meanwhile, the training of farmers to use farm machinery efficiently should be strengthened. In addition, testing, demonstration and extension of newly introduced farm machinery should also be actively pushed.

#### 9. Encouragement of the establishment of new rural communities

Following recent gains in foreign trade, the farmers in Taiwan are directed and encouraged to change the pattern of farming toward diversified as well as commercialized forms of agriculture. Regional specialization in farm production based on comparative advantage of various regions should be mapped out region by region on a collective basis throughout the island for the establishment of new rural communities. Meanwhile, agricultural processing factories in each region should be encouraged to be established so as to increase farmers' benefits and income. Moreover, farmers' organizations should step up their technical services, increase the supply of materials and equipment and improve marketing and other public facilities, so that specialization of farm operations by the various communities can be gradually realized.

#### 10. Improvement of the utilization of food aid

Most of PL 480 Title I program agreements between the U.S. and Taiwan were made on a year-to-year basis. The aid, as a general rule, was used as supplements to other U.S. economic assistance, and was not included in the overall economic development plans in Taiwan. The approach was designed to finance specific projects in agricultural development. Many worthwhile development projects require two to five years to complete. The assurance of continued food aid is essential for long-term development projects. A country that is really trying to integrate food aid into a four-year plan for economic development requires a four-year food aid commitment. If food aid is committed on a short-term basis, there is a considerable uncertainty about the continuation of the inflow of surplus agricultural commodities in subsequent years. This uncertainty leads to a less efficient allocation of scarce foreign exchange resources for overall economic development. Thus, it seems reasonable to say that food aid in support of economic development plans should be on a long-term basis. For example, PL 480 shipments have been integrated with the overall economic development plans of India where they have been used as an investment resource in the implementation of successive five-year economic developments (24, p. 137). Based on the reasons mentioned above, the following measures are recommended for improving the future utilization of food aid in Taiwan.

First, food aid should be made on a program basis rather than projects basis, and should be integrated into the national economic development plans. The government in Taiwan should estimate the approximate quantity of food required to implement its overall economic development programs.

Second, food aid commitment should be on a long-term basis to facilitate the integration of surplus agricultural commodities into the development. The government in Taiwan should try to get a four-year food aid commitment with the yearly amount specified. This would lead the government to allocate its resources in efficient way, especially for those development projects which are dependent upon surplus agricultural commodities for financing. However, in view of Taiwan's remarkable success in increased farm production and her overall self-sufficiency in food during recent years, the need of food aid will be on the decline in the years to come. Instead more foreign capital in the form of loans would be needed to accelerate overall economic development of Taiwan.

On balance, under all the previously mentioned policy recommendations, the tax burden on farmers will be lightened, the cost of production reduced, marketing systems streamlined, more agricultural loans extended, rural infrastructures improved, research and education and extension strengthened, farm mechanization accelerated, new rural communities opened in Taiwan's vast rural areas to process farm products and the

utilization of food improved. Under this new policy farmers will have a greatly increased income and a better living and working environment, and finally will give Taiwan's rural areas as a new look.

### VIII. POLICY IMPLICATIONS FOR DEVELOPING NATIONS

With high rate of population growth and relative scarcity of land and capital resources, Taiwan has shown high rate of agricultural growth with an average of 4.9 percent increase during the period of 1952-69, though the cultivated land area has remained nearly unchanged. This impressive agricultural growth has been chiefly due to substantial increase in agricultural productivity, which, in turn, has been due to a variety of factors mentioned earlier. This spectacular success of approach and methods adopted by Taiwan for the solution of agricultural problems in all its aspects from production to marketing, and thereby contributing to increased agricultural output and productivity may be expected to have applications and relevance to other developing countries where population growth is rapid, land and capital resources are relatively limited and climate condition is tropical or subtropical.

There are many important policy implications that are drawn from the main findings of this study. They are potentialities for further expanding crop production, land reform, balanced growth policy, farm size and labor-using, emphasis on increased yield per hectare, investment in human factor, economic incentives and foreign assistance arrangements.

