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FARM MECHANIZATION POLICY IN THAILAND

by

Tongroj Anchan  
Department of Agricultural Economics  
Kasetsart University  
THAILAND

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Tongroj Anchan\*\*

### ABSTRACT

The paper reviews the general situation and impact of farm mechanization. Impacts on output, employment, income and income distribution remains unclear and inconclusive. Despite the absence of specific policies for farm mechanization, many economic policies directly and indirectly affect the utilization of machine and the farm machinery industry. Many policies are inefficient and ineffective, while others have adverse influences on certain sectors. The improvement of simple farm equipments in rainfed areas should have higher priority.

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\*Staff paper No. 51, Department of Agricultural Economics, Faculty of Economic and Business Administration, Kasetsart University.

\*\*Chairman, Department of Agricultural Economics, Kasetsart University.

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Tongroj Onchan

### INTRODUCTION

Agriculture in Thailand is in a transitional stage. During the past twenty years, the relatively high growth rate of agriculture has been achieved mainly through the expansion of cultivated areas. This pattern of growth can no longer continue since Thailand has now reached its land frontier. Therefore, a new strategy for agricultural development has been adopted and emphasis has been placed on the increase of agricultural productivity. This can be achieved only if new technology is available and is widely adopted.

Agricultural development in Thailand must also take into account the fact that the growth rates of population and labour force have been quite high. In the past, agriculture was able to absorb most labour by means of expansion of land areas. Since this pattern of growth cannot be continued, an increase in cropping intensity of existing farm lands must take place. Furthermore, labour intensive techniques of farming will be desirable to help absorb the increasing farm labour force. The problem of employment has received great attention from the present government and it has been given one of the highest priorities in the next development plan.

Another policy issue of interest to the Thai government concerns the interrelated problems of rural income, rural poverty, and income distribution. Even though past development efforts have resulted in a significant decline in rural poverty (from 61 percent in 1962/63 to 25 percent in 1978), rural poverty is still a very serious problem especially in the poorest region, the Northeast, where poverty is severe. Income distribution gaps among regions and between farm and non-farm sectors are quite serious and appear to be worsening over time.

Any discussion on agricultural policy will have to bear in mind all these issues. Farm mechanization<sup>1</sup> is, at the present time,

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<sup>1</sup> Farm mechanization means here the introduction and use of mechanical procedures into farm operations in an area where these procedures have not previously been used. Several types are included, namely tractorization, improved pumps, means of transport, improved implements and first state processing of farm products (Southnorth and Barnett, 1974, pp. 335-336).

still in its early stages and much confusion surrounds the subject. This is quite understandable since mechanization involves a complex of problems-technical, economic, social, political - that must be faced by decision makers at several levels, i.e. among farmers, manufacturers and distributors of farm machinery, policy makers and administrators of public programs.

This paper attempts to present an overview of farm mechanization in Thailand, its extent, utilization and impact. Some policies which directly or indirectly affect farm mechanization will also be reviewed and discussed. Finally, some mention of farm mechanization approaches and strategy will be made.

#### CURRENT STATE OF FARM MECHANIZATION

There have been attempts at farm mechanization in Thailand ever since 1910 when steampowered tractors and rotary hoes were imported by the government. Only in the mid 1950s, however, did farm machinery (in the form of tractors and water pumps) become better known to Thai farmers. In 1955 the total import of tractors was 262 vehicles. This increased to 1,487 in 1961 and 2,414 in 1971. Of the 6,877 such vehicles imported in 1975, 4,231 were farm tractors. Evidently tractorization has become quite widespread since the 1970s. The use of water pumps has also increased remarkably, as indicated by increases in imports from 11,166 units in 1960 to 212,319 units in 1975. From 1975 to 1981, imports of both farm tractors and water pumps also increased to 12,867 tractors and 491,052 water pumps (Table 1).

Commercial domestic production of tractors actually began in the early 1970s. Data on domestic production since 1974 is available. In that year 24,808 two-wheel power tillers and 2,324 four wheel power tillers were produced. Since 1974, domestic production of power tillers, both two-wheel and four-wheel, shows an increasing trend. However, the number of tractors produced appears to have decreased slightly over time.

Data in Table 2 shows the stock in use of different types of tractors and other types of farm machinery during the period of 1975/76 to 1981/82. It is clear that the number of all types of farm machinery has increased. As for tractors, two-wheel tractors had the greatest net increase from 1976/77 to 1980/81 and then dropped markedly in 1981/82. Tractors of less than 45 hp show a wide fluctuation of net increase over time, though the net increase substantially dropped in 1981/82. The case of big tractors (over 45 hp) is quite remarkable. The net gain from 1980/81 to 1981/82 was from 3,892 to 12,867 vehicles. The slowdown of domestic production in recent years has been caused by a decrease in demand which in turn has been affected by the decline in major farm product prices.

As regards other types of farm machinery, rice threshers provide an interesting case as the increase from 1975/76 to 1981/82 was about five times. After a steady increase until 1979/80, a big jump occurred in 1980/81, when the net increase was about 19 times (from 667 to 12,170 units). The net gain then dropped drastically to 2,207 units in 1981/82. This slowdown could be attributed to the same factor(s) as that in the case of two-wheel tractors.

Water pumps have been widely used by farmers all over the country for many years. The number has increased substantially over time. From 1975/76 to 1981/82, the number has more than doubled. Net increase shows some wide fluctuations, much greater in 1981/82 than in 1980/81.

