On Agricultural Development Strategies and Problems: 

The Taiwan Experience

by

Carson Kung-Hsien Wu*

The agricultural development since 1953 in Taiwan has been an impressive one and offers lessons of possible value to other developing countries. Both the agricultural development and its contribution to the general economic development in Taiwan have been evaluated by several economists [5; 19; 22; 25; 27; 33]. The priority of agricultural over industrial development if developing countries are to reach the stage of "take off" has been emphasized by many development economists during the latter 1960's and early 1970's [10]. And the fact that increasing the productiveness of agriculture is essential to economic development has also been recognized [9, p. vii].

Evaluation of the impact of the "Green Revolution" has led to the conclusion that it can be successful if an adequate infrastructure and modern technology are available [1]. The multiple cropping system has been advocated on the basis of its successful implementation in Taiwan [1], but with warnings that it does not solve the problems of labour surplus if the surplus is excessively large [4, p. 51]. Labour intensive operations are recommended for use in Southeast Asia in the 1970's for agricultural development and rural employment problems [2; 8]. However, the question of strategies to be adopted to speed up

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1/ The long growing season with sub-tropical weather in Taiwan can only be found in other sub-tropical and tropical countries. The integration of crop and livestock production may be a worthwhile expansion of the multiple cropping idea.
this agricultural development process is still open for inquiry. The purposes of this paper are to review critically the development strategies followed in the past, to point out the present problems analytically and to provide a possible framework for solutions in the near future in Taiwan, with the hope that they might provide guidelines for other developing countries to adopt in due course.

I. Strategies to Expand Agricultural Production and Development$^2$ in Taiwan.

Based on the criteria of labour supply and institutional arrangements, the agricultural development of Taiwan$^3$ since 1953 can be grouped into two stages (or phases): traditional agriculture, and modernized agriculture. For the first stage it is argued that the development process depended mainly on the framework set up during the 1920's by the Japanese (22, pp.17 and 35; 23, p. 3). However, one new technology introduced in this post-war period was the rapidly increased application of pesticides such as BHC, DDT, Parathion, etc. (or chemical innovation). The year 1968 (or the three-year transitional period 1966–68) was the turning point, in that for the first time in the

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2/ The series of studies on the subject of Taiwan agricultural development include:
(C) Ho Y.M. 1966; and

3/ After the restoration of Taiwan to China in 1945, agricultural development emphasized the recovery of production levels to the pre-war level (i.e. 1935-37), which was achieved in 1952. Since 1953, the Four-Year Economic Development Plan has been launched. The year 1973 is the beginning of the 6th Four-Year Economic Development plan.
history of Taiwan the agriculture sector was short of labour. The second stage was characterized by labour mobility, labour migration and farm mechanization. This phenomenon is in contrast to the present situation of most developing countries and has redirected the work of agricultural economists in Taiwan.

In traditional agriculture, the basic strategy was to make efficiently use of abundant labour resources, (i.e. multiple cropping system—for annual distribution of labour utilization and integration and diversification of crops and livestocks for seasonal variation) \(^4\), and to achieve the highest possible yields consistent with high man-land ratios and the small scale of family farms \(^{39; 40; 41; 42}\)

The significant point in the trend of factors used has been the tremendous increase in working capital (i.e. increase in yield through substitution of land) and the increase of crop areas (i.e. multiple cropping system) to cope with the redundant labour supply and the ever increasing number of workers in the agricultural sector until 1968. According to my study of farm mechanization in Taiwan, mechanization in the latter part of the 1960's emphasized the substitution of machines for labour \(^{37}\). Even in 1969 with 24,640 sets of power tillers, the prevailing rate based on the potential mechanized area was 0.4 set per 10 hectares \(^5\).

\(^4\) In Dr. Wang's paper, he proved statistically that labour intensities were the most important factor in accounting for unexplained output in the discussion of technological changes in Taiwan's agricultural development \(^{33, p. 36}\).