#### A. Potentials for Further Expanding Crop Production

Further success of the development of Taiwan's agriculture depends to a large extent on the solutions of all farm problems mentioned previously. Agricultural problems in Taiwan are more difficult than those faced by the developed nations during their early stages and conditions of economic development. Much less farm land is available per capita in Taiwan than was available in the developed nations. Consequently, Taiwan now must achieve much higher crop yields per hectare than the developed nations during the corresponding stages of development. Owing to rapid population growth, limited natural resources, and large expenditures for defense, crop yields per hectare must increase at least 4 percent annually in Taiwan to meet expanding needs for food. In the developed nations, increases in crop yields 2 percent each year are large enough to meet expanding food needs due to population and income growth. Also, additional land is available for cultivation.

In addition to agricultural problems, the challenging problems in Taiwan's economic development are to maintain a high growth rate of 7 to 8 percent in gross national product, to provide added employment opportunities for the expanded labor forces resulting from population growth and to accelerate capital accumulation in Taiwan's economy to meet the mounting needs for capital investment. The government should continue to develop a long-range economic development planning to

coordinate the efforts for accelerated economic growth on the one hand. In order to achieve these objectives and obtain solutions for all farm problems, greater emphasis should be placed on the continuous improvement of farm technology through intensification of research and education and extension. A number of agricultural problems require technological breakthrough or innovations. Superior and improved farm technology can be introduced in agriculture only as a result of new capital investment in both physical and human resources. The labor productivity can be increased together with a rise of land and capital productivity. At the same time the development of non-farm sector of the economy under economic development plan can absorb the surplus labor from agriculture.

To other developing countries, there are much more potentials available today to increase crop yields than that of Taiwan because relatively high stage of development is reached by Taiwan. Moreover, there is a large accumulation of information regarding the benefits of adoption of advanced farm technology available to them. Meanwhile, wide differences in yield per hectare among these nations imply that a large potential for increase crop yields is possible. However, careful adaptation and demonstration of advanced farm technology in these countries should be needed so as to adopt for local conditions in each of them.

## B. Land Reform

Land reform is the most important single factor that has contributed to agricultural and social progress and rural prosperity in Taiwan. Big landlords were stripped for their holdings and land was parceled out to peasants. Under a sweeping program of peaceful land reform, farmers were given incentives to invest in farm improvements which increased production and thereby income, increased farm purchases of industrial products, and helped finance the expansion of industry. Land reform in Taiwan changed the entire structure of the rural economy and improve the general climate for agricultural development and the advance of agricultural production. Of course, the success of land reform alone is not enough to provide sufficient economic incentives to increase farm production significantly. All other correlated factors indicated previously should be related with the effects of land reform.

Taiwan's experience with land reform should be of particular interest to other nations where agrarian problems limit farmers' incentives to increase production and discourage investments in land improvements. It should be noted that every country has its own historical, cultural, social and economic backgrounds. Therefore, each country should take these of factors into consideration when reforming its system of land tenure.

### C. Balanced Growth Policy

For successful development of agriculture, industry must be developed simultaneously so that dependence on agriculture for employment is diminished and net resources are progressively transferred from agriculture to non-agricultural sector of the economy. Balanced growth policy, as a national policy in Taiwan, is embodied in the 4-year economic development plans. It has proved to be the key factor responsible to the development of Taiwan's agriculture.

In most of developing countries, agriculture is the major source of income and employment. Impatient for economic development and growth, these nations tend to overemphasize the role of industrialization in overall economic development at the expense of agriculture. Taiwan's experience with respect to coordinated development of agriculture and industry under balanced growth policy should deserve special attention in assessing its transferability to development.

### D. Farm Size and Labor-using

Many developing countries have the same small per capita arable land as Taiwan. However, limited land resources are not necessarily an obstacle to agricultural development. Ample evidence reveals that there is little correlation between per capita arable land and per capita income. Several countries in Far East such as Taiwan, Japan and Korea, are the

best examples of sustained and rapid development of agricultural sector despite small sized holdings. Therefore, small holdings do not seem to have any decisive effect on the development of agriculture. Abundant resources, however, surely favor economic development and growth.