Other machines such as water wheels and winnowers show generally steady net increase over the same period (except in 1978/79 for water wheels).

The extent of farm mechanization may also be demonstrated by the data in Table 3. The number of tractors in use per 1000 hectares of cultivated land varies among regions. For the whole kingdom, over the period 1975/76, 1979/80 and 1981/82 there was an increase in the numbers of all types of tractors. This is particularly true for power tillers whose number increased from 5.01 to 12.25 and 14.65 per hectare. In later periods, the number of large tractors seems to be somewhat greater than that of smaller tractors. The number of tractors has been increasing over time in all regions. In all cases, except that of large tractors in the North, the number of such vehicles especially the number of power tillers, is greatest in the Central Plain.

Estimates of horsepower per hectare in 1979/80 for selected machines are presented in Table 4. The average for all types of tractors for the whole Kingdom is 0.24.<sup>2</sup> The horsepower per hectare is about the same for two-wheel and large four-wheel tractors. The average horsepower per hectare for water pumps is quite low (i.e., 0.089). As expected, the average horsepower per hectare varies among regions and follows the same pattern as the average number of tractors per 1,000 hectares. The high level of mechanical power available in the Central Plain and in the North reflects the widespread use of power tillers and large tractors and hence relatively intensive land utilization.

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<sup>2</sup>This is considerably greater than the FAO estimate in 1967-68 which was 0.05 for Thailand (cited in Merrill, 1975).

### THE AGRICULTURAL MACHINERY INDUSTRY<sup>3</sup>

The government, through the Division of Agricultural Engineering, began to produce farm machines in 1950s, and commercial production took place in the mid-1960s. Local production capacity expanded rapidly and then started to level off in late 1970s and early 1980s. In 1982, 143 factories producing farm machinery and implements in Thailand were reported. Almost 50 percent of these factories are located in the Central Plain, especially in the five provinces of Bangkok, Chachoengsao, Lobburi, Saraburi and Ayudhya. Factories located in other regions are small (with less than 10 employees). In fact, for the whole country, about 50 percent of the factories are small and labour intensive. Large firms (having over 30 employees) constitute only about 20 percent of the total number of firms.

Production capacity does not appear to have been fully utilized. Large firms produce more than half of the total, while medium and small size firms produce 25 and 19 percent, respectively.

It is generally known that almost all factories obtain their machine designs through copying and modifying machines that are available in the market. In the early stage of the industry, many modifications of power tillers were made to suit local physical conditions and tastes. The design and the technology of power tillers are now well accepted by farmers. Any change or modification usually means more cost to the manufacturers. With regard to design and technical knowledge, it should be noted that many factories have benefited from the Agricultural Engineering Division (AED), The International Rice Research Institute (IRRI), and the Industrial Service Division (ISD). However, the assistance from these agencies has been limited mainly to supplying information.

The problems of the farm machinery industry include: high risk, low purchasing power and technical skills of users, small farm size, limited market size coupled with easy entry, and dispersed and small-scale factories. These problems appear to be inherent in the agricultural sector and in the agricultural machinery industry as well, contributing negatively to the growth of the industry. There are also problems or factors external to the industry such as lack of sound and explicit government policy and problems of tax structure. The problems of local manufacturers involve financing, marketing, and production. Details of all these may be found in Nit Sammapan et al. (1982). An understanding of these problems will be useful for policy formulation and planning for the promotion of the farm machinery industry.

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<sup>3</sup>For detailed discussions, see Loohawenchit and Pathnopas (1981), Loohawenchit (1980), Nit Sammapan, et al., (1982), Pintong (1974), Taenkam (1980) Chakkaphak, (1978).

## FARM MACHINERY UTILIZATION

### 1) Extent of Farm Mechanization

The extent and pace of farm mechanization in Thailand varies among the regions. The Central Plain, which is the most progressive farming region with the highest percentage of irrigated area in the country, has had the highest level of farm mechanization. Although largest in land area and population, the Northeast has a small share of the farm machinery, compared with the North and the Central Plain. The case of the two-wheel tractor is an obvious example. The Central Plain has about 58 percent of the total number of tractors while the North, South, and Northeast have 26, 9, and 7 percent, respectively. The case of small farm tractors is quite similar, while big farm tractors (over 45 hp) appear to be distributed relatively more evenly among the Central Plain, North and Northeast regions (Table 5).

About 55 percent of all water pumps are in the Central Plain compared with 23, 19, and 4 percent in the North, Northeast and South. Other types of machinery are not shown in the Table. However, data from elsewhere shows that rice threshers and water wheels are used mainly in the Central Plain (over 90 percent of the total number). Corn threshers are found mostly in the North (66 percent of the total). Sprayers are used in the Central Plain (41 percent), North (40 percent) and Northeast (24 percent) (Sukharomana, 1983 Table 4).

From the data presented, it is quite clear that tractorization has been most dominant in the Central Plain. The use of large tractors is quite significant in the North and in the Northeast only slightly so. This is due to the fact that most upland areas in the Northeast require large tractors for land preparation, especially during the dry season or early rainy season when the soil is too hard to be ploughed by animals.