Proportion of Unexplained Output assignable to land and labour intensities

<table>
<thead>
<tr>
<th>Period</th>
<th>Land</th>
<th>Labour</th>
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<tbody>
<tr>
<td>1951-55</td>
<td>7.5%</td>
<td>16.81%</td>
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<tr>
<td>1956-60</td>
<td>5.3%</td>
<td>22.17%</td>
</tr>
<tr>
<td>1960-65</td>
<td>4.7%</td>
<td>22.07%</td>
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\(^5\) The cultivated land in Taiwan has been around 850,000-900,000 hectares for the period of 1952-72. However, the potential area for mechanization was estimated at 560,299 hectares \(^{34}\).
power tiller was estimated at 10 hectares.) Agricultural production in Taiwan was mainly characterized by the joint use of more working capital and intensive labour inputs. In short, the development was based mainly on biological and chemical innovations.

The second strategy of agricultural development depended on the use of foreign aid in both agricultural and economic development. There were two basic elements making U.S. aid a successful programme in Taiwan. U.S. aid was used to augment the supply of food to cope with increasing population and to stabilize the price level so that development plans could be carried out.

Taking the whole period (1951-68) into consideration, the share of agricultural materials in U.S. aid was over 30% in the 1950's and 50% in the 1960's, while the share of aid for industry was 50% in the 1950's and 40% for the 1960's. The balance was used for direct military aid in the 1950's and administration in the 1960's.

This aid pattern was considered appropriate in view of the total import situation. In the 1950's, agriculture received 25% of total imports; this fell to 13% in the 1960's and near the end of 1960's and early 1970's to less than 10%. During 1950's, about 50% of imports were financed by exports (mainly sugar and rice which accounted for 50% to 75% of foreign exchange earnings in the 1950's and 30% of the total value of exports in the early half of the 1960's). The balance was U.S. aid, with the share of U.S. aid in total imports dropping to 30% in the first half of the 1960's.

A major element in the successful use of aid rests on the sound principles adopted by the Sino-American Joint Commission on Rural Reconstruction (J.C.R.R.). The achievements of the J.C.R.R. in rural area reconstruction in the 1950's were remarkable, whether in technical assistance or financial grants and loans. All these efforts enabled Taiwan's agriculture to achieve sustained growth after U.S. aid was phased out in 1965. As regard to the

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6/ A detailed analysis on organizational components of development, see Hsieh and Lee 1966, Chapter IX, pp. 100-106 (22).
basic principles of J.C.R.R. in the utilization of U.S. aid, I will summarize the words of Finance Minister K.T. Li spoken in his Ramon Magsaysay Award Foundation Seminar [6] as follows:

The Commission decided as a policy that the programme would be directed towards assisting the people to help themselves, and the following basic principles were evolved:

1) **There must be a demonstrated need** for JCRR services and activities.

2) **There must be a fair distribution of benefits.**

3) **There must be a local sponsoring agency** qualified to utilize JCRR assistance effectively.

4) **The feasibility of any particular project or activity has to be demonstrated** before undertaking its broad expansion.

5) **Certain approaches and activities should be avoided.**

   Its policy is to help local organizations and institutions thrive and grow.

As this point, it is important to note the environment in which Taiwan’s development took place since the environment itself has been a contributing factor to success. The key factors were (1) a progress-oriented, stable society in terms of the economic, social and political situation (Land Reform, including Rent Reduction, Sales of Public Land and Land-to-the Tiller Programmes had a profound effect), (2) the development of the infrastructure during the Japanese occupation and post-war through U.S. aid, and (3) an abundant supply of low-wage but hard-working, literate and receptive farm workers [22, p. 80-81]. Under this setting, a planned economy was and will be carried out smoothly.

II. The Problems and possible Strategies in a Transitional Period in the Agricultural Development Process.

Since 1968 the seasonal and locational shortage of farm labour has been felt acutely [14]. This situation can be illustrated in three ways: change of the agricultural wage rate (increased from NT$35 in stage 1 to NT$60 in stage 2), change of allocation of
the labour force among industries (see Table 1), and the altered farm family structure. Transformation of the economy from a predominantly agricultural one to one in which industrial and agricultural employment are approximately equal has resulted, to a large extent, in the increase of commercialized agriculture. In addition, the mix of enterprises on the farms has been changing to put more emphasis on livestock and export-oriented production.