In densely populated countries with abundant labor and limited land, effective use of plentiful labor and scarce capital are necessary. Taiwan's experience with labor-intensive but thoroughly modern agricultural methods have turned out to be very successful. The historical process of increasing agricultural productivity in Taiwan from early 1920's to 1964 was chiefly characterized by the adoption of labor-intensive technology, which is associated by intensive utilization of labor and land resources supplemented by working capital inputs. Policies to increase the demand for farm labor and to improve the management for the labor market should be given high priority. Growth in the non-agricultural sector is not fast enough to absorb large amount of surplus farm labor in most developing nations. In most of these nations, the farm labor will continue to grow up for many years to come. Thus, agricultural development strategy with promoting labor-absorbing activities will be important.

On the other hand, capital resources in Taiwan were scarce during the early stages of development. However, careful and effective use of this scarce resources also achieved

remarkable achievements in supporting to rapid development of Taiwan's agriculture. For example, land reform programs gave landowners the economic incentives to improve their land, and the agricultural research institutes, improvement and experimental stations, and farmers' associations have proved successful in introducing new techniques and obtaining acceptance of them. This organizational network was not expensive to support, and functioned efficiently at the local level, where its impact was felt quickly. Also, public work programs for unemployed farm workers can provide social overhead capital such as farm roads, storage facilities, and other farm improvements needed to increase production and transport farm products to markets.

#### E. Emphasis on Increased Crop Yield Per Hectare

In highly populated countries with little possibilities of bringing additional land under cultivation, Taiwan's experience increased yields per hectare are the most appropriate techniques to increase agricultural output. Historical patterns of agricultural development during both prewar and post-war periods convincingly indicate that advanced agricultural technology that increase crop production per hectare and per worker has been a key factor contributing to the high growth in agricultural output and productivity. This may be partly due to the poor land expansion potential in Taiwan and partly to the high level of economic development reached by

Taiwan. This high growth rates in crop yields per hectare in Taiwan was highly significant, since it indicates that there may be large potential for increased crop yields in other developing nations on land already under cultivation. Thus, technology has great potentialities and increases in crop output per hectare probably ranks as one of the most important means of increasing agricultural output in most of nations, particularly for developing nations with limited land resources.

Taiwan's experience demonstrates the importance of adopting combinations of advanced agricultural technology, which was mentioned earlier, rather than single practice. This approach of the adoption of package of advanced farm technology by Taiwan should be to have some implication to other developing countries, if farm management and technical skills are used with a limited amount of capital to develop systems of farming that involve combinations of advanced farm technology, substantial increases in crop yields is to be expected.

#### F. Investment in the Human Factor

Agricultural education, research and extension work are essential for agricultural progress. The experience of Taiwan's agricultural development illustrates that increased use of modern productive inputs has been essential factor contributing to increased agricultural productivity. This emphasizes the significance of the successful application of

innovations and techniques and their infusion through the development of farmers' management and skills, all born out of well-developed systems of farm education, research and extension work vis-a-vis development in human agent. The past growth of Taiwan's agricultural output supports the view that mass investment in farm education, research and extension services has yielded very high returns.

The highly favorable consequences of agricultural research on Taiwan's agricultural progress have been proved since early 1920's. The basic handicap for most of developing nations in the field of research is the fact that it cannot be imported and hence adopted, because advance technology can be adopted to meet local conditions of the country only through each country's own research. The expansion and improvement of education was another important factor responsible to the process of agricultural development. Farm extension services have played a major role in disseminating information of superior farm technology about its benefits and increasing farmers' knowledge and skills and management. Extension service is an instrument of services to the farmers and it also serves as the channel through which the government agricultural policies are implemented. Taiwan's experience in this respect suggests that other developing nations shall have high priority to invest in the human factor which should be closely associated with other activities.