### 2) Factors Affecting the Utilization of Farm Machinery

Experiences in other relatively advanced countries like Japan, Taiwan, and South Korea seem to indicate that the level of farm mechanization increases with the level of farm commercialization. As farming becomes more and more commercialized, the demand for farm machinery will continue to increase. If this is the case, there must be a number of factors which will affect the utilization of farm machinery. These factors have been identified by Loohawenchit and Renu Pathnopas (1981) and Loohawenchit (1983). They include:

1. Irrigation and double cropping
2. Adoption of HYV's of seeds
3. Profitability of machine use
4. Increased purchasing power of farmers

5. Contractor service
6. Natural environment
7. Demonstration effect and the learning process
8. Other non-economic factors
9. The ability of local farm machinery industry to adjust to the needs of local farmers.

These factors are quite familiar to those interested in Thai agriculture. For example, over the past three decades, the Thai government has invested a tremendous amount of money in irrigation projects. Irrigated areas comprise about 20 percent of the total area, and are increasing over time. Cropping intensity has also been increased. New rice and corn varieties have increasingly been adopted by farmers, especially in the Central Plain, North and Northeast. The use of both farm tractors and rice threshers has proved quite profitable (Pinthong, 1974, Taenkam 1980, Pathnopas, 1980). The income of Thai farmers, though relatively low, has increased over time, especially in the Central Plain, and this has resulted in an increase in the purchasing power of the farmers. Contract services have been very common and in fact have helped speed up farm mechanization in the initial stage. Big tractors, which are very expensive, are nonetheless used by farmers even in the poor region of the Northeast and are easily accessible through contract services (Wattanachariya, 1983, Pak-uthai, 1981, and Chancellor, 1980). The need for tractors also arises from the natural environment especially when the soil is too hard for animals to work. Non-economic factors also have an effect on the demand for tractors. Finally, the ability of local farm machinery industries to adjust to local needs is well documented. The machines are usually modified to make them more operational under local conditions. Provision for after-sale services has also been very good. The factories usually get feed-back from the farmers which results in improvement of the machines.

In addition to these factors there are others, such as agricultural policies of the government, which will directly or indirectly affect the use of farm machines. These include subsidized credit, infrastructural investments, subsidized fertilizer, and price support programs. Some of these policies will be discussed later.

#### IMPACT OF FARM MECHANIZATION

Among the most controversial issues with regard to farm mechanization in a developing country like Thailand is the potential impact on production, employment, income and income distribution. Farm mechanization may be regarded as a major indicator of development and therefore, an essential part of agricultural development. It is then arguable that mechanization will increase agricultural production and employment by bringing more land into production, increasing multiple cropping, and improving cultivation practices. However, it

may also be argued that, if introduced too early in the development process, in a country where labour force increases at a high rate, farm mechanization may create unemployment, causing even more unequal distribution of income within the farm sector.

These important issues of farm mechanization have been of great interest to various agencies in many parts of the world, especially in the developing countries of South and Southeast Asia. A comprehensive review on this has been done by W.C. Merrill (1975). Merrill's review covers a wide range of countries including those in Latin America and Asia (though Asian experiences appear to get more attention). Hans P. Binswanger has also taken a careful look at the economics of tractors in South Asia (Binswanger, 1978). Another recent publication of findings of a farm mechanization study in Asia has just been released by IRRI (1983). The IRRI sponsored project on the consequences of small rice farm mechanization in Thailand has recently been completed. The interesting results of this study have been reported in a seminar in Bangkok, November 10-11, 1983.

Though all these major works deal with the impact of farm mechanization, the findings are still inconclusive. A careful study of the conclusions of Merrill's 1975 report compared with the IRRI's 1983 findings (for Asia and Thailand) will show that the two had remarkably similar results. This, if anything, indicates that systematic research on the problem is still required. The research methodology may have to be modified to obtain results which will give more concrete conclusions on the immediate and long-term impact of farm mechanization in the process of agricultural development in a country like Thailand.

This section will attempt to summarize findings on the impact of farm mechanization indicated by available research. A more detailed discussion on this may be found in the studies mentioned above.

#### 1) Farm Mechanization and Output

Farm mechanization is usually said to affect output in four ways. (1) it can increase yields. (2) It can increase cropping intensity. (3) It can expand cultivated area. (4) It can reduce losses and improve quality in post harvest operations (Adulavidhaya and Duff, 1983). However, available findings of research studies in Asia (including Thailand) do not indicate a clear relationship between mechanization and crop yields, cropping intensity, and growth in the cultivated area. These studies suggest that farm mechanization contributes little, if anything, to farm output.<sup>4</sup>

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<sup>4</sup>A number of studies report a positive yield and output effect (see for example, Inukai, 1971 and Pongsrikul, 1983). However, they are too few and too area specific. Most findings are inconclusive.

Merrill states that "In its early stages, farm mechanization, usually has very little, if any, effect on crop yields ...., it appears unlikely that deep plowing, better weed control, or improved gain harvesting resulting from mechanization will increase yields by more than 10 percent" (Merrill, 1975, p.1). He gives several reasons for this. One is that the introduction of tractors, when other technological inputs are unchanged, merely substitutes one power source (tractors) for another (usually are animal). Furthermore, during the early stages, it is only a partial mechanization, i.e. for land preparation. A more complete mechanization, e.g., weeding, fertilizing and harvesting, would have a greater effect on yields. Clearly, mechanization alone without additional inputs such as fertilizer, irrigation, new varieties of seeds, and pesticides, would not have a significant effect on yields and output.