A. Two Fronts of Problems and Evidence

At the present moment, the development of the agricultural sector in Taiwan encounters two fronts: product markets and input markets. On the product market front, the question is what the new products can be developed in order to employ the excess resources in agriculture during this transitional period. The rapid adoption of many new enterprises (e.g. asparagus, mushrooms) resulting in poor quality of products with setback in export markets and lower prices because of over-production has been a common phenomenon for the past few years. Chicken raising is another example. Products of any new enterprise can easily saturate the local market if production is organized to take advantage of economies of scale. Equipped with skilled farmers and relatively advanced technology in farming, Taiwan has been plagued with the problem of finding export market for its products since the latter half of the 1960's. The search for foreign markets has seemed to be the only solution for any enterprise during this reallocation of resources among industrial, tertiary and agricultural sectors in this period [3, pp. 21-22].

7/ According to the Farm Income Survey, the number of persons per family changed from 8.14 in 1952 to 8.39, 8.58, 8.34 and 7.5 in 1957, 1962, 1967 and 1972 respectively. The average number of man-equivalent units (for farm work) decreased from 3.21 to 2.80, 2.15 and 1.56 for the corresponding periods. The opportunity cost of labor resulted in the withdrawal of labour to the non-farm sector [16, pp. 117-123].
### Table 1: Labour Force and Employment by Industry

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</thead>
<tbody>
<tr>
<td>Item</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Population (A) (Aged 15 &amp; over)</td>
<td>6.9</td>
<td>7.2</td>
<td>7.4</td>
<td>7.8</td>
<td>8.1</td>
<td>8.5</td>
<td>8.7</td>
</tr>
<tr>
<td>Labour Force</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (B)</td>
<td>3.8</td>
<td>4.1</td>
<td>4.2</td>
<td>4.5</td>
<td>4.6</td>
<td>4.8</td>
<td>4.9</td>
</tr>
<tr>
<td>(B)/(A) %</td>
<td>55</td>
<td>57</td>
<td>57</td>
<td>58</td>
<td>57</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>Unemployed %</td>
<td>5.1</td>
<td>2.5</td>
<td>—</td>
<td>2.0</td>
<td>2.1</td>
<td>2.1</td>
<td>—</td>
</tr>
<tr>
<td>Employed %</td>
<td>5.1</td>
<td>2.5</td>
<td>—</td>
<td>2.0</td>
<td>2.1</td>
<td>2.1</td>
<td>—</td>
</tr>
<tr>
<td>Primary Industry %</td>
<td>(44.2)</td>
<td>(42.6)</td>
<td>(39.3)</td>
<td>(39.4)</td>
<td>(37.1)</td>
<td>(35.5)</td>
<td>(32.8)</td>
</tr>
<tr>
<td>Agriculture</td>
<td>159</td>
<td>171</td>
<td>165</td>
<td>173</td>
<td>167</td>
<td>167</td>
<td>161</td>
</tr>
<tr>
<td>Secondary Industry %</td>
<td>(22.2)</td>
<td>(25.7)</td>
<td>(25.5)</td>
<td>(25.6)</td>
<td>(27.5)</td>
<td>(29.6)</td>
<td>(32.6)</td>
</tr>
<tr>
<td>Tertiary Industry %</td>
<td>(33.6)</td>
<td>(31.7)</td>
<td>(35.2)</td>
<td>(35.0)</td>
<td>(35.4)</td>
<td>(34.9)</td>
<td>(34.6)</td>
</tr>
</tbody>
</table>

Notes: 1/ Civilian labour force only.
2/ Surveys are conducted in January, April July and October annually. The numbers are averages for each year.

Source: Taiwan Provincial Labour Force Survey and Research Institute.