### G. Economic Incentives

In many developing nations farmers are bound to traditional farming systems by which they have survived. They are not willing to take risks to try new production methods. Therefore, better farm management and technical assistance should be demonstrated and then extended to farmers so as to learn new ways of farming and life. In addition, farmers should be provided adequate production inputs such as fertilizers, insecticides and pesticides, new and improved varieties, farm implements, etc., as a means to increase agricultural production. These means, however, are often not very effective because farmers are always afraid of decline in farm prices due to increased production. Thus public programs, like assured markets, market facilities, stable and favorable prices of farm products, are among the economic incentives required to induce farmers to try new production methods so as to increase production, and thereby farmers are further encouraged to shift from subsistence farming to commercialized farming.

Moreover, most farmers in developing countries are short of many or credit to purchase production inputs and to make investment on land improvement and other more productive inputs. Therefore, new agricultural financing institutions are required to provide farmers adequate credit for production purposes. Meanwhile, local marketing facilities and

transportation should be improved and strengthened, and information regarding farm prices should be provided constantly to farmers.

Taiwan's experience with the development and improvement of farmers' organization based on comprehensive cooperative system, to which virtually every farmer belongs and through which he obtains from credit to marketing help, should be interested to other countries where economic incentive to farmers is weak, and marketing and credit systems are poor.

#### H. Food Aid Programs

The Marshall Plan which helped the European countries rehabilitate after World War II was a shining example of what aid can do. In Asia there has been no Marshall Plan as such but the United States has instituted aid programs in many developing nations in the post-war years. Taiwan, one of Asian countries, enjoyed massive American economic aid during 1950-65. When the economy of Taiwan took off, and U.S. aid ended, but the food aid program was continued. A striking successful story of Taiwan's economic progress indicates that American aid was well spent. Also, it demonstrates that American aid can be used efficiently. Taiwan, it should be noted, been under great stress, domestic and foreign, and yet she has rehabilitated and built up her own economy with U.S. aid as a booster. If it has been done in Taiwan, it can be

done in other developing countries provided such aid is given wisely and administered efficiently. Taiwan which is now standing on its own feet economically should set an example for other developing nations for aid for their economic development.

Taiwan's experience shows that sustained and rapid economic growth has heavily depended on improvement of agricultural productivity and output, which, in turn, is partly attributable to U.S. economic assistance in the form of food aid.

In most developing countries, which are mainly characterized by low-income, rapid population growth and limited natural resources, the gap between demands for food and available supply tends to be widened because income elasticity of demand for food is relatively higher than that of developed nations. Consequently, the process of economic development in these nations can be seriously retarded, unless ways are found to meet the urgent needs for more food. Since foreign exchange in these nations is extremely limited which confined the imports of food on commercial basis. Therefore, American aid in the form of food aid, if properly handled, can be used to help agricultural and economic development.

Finally, JCRR, as indicated previously, has played a crucial role in the development of Taiwan's agriculture. The approach of JCRR to Taiwan's agricultural development should

be considered as foreign economic aid program to other developing nations.

## IX. SUMMARY

In this study, our central theme has been the growth in agricultural productivity and output of Taiwan, the capital formation, the means by which the increased agricultural productivity and output was achieved during the period 1952-69, and the role of American food aid under PL 480 Title I program in this process.

The review of literature, both theoretical and empirical, has been made to find out the significant relationships among agricultural progress, capital formation and food aid in overall economic development and growth.

An economic framework, using Harrod-Domar, Solow and Keynesian growth models under certain assumptions, has been developed to assist to analyze the contribution of the food aid to the process of agricultural development and capital formation in the overall economic development of Taiwan. Throughout this study, our primary efforts have been directed toward seeking a consistent viewpoint on the area of analysis concern and toward determining a sound procedure for empirical investigation of the role of food aid, agricultural development and capital formation in Taiwan's economic development. The empirical findings of the study appear to be sound and consistent with economic framework.

Basic conclusions drawn from the findings of the present study may be summarized as follows.

Agricultural development plays crucial role in economic development. Agricultural development is chiefly concerned with the feasibility of the transfer of net capital from the agricultural sector into the non-agricultural sector of the economy. In the developing countries, economic growth depends on a more productive agriculture. Taiwan is no exception. The transfer of net capital from the agricultural sector has to depend on the agricultural development and growth, which, in turn, will heavily depend on government strategy for agricultural development.