## 2) Farm Mechanization and Employment

The impact of mechanization on employment is of particular interest to policy makers. Unemployment problems are receiving great attention at present. Unless policy makers are convinced that mechanization will not worsen the current and future unemployment problem, mechanization will not be justified. Supporters of farm mechanization point out that more on-farm employment can be generated through increased cropping intensity. Additionally, off-farm employment can also be increased. For example, labour inputs are required to build and maintain the machines. These inputs may more than offset the reduction in farm employment. Furthermore, if labour is saved on the farm, it may be employed outside the farm (in construction work, for example, or for other non-farm activities in villages, towns, and cities). However, this can only occur if off-farm employment is available.

Again, available data are not adequate to provide a clear conclusion on this issue. In fact, it is difficult to separate the employment impact of mechanization from that of other technological or institutional changes that may occur simultaneously with mechanization. Moreover, the reliability of data on employment (or labour utilization) is always subject to question.<sup>5</sup>

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<sup>5</sup>To collect data on farm employment over a one-year period is more difficult and more costly than other types of farm data since it may require several interviews to capture seasonal variations.

At the current state of art, it may be said that mechanization which replaces animal power usually results in a reduction in labour inputs. According to Merrill, during the early stages of mechanization of grain production, labour requirements may be reduced by as much as 30 to 40 percent. Non-farm employment engaged in the manufacture distribution and maintenance of farm equipment replaces only a small part of the on-farm employment displacement (Merrill, 1975, p.2). Displacement of on-farm employment by mechanization is also found in IRRI studies (Adulavidhaya and Duff, Dermot Shields, and Pongsrikul).

The employment impact of mechanization cannot be considered independently. Account must be taken of the overall employment situation in both rural and urban areas. off-farm employment may indeed be very significant in rural development which has the dual objective of growth with equity. It must be promoted, especially in the provinces. If this policy is successful, farmers, especially the tenants and the landless, may be able to find more attractive jobs elsewhere. This issue, however, is a rather complex one and requires careful consideration.

#### FARM MECHANIZATION AND INCOME DISTRIBUTION

Related to employment is distribution of income. If mechanization does in fact displace labour, those who will most likely be affected are landless farmers who depend largely on farm work. There is evidence that mechanization (e.g., mechanical threshing) reduces total labour requirements of which a substantial portion is hired (Adulavidhaya and Duff, 1983, Table 15). The net effect is a reduction in earnings by hired labour. The result may be a more unequal distribution of income. This is somewhat confirmed by the findings of Saitan (1983) and Pongsrikul (1983). Saitan finds that farm income distribution as measured by Gini ratios is more unequal among those farms that hire tractors than among those farms that own tractors. The results also indicate that when off-farm income is added to farm income, income distribution improves among all classes of farms. The contribution of off-farm income to a more equitable income distribution among rural household is also found in other studies (see, for example, Onchan, 1979).

#### AGRICULTURAL MECHANIZATION POLICY

Until now the government has had no explicit or declared policy on farm mechanization. However, the formulation of such a policy is

in process.<sup>6</sup> It can be expected that Thailand will finally have farm mechanization in the very near future. The government policy or view on farm mechanization is now clearer than before. In a document prepared by the Ministry of Agriculture and Cooperatives, "Views of the Government on Certain Aspects of Farm Mechanization in Thailand and the UNDP/FAO Agricultural Machinery Project", a quotation is taken from the inaugural address by the Deputy Minister of Agricultural and Cooperatives. It states:

"I wish to clearly state that it is the Government policy to give high priority to the development, production and use of agricultural machinery appropriate for different areas. Farmers in the poverty-stricken areas should have improved tools with human beings or animals as the source of power. Machinery with mechanical power should at the same time be further developed. These small machinery are not meant to replace labour but will help facilitate and better the work ..... It is therefore a government policy to promote appropriate agricultural machinery...." (p.2).

There is no doubt that this statement clearly spells out the current thinking of the government on this important issue. Emphasis will be on improved tools and on the development of appropriate small machinery for poor areas. This is clearly quite different from the past and current state of farm mechanization.

According to the above statement, agricultural machinery is considered a part of agricultural engineering. This includes development, production and use of tools, equipment and machinery used in the process of farming soil preparation, planting, watering, weeding, plant protection, harvesting, threshing, transport, and storage and processing of agricultural produces. Such equipment has three sources of driving power-human, animal and mechanical or other substitute power (MOAC Document, pp. 2-3). Hence, there is a need for a balanced development of appropriate farm mechanization, something which is generally not adequately covered in most farm mechanization studies. In too many cases, farm mechanization is treated as tractorization, a very narrow view of mechanization. Unfortunately, this present paper is not much of an exception.

There are several policies that may directly or indirectly affect the extent and the pace of farm mechanization in the country. Some of the most relevant will be discussed here. They include: taxes and tariffs, credit policy, industrialization policy, research and development and/or training and agricultural development.

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<sup>6</sup>The National Committee for Agricultural Mechanization was set up in 1979, among other things, to formulate policy and implementation plan for farm mechanization.

### 1) Taxes and Tariffs<sup>7</sup>

Prior to 1982, the local farm machinery industry had to pay more taxes than those who imported farm machinery. This put local manufacturers in a disadvantageous position. Tractor import was at a high level of 15,480 vehicles in 1981. The policy of the government appears to have worked against the development of the local small-scale industry, an effect conflicting with the industrial development policy.