On the input market front, the problems are two fold. The first phase involves the transfer of emphasis from biological innovation to mechanical innovation. The present problem of low labour productivity is the results of (a) rapid decrease of land area per agricultural worker (i.e. before 1968 when the increase of workers was at its peak and even in 1972 when farm family numbers registered a decline), and (b) insufficient increase of capital intensity in agricultural production. Under existing institutional arrangements (size of family farm, scale of business of farmers' associations, and the overall plans for the whole island which are far from satisfactory in details), the promotion of mechanization in both farm operation and the marketing sector will be very difficult in the foreseeable future [16, pp. 62-70].
The second phase on the input market front involves the adjustment of an agricultural economy that is heavily oriented around biological innovations. This needs further study in order to reduce operational costs resulting from an increasing amount of purchased inputs. Fertilizer stands out as the major item, constituting 24% of total operational costs in general in Taiwan for 1960-68 (15, pp. 177-207). The rising price of petroleum and the world energy situation may have established 1973 as a major turning point in the relative cost of fertilizers. Fertilizer prices (in real terms) had declined steadily for a quarter century, but the future trend may be up. The new chemical technology may need further consideration as a means of encouraging further agricultural development. In addition, the opportunity cost of labour utilization and the ever-rising feed costs have been and will be a major concern. The two problems of "low labour productivity" and "relatively low income" are really rooted in the cost structure of labour and feed expenses at the present moment.

The information in Table 2, based on a series of Farm Income Surveys published by The Rural Economics Division, J.C.R.R., provides some background material for questions. The comparison is followed by the philosophy and content of the survey in 1952 with necessary modifications (e.g. living expenditure, estimation of unpaid family labour) in order to show the significant changes. Several important changes are:

(1) While farm family receipts increased in real terms at an annual growth rate of 4 percent for the period 1952-72, the percentage of non-farm receipts increased from 13 to 33 percent and that of cash receipts from 44 to 78 percent.

(2) Within the farm, the percentage of cash receipts and expenses increased. The former increased from 53 to 78 percent while the latter from 40 to 70 percent. The different rate of increase in cash form caused farmers to rely on non-farm income to support family living expenditures which also increased in the form of cash from 60 to over 70 percent.

(3) The level of living of farmers in Taiwan improved. While
family size either remained roughly constant at 8 persons or declined slightly to 7 persons, living expenditures increased from NT$7,944 to 11,200 (in 1952 prices) within 15 years (1957-72). One significant phenomenon was that expenses on supplement food surpassed that of staple food in 1972 while the percentage of food expenses in total living expenses confirmed Engel's Law and declined from 57 percent to 51 percent in the period 1957-72.

(4) In farm expenditures, three important components (feeds, fertilizer and labour costs) increased their share from 54 percent in 1957 to 63 percent in 1972 and changed their relative shares. The share of fertilizer, which had been around 25 percent for a long time, dropped to 13 percent in 1972 due to the adoption of a price