Taiwan's achievements in agricultural development since 1952 has been the most significant and unique despite the nature of small scale farm operation, high population growth rate and limited land resources. From 1952 through 1969, the growth rate of agricultural sector averaged 4.9 percent, which surpassed the population growth rate of 3.1 percent. Crops registered an annual growth rate of 4 percent, which came about almost entirely as a result of the increase of yield per unit area. These remarkable achievements have been the result of continued improvement of production conditions and the increase of agricultural productivity and output.

The remarkable success of Taiwan's agricultural development and the major contribution of the agricultural sector to

overall economic development can be explained by appropriate policy decisions and an effective approach to agricultural and economic development made by government agencies concerned. Taiwan's experience indicated that substantial increases in agricultural productivity was achieved by a variety of factors, namely, the application of advancing farm technology, institutional and organizational arrangements, and foreign aid. Technological factors were directed toward the development and diffusion of advanced farm technology. Institutional and organizational factors such as land reform program, activities of JCRR, government's balanced growth policy, reorganization of farm service organizations, effective farm credit and marketing systems, and a well-developed system of agricultural research, education and extension services. Foreign aid was chiefly provided by American economic assistance in the form of food. Thus, Taiwan's agricultural development strategy can best be described as an integrated package approach. New and improved technology that could increase agricultural productivity was developed and new institutional and organizational systems for obtaining new and improved farm technology were put into effect. Food aid was effectively channeled into capital formation projects for promoting overall economic development in Taiwan.

The historical process of increasing agricultural productivity in Taiwan during the period 1952-64 was associated with the labor-intensive method of cultivation. However, the application of capital inputs was more prominent during the period 1965-69 than in the period 1952-64. Thus, the development pattern of Taiwan's agriculture has gradually shifted from the labor-intensive method of cultivation to the capital-intensive method since 1965. It should be noted that the pattern of agricultural development under conditions of limited land and capital resources with extensive use of surplus labor in the period 1952-64 in Taiwan has proved that this type of green revolution has succeeded in increasing agricultural productivity.

During the period 1952-69, the large increases in agricultural productivity and output in Taiwan contributed to economic development and growth of non-farm sectors in many ways. It supplied increasing amounts of food and other farm products at relatively low prices. It supplied farm raw materials for the development of industry, freed sizable surplus labor forces for employment in non-farm industries, served as a source of capital for non-farm industries. This increased productivity also left sizable agricultural surplus to earn foreign exchange through exports that helped finance imports of scarce capital goods. A rise in farm income resulted from increased farm productivity and output,

stimulated other aspects of development. It provided an expanded market for industrial goods such as chemical fertilizers, agricultural equipments and manufactured consumers' goods and services. It also provided the investment needed for further economic growth, through savings and resulted in the contribution of capital from the agricultural sector to industrialization. At the same time, the increased use of modern inputs in agriculture also lent support to the expansion of domestic industries.

The role of capital contribution of the agricultural sector to non-agricultural sectors of Taiwan's economy has been examined primarily in the period 1952-69, adopting Kutznets' approach. Our discussion on net capital transfer from the agricultural sector to non-agricultural sectors, in terms of visible capital, included agricultural savings and capital formation, government programs under the rice-fertilizer barter system and low government purchasing price of paddy rice, agricultural export earnings and government taxing of agriculture. All of them were factors in maintaining a positive net capital transfer from agriculture. During the period 1952-69, a visible capital transfer from agricultural to non-agricultural sector totaled \$2,242.1 million, averaging \$120 million per year. Furthermore, the percentage share of the agricultural sector in total domestic capital formation had been declining from 17 percent in 1952 to 10

percent in 1968. However, the amount contributed by the agricultural sector to total domestic capital formation in 1968 was about ten-times the value in 1952. According to Pein's estimation, on average, the contribution of agricultural sector in Taiwan's total domestic capital formation accounted for 33 percent per year during the period 1952-69. These statistical figures indicate that capital contribution of the agricultural sector played a vital role in the growth and development of non-farm sector of the economy and domestic capital formation in Taiwan.