The local machinery producers, through the Association for Thai Industries, were successful in pressing the government for increased protection in the form of higher tariff rates for imported machinery and imported engines amounting to 33% of the C.I.F. value in both cases (compared to the previous 5% of the import price). In addition, an import quota was set for farm machines in order to control the quantity imported. For example the quota was 5,337 for two wheel power tillers, which is much less than the quantity imported in 1981, 15,480 vehicles.

In order to study this issue carefully, Loohawenchit made a calculation of the tax burden before and after adjustment in 1982. He found that local manufacturers did indeed pay a higher percentage of taxes before the adjustment (24.14% of the cost of production compared to 20.32% of the C.I.F. price). However, after the adjustment in 1982, machine importers had to pay higher taxes than those for locally produced machines, i.e. 52.4% of the C.I.F. price as compared to 35.6% of the production cost. Clearly, local manufacturing firms are now well protected. This has been interpreted as a government action for the promotion of the local, small-scale, and labour intensive industry, which is in accordance with the current industrial development policy. But Loohawenchit is of the opinion that this policy of protectionism will retard the growth of the industry since local producers will be less inclined to innovate and cut production costs in order to compete with imported machines. As a result, he stated, farmers will end up paying higher prices for the machines. This is the common case of government protecting the local industry at the expense of poor farmers. This type of policy has been controversial for a long time. If not carefully designed and implemented, it may indeed be detrimental to rural development.

### 2) Credit policy

Credit policy affects both farmers, who are the users, and producers, who are the manufacturers, of farm machinery. It is

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<sup>7</sup>This section is drawn largely from Loohawenchit (1983).

quite possible that the new farm credit policy<sup>8</sup> which has resulted in a dramatic increase in commercial bank credit since 1975, has contributed to the increasing demand for farm machinery. All banks have provided funds to farmers for the purchase of farm machines, including tractors. In this regard the credit operation of the Bank of Agriculture and Agricultural Cooperatives (BAAC) is of particular interest. Since 1980, the BAAC has been extending credit in kind to its clients. Credit for the purchase of farm machines is now being given in kind instead of in cash as previously done. Manufacturers of farm machinery will have to register with the BAAC. Once the machine brands have been approved by the BAAC, the farmer client can get the machine, which will be delivered by the manufacturer or the dealer. In the first year of operation, a great deal of criticism came from tractor dealers or manufacturers who did not participate in the programme. The BAAC was accused of playing the role of middleman and it was charged that the selection of machine brands was not really fair. However, this "farm mechanization credit" has been quite successful, and the farmers do appear to be getting machines of good quality at relatively low prices.

The extension of credit for farm machinery by BAAC and other commercial banks must have been increasing over the past 10 years, although the total amount of credit for this purpose has not been separately reported. Nevertheless, the BAAC reports that this credit in kind project has been very successful. The number of borrowers and the total credit for farm equipment and supplies has increased four times in 2 years (BAAC, 1982).

The fact that commercial banks and the BAAC have been providing credit for the purchase of farm machinery at an increasing amount over time may indicate the profitability of farm mechanization from the farmer's point of view. Therefore, if the demand for farm machinery increases in the future, and if it proves to be profitable, credit institutions are likely to provide the financial services required. However, it must be noted that there is evidence that the increased credit from institutions has been extended primarily to the relatively large rich farmers. Credit distribution has been very unequal among different groups of farmers and among the regions. If small farmers cannot get an equal share of subsidized credit, the problem of income distribution may worsen. This is a major policy issue of interest to the current government.

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<sup>8</sup>Starting in 1975, in an attempt to increase institutional credit to farmers, all commercial banks were requested to give loans directly to the farmers (or through deposits with BAAC). The required credit quota was set as a proportion of total deposit, now 13%. As a result, credit from commercial banks increased markedly from a few hundred million baht in the 1960s to over 25,000 million baht in 1982 (For discussion on this policy, see Onchan, 1982).

Credit for manufacturers is a different story. As pointed out before, finances is one of the major problems of the manufacturing industry. Generally, small firms suffer more in this regard than do the larger ones. Commercial banks are usually the most important credit institutions for these manufacturers. Credit from informal sources has also been quite significant. The Small Industry Finance Office (SIFO) under the Ministry of Industry has thus far not given much support to the industry. Only a few firms have received loans from this Office (Sammapan, 1982). The Industrial Finance Corporation of Thailand (IFCT) has been providing funds to some large firms, but the amount extended to this type of industry is still relatively small.

If farm mechanization policy is going to be given a high priority, as policy makers have stated, it is clear that the IFCT and the SIFO will have to play a greater role in financing the industry.

### 3) Research, Development, Extension and Training

This is the area where the government could be most effective, playing an important role in supporting the growing farm machinery industry and promoting farm mechanization in the country.

Farm mechanization has been characterized by limited types of machinery which concentrated mostly on land preparation (i.e. tractors). In recent years, however, farm machines of different types have been introduced and used. Small four-wheel tractors have been manufactured in Thailand. Rice threshers have become increasingly popular in certain areas. Water pumps have been widely used and rice reapers are found to be used by a limited but increasing number of farmers. The development of farm mechanization in Thailand has therefore paralleled that of Japan, Taiwan and Korea (Adulavidhaya and Duff, 1983, p. 9). In fact, Mechanization strategy should be aimed at mobilizing resources to help ensure that farmers have a wide range of implements and tools from which to choose and that farmers know how to use and manage machinery input effectively and efficiently (Gifford, 1981).