Table 2: Farm Family Situation in Taiwan
Selected Years, 1952-1972

<table>
<thead>
<tr>
<th>Farm Family Receipts</th>
<th>Farm Receipts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sources</td>
</tr>
<tr>
<td></td>
<td>Current In 1952 NT$</td>
</tr>
<tr>
<td></td>
<td>price</td>
</tr>
<tr>
<td>1952</td>
<td>12,500</td>
</tr>
<tr>
<td>1957</td>
<td>24,061</td>
</tr>
<tr>
<td>1962</td>
<td>39,407</td>
</tr>
<tr>
<td>1967</td>
<td>71,127</td>
</tr>
<tr>
<td>1972</td>
<td>89,554</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Farm Expenditure (excluding unpaid family labour)</th>
<th>Percentage of Important Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Current In 1952 NT$</td>
<td>Forms</td>
</tr>
<tr>
<td>Cash</td>
<td>Non Cash</td>
</tr>
<tr>
<td>1952</td>
<td>5,139</td>
</tr>
<tr>
<td>1957</td>
<td>9,936</td>
</tr>
<tr>
<td>1962</td>
<td>15,299</td>
</tr>
<tr>
<td>1967</td>
<td>30,739</td>
</tr>
<tr>
<td>1972</td>
<td>40,495</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Family Expenditure (B)</th>
<th>Food 2/</th>
</tr>
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<tbody>
<tr>
<td>Current In 1952 NT$</td>
<td>Amount (B)/(A)</td>
</tr>
<tr>
<td>price</td>
<td>(%)</td>
</tr>
<tr>
<td>1952</td>
<td>22,964</td>
</tr>
<tr>
<td>1957</td>
<td>35,996</td>
</tr>
<tr>
<td>1962</td>
<td>57,905</td>
</tr>
<tr>
<td>1972</td>
<td>78,788</td>
</tr>
</tbody>
</table>
Notes: 1/ The deflators were 164, 249, 293 and 343 for the years of 1957, 1962, 1967 and 1972 respectively.
2/ Includes both staple and supplementary food.
3/ On page 36 it stated as 51.2% while it was shown as 46.8 on page 20.
4/ In 1972 farm expenditures (excluding unpaid family labour) were NT$40,495 and the estimated unpaid family labour costs were NT$7,550.


reduction policy. The share of feeds increased from 19% in 1957 to 34 percent in 1972. The share of labour costs was around 30 percent 8/ (total labour costs including hired and family labour, total costs including costs of unpaid family labour at the wage rate of hired labour). However, the share of hired labour in total labour in terms of man-days increased. In addition, due to increased wage rates, the costs of hired labour occupied a higher percentage in total costs (i.e. 13 percent in 1957 and 16 percent in 1972). This situation of feed costs and labour costs in the structure of total costs strongly supports argument that they are the roots of problems and deserve further studies.

The following questions need precise answers through research and analysis to provide a basis for formulating future agricultural policies. What types of farming are associated with off-farm work

8/ According to the data from program of record keeping-farm families in Taiwan, labour costs occupied 45 percent of total costs in the structure of total costs.
that provides on average, 33 percent of farm family receipts. Where did this 33 percent of non-farm receipts come from (70 percent from salary, wages and business operations)? Did it come from agricultural labour or from non-farm employment in rural areas? Is it possible that there was a close relationship between non-farm receipts and hired labour, in that the farm was operated by hired labour while family labourers worked outside? Regarding feed expenses, did the increase mean that the farmer converted to livestock production, or that specialized poultry farms, hog farms and cattle farms exercised primary influence on the average figures, or that the conception of producing livestock from sideline type to commercial type was overemphasized? Some recent studies and analyses of part-time and full-time farms and economics of large farms were along this line and deserved to be pushed further [18].

This concept of a moving adjustment of agricultural operations [11] in Taiwan seems to support a recommendation for further study of the structure of Taiwan's agriculture. The agricultural regions, types of farming, and the organization of farm operations all deserve further study from a new angle.

B. Possible Strategies for Further Development

From the above analysis, it is obvious that the future development of agriculture requires a new set of policies and measures if Taiwan is to reach two major objectives: (1) production of good quality farm products, and (2) low cost farm products based on efficient operation. These objectives are associated with efforts to raise farm income to comparable levels with non-farm income and a reduction of the price of purchased inputs.

To tackle this new situation, the Government has promulgated two measures: (A) 14 guidelines of agricultural policy (Nov. 1969) and four follow-up programmes: (1) The reduction of the price of commercial fertilizers (2) Farm mechanization program (3) Establishment of an Agricultural Finance Planning Commission and (4) Improvement of the marketing system and facilities; and (B) 9 improvement measures (1972) for agricultural development.
to attract more fixed and working capital inputs to raise both labour and land productivity. The above two objectives can also be considered as the contribution of agriculture to general economic development.