During the period 1951-69, U.S. economic aid, which totaled \$1,481.2 million, contributed largely to Taiwan's economic progress. American economic aid included large shipments of agricultural commodities under food aid programs, as well as capital goods and materials urgently needed for industrial development. Thus, rate and direction of development and growth of Taiwan's economy since early 1950's have been influenced materially by U.S. economic assistance. U.S. economic aid helped to promote internal stability and economic development and growth in Taiwan. Without such assistance the development of Taiwan's economy could certainly have been less rapid. Jacoby estimated that without U.S. economic aid to Taiwan, gross national product would have grown only by 3.5 percent a year until 1983. He concluded that aid more than doubled the annual rate of growth of Taiwan's GNP, quadrupled

the annual growth of per capita GNP, and reduced the time needed to attain 1964 living standards by 30 years.

Moreover, rapid economic growth in Taiwan has heavily relied on increased agricultural productivity and output since early 1950's. U.S. economic assistance in the form of food aid accounting for one-fourths of the total U.S. aid during 1951-68, has been a major factor contributing to highly productive agriculture in Taiwan. While importing agricultural commodities under PL 480 Title I program from 1957 to 1969, Taiwan made a significant progress in increasing agricultural output, which, in turn, contributed to rapid economic growth. Imports of farm products under Title I programs contributed to agricultural and economic development in many ways. They helped to meet the increasing demand resulting from increasing population and per capita income. They provided the basis for establishment and development of livestock and poultry, textile, feed, flour mills and edible oil industries. Hence, they promoted private investment in agricultural and other sectors, consequently increasing output, employment and income. They helped in saving a large amount of foreign exchange which could be used to import scarce capital goods required for overall economic development. They contributed in checking inflation, balancing international payments and stabilizing the economy. A large import of wheat made export of rice and increased consumption of wheat flour possible on the one hand,

and hence added foreign exchange earnings to Taiwan on the other. Local currency funds derived from the sale of Title I imports played a significant role in fostering the growth of private sector in Taiwan, which has become the mainsprings in the Taiwan economy since 1965. Consequently, they had the effect of increasing industrial output, income and employment in private sector. Furthermore, a large part of the funds were used in facilitating the financing of agricultural developmental projects, and hence contributed to the expanded productive capacity of Taiwan's agriculture, which, in turn, had a positive effect on the development of Taiwan's economy. Meanwhile, economic progress in Taiwan helped create commercial markets for U.S. farm products.

Special consideration has been given to the welfare effects of imports of farm products under entire food aid programs. They increased people's consumption levels and also improved nutrition levels of people.

Due to rapid industrialization since 1965 many serious problems affected agricultural development and growth in Taiwan. These problems are shortage of farm labor, rising cost of inputs, low rates of return to capital in agriculture, and weaknesses in farm credit and marketing systems. These factors coupled with the small scale of farm operation resulted in relative decline in farm income. Therefore, a new agricultural policy was recommended for improving future

agricultural policy to find out the solution to current farm problems, at the same time, to achieve the objectives of continued increased agricultural productivity and output and higher farm incomes by the more intensive application of capital inputs, improvement of farmers' organizations and marketing and credit systems, strengthening of agricultural research and extension services, reduction of production cost, abolition of the rice-fertilizer barter system and improvement of land and water resources. In addition, measures for improving future utilization of food aid were also recommended. In order to use food aid efficiently, our study indicates that the use of food aid should be integrated into overall economic development plans in Taiwan. However, Taiwan has reached high stage of economic development, the case of continuing to receive PL 480 Title I farm commodities will be not strong.

Finally, policy implications derived from the main findings of this study for developing countries were sketched out. Since agricultural conditions in Taiwan are similar to those of many developing countries where population growth is high and land and capital resources are extremely limited; consequently, the lessons obtained from Taiwan's experience of agricultural development may be expected to have applications and relevance to those developing nations.

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