This points directly to the role of research, development, extension and training in which much remains to be done. The public sector alone cannot possibly undertake all these functions. Cooperation from the private sector is therefore necessary.

With respect to the manufacturing industry, much mention has been made of its dynamism as indicated by the frequent modifications of machines and the necessary responsiveness to changing situations and farmers' needs. However, most small firms do not have technical expertise in agricultural engineering. Government agencies such as the The Agricultural Engineering Division (AED), Department of Agriculture (DOA) and the Department of Industrial Promotion (DIP),

can serve to upgrade and help standardise farm machines. In fact, AED has been quite active in this regard over the years. However, with limited capability, the AED is not able to provide adequate services. Increasing the capability of AED is requisite to the promotion of farm mechanization.

Research in agriculture has generally ignored rainfed and upland areas. If rainfed areas are to get priority in terms of development, research in farm machinery for these areas and for upland crop farming will have to be done. At present, research capabilities in this area are extremely limited. Besides strengthening research capability, there is also a need for research reorientation in farm mechanization so that new concepts will be learned and accepted by the researchers who are more familiar with irrigated mechanization. This issue is strongly emphasized by Chinsuwan (1983).

Extension work which involves mainly the users or farmers is also important and the Department of Agricultural Extension (DOAE) has begun to work in this area. Again, its limited capability in terms of personnel and knowledge will not allow a wide coverage. There is also a need to draw up an extension for farm mechanization.

As for training and education, the need extended to all levels, farmers, government officials, and college and university students. Three universities, namely Kasetsart, Khon Khaen, and Chiang Mai have been particularly active. The training of farmers may be done effectively by DOAE and AED. This is also true for the case of government (extension officers, and officers of MOA). However, in addition to AED, MOAE, trainers may also come from the universities. Finally, providing training to the staff of private firms (manufacturing and distributing) is also essential to mechanization development. In this regard, the public and private sectors may work together.

#### 4) Industrial Development Policy

Increased industrialization usually enhances farm mechanization. As for Thailand, over the past twenty years, industrial growth has been particularly rapid. The share of manufacturing has increased from 13.1 percent of GDP in 1960 to 21.0 percent in 1982 compared with the agricultural share of 24.8 percent of GDP in 1981. It is estimated that at the end of the Fifth Plan period, the value of manufacturing output will roughly equal that of the agricultural sector. Furthermore, by that time, it is expected that the Thai economy will have been transformed into a semi-industrialized one. If this is the case, farm mechanization can be substantially increased (NESDV, Fifth Plan, p. 59).

The past performance of the industrial sector has caused great concern to the government. There are several reasons for this concern. First, the industrial structure is still very import dependent. Second, the export industry is not efficiently developed. Third, the technology used is still not labour intensive. And, fourth, development of basic industry has not occurred. Another issue which is of particular interest is the concentration of industries in and around Bangkok and their failure to disperse to provincial areas. Measures to reach planned targets have been many. One of these has been the promotion of small-scale industry in provincial areas.

In Thailand, most industries are small. Small firms tend to be very labour intensive. Therefore, to generate more employment, these industries should be promoted. As mentioned earlier, about 50 percent of farm machinery establishments have less than 10 employees. These establishments are also located mainly in and around Bangkok. If small scale industry is to be promoted, it is quite logical that farm machinery industry should be a high priority. This is because small farm machinery factories are labour intensive (Loohawenchit, 1983). Furthermore this type of industry is closely linked with the farm sector. As commercialization of agriculture increases in the future, farm inputs from this type of industry will become more and more necessary. Besides, mechanical technology cannot be readily transferred or imported. It must be experimented with and modified to suit the local environment. This process will take some time. R & D activities must be done continuously. This can be jointly or cooperatively undertaken by both public and private sectors.

Development of farm machinery is actually an integral part of the rural industrialization which has been one of the major policy objectives of the current Plan. Promotion of the farm machinery industry, even if it must be done gradually and carefully, can take place in many ways. For example, a credit extension system and related institutions for industries in outlying regions can be developed. There should be improvement of research work and the development of production. Improvement of management techniques is also desirable as well as the promotion of subcontracting systems between small and large scale industries (NESDB, Fifth Plan, pp. 63-64). Major public institutions that may be involved in these effort include SIFO, IFCT, Department of Industrial Promotion (DIP).

#### 5) Agricultural Development Policy

The extent and pace of farm mechanization will depend mainly on the development of agriculture. Since agriculture in Thailand is in a transition period, the next strategy must be to increase the productivity of land and labour. To implement this policy, new technology is called for, i.e. improved cropping or farming system, new seeds, fertilizer, insecticide, irrigation water, and farm machinery.

The adoption of new technology can occur only if production incentives are provided. Product prices must be raised and stabilized, land tenure security improved, and credit provided at reasonable interest rates. Past performance of productivity improvement has been very unsatisfactory, especially in rainfed areas where farming is of a subsistence nature. In these areas, yields of some crops have even shown a declining trend. Improvement of yields in this type of farming will be very difficult as the natural environment is not favourable and new technology usually unavailable. Farm mechanization must take a different form in these areas, for example, improved hand tools, animal-drawn machines, and so forth.