The first strategy involves comprehensive land use planning. After 15 years of development Taiwan's agriculture has changed fundamentally. The predominant type of farming (rice and sugarcane) was expanded further in the post-war period up to 1960 and earned the largest part of foreign exchange. Though the development of tidal land and slopeland introduced new problems of soil conservation and salinity, there was a growing competition of land use among crops, fish culture, and fruit trees. This sometimes occurred even within the plains areas (e.g. banana and paddy; fish pond and paddy). This was accompanied by the rise of the livestock industry and of specialized farms, in particular specialized fruit tree farms, chicken farms, and integrated hog and crops farms. After 1960 the composition of agricultural output also changed because of the emergence of new enterprises (mushroom, pineapples, prunes, oranges, etc.)

The specialization of enterprises in certain geographic locations is in order. Following this line of development, different agricultural policy and development measures will be required for various enterprises. I have considered the three different types of farming in Taiwan: orchards on slopeland, farming in the plains area, and seashore farms. Within this broad classification, we still can have specialization of enterprises. For example, on slopeland we can roughly divide the land uses into three zones: oranges in the

north, lichee and pineapple in the central zone, and mango in the south. The recently promulgated aerial survey and mapping, which should be considered at 1:10,000 scale to show one hectare in one square centimeter on planning maps, will aid in this development. Once we have a bird's eye-view of present land use we can depend on certain approaches (e.g. requirement-approach) to predict the amount and areas of land to be used for staple food, for feed grains and for cash crops (15, pp. 102-110). The argument over competition in land use between farm and non-farm sectors will be solved in due course. Land resources will be allocated based on the trend of overall economic development.

An important prerequisite question we have to ask ourselves is: What kind of a country we are going to build? A pure open-island economy? An open economy that will guarantee self-sufficiency in staple foods? A pure industrial state producing some vegetables and importing all other agricultural products, on the pattern of Hong Kong and Singapore? It is understandable that both land use plans and the underlying goals of the society pose difficult questions to be answered. They will require time to formulate, but we will have to face them anyway, sooner or later. The speed with which we find answers will determine the pace of further development.

The second strategy is to deal with the input side of farm operation with a dual emphasis on farmers' management functions accompanied by renewed attention to government's function of supplying market information concerning both foreign and domestic trends. Farming is a business on Taiwan and the response of Taiwan's farmers has been excellent. The moving adjustment achieved in the 1960's demonstrates this point. Yet the shift from "output increase" as the major goal to new goals involving the proper choice of product (and hence land use) combinations requires new measuring devices. In the future, this decision making process involves the choice of both goals and means, rather than means only. Price policy is less important when output increases dominate agricultural policy goals. With the shift to a focus on product mix,
price policy becomes much more important. Furthermore, the burden placed on the price and market system increases. Questions to be answered now are: Can the system support this burden? How efficient are markets? How good is the price-reporting system? How promptly do price-signals reach producers? Do national fiscal and monetary policies (e.g. balance of payments problems) distort agricultural price systems, especially as between input and output prices?

Due to the migration of young people out of the farm sector, the age of farmers remaining on farms is increasing and many are without successors in sight. This phenomenon was resulted from two causes. The successful farmers (i.e. with larger farms and mechanized farms) have the financial ability to provide better education for their children and this accelerates transfer to non-farm jobs. For the small farms, the unit is so limited that it cannot generate enough income for living. Most of them are part-time farms and members of the family with working ability are certainly seeking jobs elsewhere. The extension of compulsory education from six years to nine years eventually benefits general economic development, but it is less clear that it benefits agriculture. A study [36] shows that the rate of change of occupation averaged over 20% below the age of 35. The rates of change of jobs were closely related to the level of education (the higher the level the higher the rate). The absolute number of workers in agriculture declined. In the group of persons retired from employment, agriculture accounted for 43.5%. Judged by labour allocation among industries, the decline of persons in agriculture is a good symbol. Yet the quality of labour inputs in agriculture resulting from the present trend is ominous and deserves more attention.

The promotion of 4-H club activities and vocational high school training needs a new direction, embodying both concepts of farm mechanization and farm business management. A new set of farm management techniques needs to be developed. Based on observations and conclusions gained from participation in a farm mechanization workshop, sponsored by the Agricultural Development
Council (ADC, U.S.A.), the farmers in Japan and Taiwan are apparently facing similar problems in the mechanization of the agricultural sector. The Japanese procedures of research and farm management extension to promote mechanized farm practices are worth copying and implementing in Taiwan.