In more progressive areas where infrastructural facilities are more available, the potential for yield improvement and increased output is considerable. Irrigation systems must be improved, especially in terms of management, and cropping intensity must be increased. Agricultural development in this area appears to be a relatively easier task as new technologies (seeds, fertilizer, farm machines & implements, insecticide, etc.) are usually available. This is also an area in which farm mechanization (tractors, sprayers, threshers, water pumps, reapers, etc.) can be easily promoted.

#### SUMMARY AND CONCLUSIONS

Though farm mechanization in Thailand has, over the past 10 years, increased greatly, the level of farm mechanization is still very low. This is indicated by the very low horsepower per hectare (0.25 hp) and the low machine density per 1000 hectare ratios. Thai farm mechanization has been characterized by: (1) the dominance of hand-tool technology, (2) the use of locally manufactured or assembled major types of farm machinery, (3) the use of limited types of tractor attachments, (4) Mechanization, mainly in progressive farm areas, and (5) private contractor services, especially for large tractors. The farm machinery industry started to grow rapidly in the early 1970s and then slowed down considerably in the late 1970s and early 1980s. Over 50 percent of farm machinery producers are small and mostly located in and around Bangkok. The copying of farm machinery design has been common. Modifications on farm machinery were frequently made during the early stages of manufacturing. Standardization of farm machinery has not yet occurred, though there are some exceptions.

Utilization of farm machinery has been increasing at a high rate over the past 15 years. Power tillers appear to be the most popular machines, while small tractors have gained increasing popularity in recent years. Other farm machines of importance include large tractors, water pumps, sprayers, and threshers. The introduction and adoption of rice threshers has been particularly spectacular. Another machine which is relatively new is the rice reaper. It is being used only by a limited number of farms, but may be more widely accepted in

the future, especially in the progressive rice growing areas of the Central Plain and upper North.

The impact of farm mechanization on production, employment, and income distribution, based on available data in Thailand, remains unclear and findings from research are still inconclusive. In fact, available data does not show a significant yield and/or cropping intensity effect. Data on employment is even more unsatisfactory. Nevertheless, the data we have tends to indicate a negative effect on employment as many types of machines help save human and/or animal labour. If cropping intensity is not increased by increased mechanization, labour will be reduced. However, off-farm employment may help offset this effect. Finally, the effect on income distribution is also inconclusive. What can be said is that the effect has been very little, though there is some evidence of income inequality between farmers who own tractors and those who hire tractors. The data is still inadequate for the analysis of income distribution.

At present, the government has no declared policy on farm mechanization. However, a policy on this is being formulated by a national committee on farm mechanization. It can be expected that the government will promote farm mechanization through a number of measures which will soon be known.

Several policies and programs which have directly or indirectly affected farm mechanization include import taxes and tariffs, credit policy, industrial development policy, research and development, training and extension, and agricultural development. Taxes and tariffs affect both farm machinery producers and farmers. Since 1982, the government has decided to provide both tariff and non-tariff protection for the local manufacturing industry. Farm credit policy has resulted in a tremendous increase in credit supply from the commercial banks and the BAAC. This also has had much effect on the extent of farm mechanization in Thailand. Current industrial development policy is quite consistent with the promotion of the farm machinery industry. Research, development, and extension and training programs have been intensified in recent years. Much, however, remains to be done. Agricultural development, which has always received the highest priority in every national economic plan, will emphasize improvement in productivity through increased use of new technology, including mechanical power.

If farm mechanization is to be promoted as is now proposed, it must be done with caution in view of the possible adverse effects on employment and income distribution. A few approaches have been suggested by Merrill (1983, pp. 31-32). They appear very applicable to Thailand. One approach is to promote selective mechanization by mechanizing only those operations which will reduce costs, have the least effect on employment, and have the greatest effect on output.

The second approach is referred to as fractional mechanization which focuses almost exclusively on the small farmer. Under this approach, a two-wheel tractor can be adopted as it will replace animals rather than people. The last approach is appropriate mechanical technology. For example, technology should be profitable to the large proportion of farmers, be produced locally, and enable farmers to have more effective and timely farm operations which will raise yields and output. In practice, a combination of the three approaches may be desirable. However, a great deal of consideration will be necessary before an appropriate farm mechanization strategy can be prepared and executed.

Since subsidy policy (low-cost credit, special exchange rate) is often used in the promotion program for farm mechanization, it should be mentioned that such policy usually benefits large farmers. Tax and tariff policy and other types of import controls to protect local industry may do more harm both to producers and farmers. In most cases, farmers suffer more from such a policy than do the manufacturers. If these policies must, for certain reasons, be implemented, the government should make sure that ill effects are eliminated or at least minimized.

It is suggested that policy to support hand-tools, implements and small machines in rainfed areas should receive a higher priority than before. R & D activities must therefore be increased and strengthened.

Finally, farm mechanization must be viewed as part of the development process. Other new forms of inputs must also be available and used to raise output, generate on-farm employment, and improve income distribution. If these can be done, farm mechanization will be able to fulfill its essential role in the development of agriculture in Thailand.

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Table 1. Imports and domestic production of agricultural machinery in Thailand, 1951-1981.