The focus of third strategy is on agri-business, and especially, on the processing industry, and marketing. Taiwan's foreign trade in processed foods has contributed tremendously to economic development and the prosperity of agriculture. In order to develop it further, the canners must be asked to improve quality maintenance procedures. This improvement involves not only a change in marketing strategy, but also a shift in the focus of sales promotion from price to quality. Canned mushrooms and asparagus have earned Taiwan a very good reputation in European and American markets. However, most fruits have achieved their production momentum only in recent years. The production of oranges is in the early stages of potential production (only about 30% of trees planted are in full production) and will demand attention in the very near future. Grapes and mangoes are the next two items for which Taiwan will have to develop markets. Other fruits such as lichee and peaches still have a prosperous future. When export in the form of fresh fruit is limited, they have to be marketed in preserved and canned form. Although the processing industry in Taiwan had been prosperous for at least the past 15 years, expansion and up-dating of equipment is needed in the near future. In order to maintain and expand international markets, quality control on fruit, containers, and processing procedures deserve special attention.

On the one hand, development in the industrial sector has reached the stage of heavy industry (i.e. machine, chemical and oil industry). Development of the machine industry, and especially farm machinery, will be a contribution of the industrial sector to agriculture in the balanced growth and integration of development. It is this kind of mechanical rather than biological contribution from the industrial sector that will lead to the
further development of Taiwan's economy. Modernization or mechanization in this segment of agri-business probably is one of the most important tasks in agricultural development in Taiwan.

The fourth strategy involves institutional arrangements and social innovation. As William N. Morell, Economic Counsellor of the U.S. Embassy in Taiwan, has said, "As the economy and society become more complex, old institutions and systems often are unable to cope adequately with changing needs. This situation exists in all countries — developed and developing alike. Paternal elements in developing nations must gradually give way to more self-generating systems involving more specialization, individual initiative and teamwork, and less day to day direction from a limited number of key individuals in government, business and other elements of society" [7].

It is understandable that the reorganization of institutions is a very complex matter, however, in order to modernize agriculture, Arthur Mosher has stressed that one of the two pillars is organization. (The other is planning.) The characteristics of a truly modern agriculture are that it is flexible and dynamic as well as increasingly productive. In addition, it is realized that a modern agriculture should be carried out by a process in which there is a definite way to integrate planning, budgeting and implementation. In Taiwan's experience, the contributions of the J.C.R.R. and farmers' associations in agricultural development [25] have been evaluated very highly. Due to the changed agricultural situation, the recent revision of regulations of the farmers' organization placed emphasis on marketing and farm mechanization. Furthermore, the farmers' organization has been encouraged to change its structure to one that is better able to serve farmers, and more businesslike (to provide management staff training to insure high quality of general management). As a matter of fact, because of the importance of agricultural exports, the Provincial Farmers' Association has extended its activities into foreign markets in exporting oranges. Based on these observations, it is clear that the agricultural administration, the Ministry of
Economic Affairs, and related organizations, i.e. J.C.R.R. and the Economic Planning Council, should be encouraged to undertake further study of both domestic and foreign markets. Information systems need to be strengthened and expanded emphasis given to farm management, especially on mechanized farms, to the marketing system, and to trading companies.

Up to now, the agricultural administration has seemed to require a closer relationship with land administration than it used to. Since agriculture is a land consuming industry in terms of both land fertility and space, the use of land and the transfer of ownership (which are a part of land administration) actually affect the achievement of agricultural development. This will intensify in the near future, when farm mechanization involves expansion of farm size and land consolidation in rural areas. To avoid over investment of small scale farm operations in machines, and to achieve efficient agricultural use of land after land consolidation, it is time to orient land planning to the use of land rather than to its ownership. Any land improvement programme for agriculture should be coordinated with the planned use of the land. Hence all the temporary committees which have been in existence for 5-10 years should be incorporated into a permanent structure. The rearrangement of existing institutions seems indispensable.

III. Concluding Remarks

The argument throughout the whole paper is this: Agricultural development in Taiwan is in need of different sets of strategies to parallel changes that have occurred in the role and structure of agriculture in the course of economic development. In an early stage, agricultural development through capital saving devices, labour intensive techniques, and the utilization of foreign aid helped industrial development and the general economy in Taiwan. On the one hand, the role of industrial development in helping

11/ For example, Japan has encountered this problem in their drive for farm mechanization.
agriculture was concentrated on biological innovations which substituted mainly for land resources in the mix of production resources. On the other hand, this industrial development was more or less focused on import substitution rather than export oriented (fertilizers). However, since the economy developed so fast that a shortage of farm labour was created and the absolute number of farm workers declined, the introduction of farm mechanization was urgently needed and advocated. At the same time, the industrial sector reached the stage of heavy industry development in the machinery and chemical industries. Hence a whole new set of strategies will be needed to tackle the internal problems of agricultural development.

At this stage of development, the main problem of agriculture has been labour productivity and consequent rewards to labour in agriculture. It is interesting to point out that the strategies used from 1952 to 1967 raised labour productivity as well as land productivity [22, p. 42-45]. The focus on farm mechanization (previously substituting for draft animals and now for farm labour) in the transitional period and the positive action for mechanized agriculture since 1969-70 reflects this concern with labor productivity. The emphasis of farm mechanization is changing from a passive desire to replace lost labour to an active desire to increase labour productivity. The farm mechanization promotion programme in this connection has created a problem of mix of inputs in production that is unlike previous problems experienced in traditional agriculture.

The continued development of agriculture shifts emphasis from land productivity to labour productivity and the opportunity cost of farm labour becomes a major subject. This is not to deny that in traditional agriculture economy in the use of labour was also emphasized. The previous problem was how to use fully the underemployed family labour in traditional agriculture. Now the problem is how to allocate labour resources between industry and agriculture, and what is the equity of rewards. This process of agricultural development is a lesson different from developed
countries. Labour intensive operation in farming was emphasized to use labour fully to develop agriculture and also was applied in industry. Then allocation of labour force between industry and agriculture has been encountered, when industry has been more developed. The impact of migration of labour force from rural areas induced the emphasis of mechanization of agricultural sector to raise labour productivity and to modernize agriculture. In many developed countries, agricultural development involved the process of mechanization first (colonization, plantations, or farming with low man-land ratios) and later encompassed biological innovations associated with mechanized farming. Even within the scope of farm mechanization, the trend in developing countries may be reversed. For example, after 1945 the big increase in labour productivity in U.S. agriculture came from the mechanization of materials handling (loading, unloading, transport, storage, livestock feed handling equipment, hay handling equipment, etc.). It is possible that labour saving through materials handling equipment may come earlier (before full mechanization of field tillage) in newly developing countries. Materials handling equipment is generally cheap and easy to manufacture. From now on, the further development of the agricultural sector in Taiwan will rely on both mechanical and biological processes. Perhaps the stress on mechanization should include more attention to materials handling equipment. Mechanization is more than power tillers.

Four interrelated strategies have been recommended to modernize the agriculture industry. They are the comprehensive planning of land use; improving entrepreneurship of farm managers; modernizing the marketing of products and inputs through mechanization; and the necessary reorganization of institutions which will affect all of the other three strategies. Under the new institutional arrangement, agriculture is treated as an enterprise which requires managerial ability in production (or skilled professional services), with products being produced for markets both foreign and domestic. The function of government in agricultural development is to provide market information and promote new
facilities (land units of suitable size; skilled farmers and mechanized operations). In short, the indicated organization of administration involves three different divisions: policy making and planning (including land use planning and surveying); market analysis and information; and farm mechanization. In a word, the development strategies in Taiwan stressed biological and chemical innovations in the past and will require mechanical and social innovations in the future.

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