Year	Imports		Domestic production		
	Tractors <sup>a</sup>	Water pumps <sup>a</sup>	Two-wheel power tillers	Four-wheel power tillers	Tractors
1951	-	2,598			
1955	262	11,294			
1960	855	11,166			
1961	1,487	12,059			
1965	3,047	39,099			
1970	1,763 (688)	136,686			
1971	2,414 (1,367)	105,109			
1974	3,318 (1,112)	168,524	24,808	2,324	n.a.
1975	6,877 (4,231)	212,319	27,860	2,582	2,426
1976	n.a. (5,257)	291,189	31,766	2,914	2,332
1977	n.a. (6,161)	303,026	35,568	3,808	2,158
1978	n.a. (4,298)	320,933	39,568	3,808	2,158
1979	(3,348)	359,508	38,756	4,142	-
1980	(3,892)	380,495	50,075	6,853	-
1981	(15,840)	491,052	60,000	7,000	-

n.a. = not available.

<sup>a</sup> Imports relate to all tractors, including those for industrial units and consists mainly of 4-wheel tractors. Source: Jongswat, 1980, assembled from the Customs Department's "Annual Statement of Foreign Trade Statistics". Figures in brackets relate to farm tractors as reported by Loohawenchit, 1980, Table 7. In later years, data are from Ministry of Agriculture and Cooperatives.

Source: World Bank, Nonfarm Employment Study, April 1982, Ministry of Agriculture and Cooperatives, Bank of Thailand and Department of Customs.

Table 2. Stock and increase of farm machines in Thailand, 1975/76 - 1981/82.

(unit):

Type of machine	Crop year						
	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82
<u>Tractor (45 hp)</u>							
stock in use	13,338	17,569	22,826	28,987	33,285	37,177	50,044
net increase	-	4,231	5,257	6,161	4,298	3,892	12,867
<u>Tractor (45 hp)</u>							
stock in use	14,575	16,427	23,942	26,984	31,158	36,158	39,158
net increase	-	1,852	7,515	3,042	4,174	5,000	3,000
<u>Two-wheel tractor</u>							
stock in use	90,001	113,286	151,504	192,004	230,591	280,591	284,351
net increase	-	23,285	38,218	40,500	38,687	50,000	3,760
<u>Water pump</u>							
stock in use	251,288	277,084	317,328	359,308	473,975	517,975	603,548
net increase	-	25,796	40,244	41,980	114,667	44,000	85,573
<u>Water wheel</u>							
stock in use	56,891	68,219	81,923	87,775	107,730	125,811	146,927
net increase	-	11,328	13,704	7,852	17,955	18,081	21,116
<u>Rice thresher</u>							
stock in use	3,955	4,430	4,962	5,557	6,224	18,934	20,601
net increase	-	475	532	595	667	12,170	2,207
<u>Winnower</u>							
stock in use	42,342	47,432	53,114	59,488	66,806	74,782	83,801
net increase	-	5,081	5,691	6,374	7,318	7,976	9,019

Source: Loohawenchit (1983). Data are from Division of Agricultural Economic Research, Office of Agricultural Statistics, Ministry of Agriculture and Cooperatives.

Table 3. Number of tractors per 1000 hectares of cultivated land by region, 1975/76, 1979/80, and 1981/82.

Year	Whole Kingdom			North			Northeast			Central Plain			South		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1975-76	0.74	0.94	5.01	1.21	1.09	2.94	0.40	0.17	0.40	1.16	2.36	15.50	0.28	0.07	0.52
1979-80	1.77	1.65	12.25	2.50	1.28	11.61	0.82	3.56	1.70	2.37	4.14	24.51	0.60	0.41	7.83
1981-82*	2.58	2.02	14.65	-	-	-	-	-	-	-	-	-	-	-	-

Note: 1 2-axle tractors over 45 h.p.  
 2 2-axle tractors under 45 h.p.  
 3 Single-axle tractor (power tillers)  
 \* Data by region are not available.

Source: Office of Agricultural Economics, Ministry of Agricultural and Co-operatives, Bangkok, Thailand.  
 No. 84(6), 1982 and No. 84(3), 1978.

Table 4. Horspower available of selected farm machines by region, 1979/80.

Unit = hp/ha

Region	Type of machines				
	2-T	T-TS	4-TL	Total	Water pump
Northeast	0.019	0.003	0.135	0.057	0.038
North	0.136	0.018	0.192	0.346	0.1
Central Plain	0.256	0.906	0.176	0.491	0.194
South	0.094	0.006	0.045	0.14	0.029
Overall Average	0.111	0.02	0.116	0.247	0.089

Source: Supachat Sukharomana (1983), Table 5. Data from Office of Agricultural Economics (1981).

2-T = Two wheel tractor

4-TS = Small four wheel tractor

4-TL = Large four wheel tractor.

Table 5. Distribution of major farm machines by region, 1979/80.

Categories	Northeast	North	Central Plain	South	Whole Kingdom
Farm tractor (>45 H.P.)	7,912 (23.77)	11,170 (33.56)	12,719 (38.21)	1,483 (4.45)	33,284 (100)
Two wheel Walking tractor	16,789 (7.28)	58,788 (25.48)	133,551 (57.89)	21,563 (9.35)	230,691 (100)
Farm tractor (<45 H.P.)	1,828 (5.86)	5,888 (18.89)	22,452 (72.06)	990 (3.17)	31,158 (100)
Water pump	87,502 (18.46)	109,572 (23.12)	259,203 (54.68)	17,698 (3.73)	473,975 (100)

( ) = percent

Sources: Office of Agricultural Economics Ministry of Agricultural and Co-operatives, Bangkok, Thailand. No. 84(6), 1982.