

***COUNTRY REPORT: THAILAND***

**AGRICULTURAL MECHANIZATION  
DEVELOPMENT IN THAILAND**

**Submitted to**

**The Fifth Session of the Technical Committee of APCAEM  
14-16 October 2009, Los Banos, Philippines**

*By*

*Viboon Thepent  
Senior Agricultural Engineer  
And  
Anucit Chamsing  
Agricultural Engineer*

*Agricultural Engineering Research Institute  
Department of Agriculture, Chatuchak*

***Bangkok 10900, Thailand***

## **1. General Background**

Thailand is an agricultural country. Approximately 21 million ha or 40.9% of the total area is used for agricultural production, 31.3 and 27.8% are under forest and unclassified land respectively. About 49.8% of the agricultural land is used for growing rice, 21.5% for field crops, 21.2% for fruit or horticultural crops and 7.5% for others (OAE, 2008). Thailand is almost self sufficient in food production. Agriculture is an important sector and the largest source of employment of rural population of the country. About 46.6% of the total population is engaged in this sector. Agricultural production does not only contribute to domestic consumption but also play significant role in export earnings. Although, the importance of agriculture has declined a bit due to the expansion of other sectors (industry, tourism, construction and other service sectors), its contribution was still about 10.1% of total GNP in 2007 (FAO, 2009).

## **2. Agricultural Machinery Development**

### **2.1 Technological needs of farm mechanization**

Development of agriculture in Thailand can be divided into three, somewhat distinct stages (Chomchalow, 1993); (i) Rice monoculture/natural resource-based (Pre-1955), (ii) Land-based resource/labor-intensive methods (1955-85) and (iii) Structural shift in agricultural production (Post-1985). In the past, Thailand's crop production increased as a result of increase in area under production, rather than an increase in land productivity. During 1960-83, 78% of the growth in agricultural production was due to area expansion and 22% due to increase in land productivity (Rijk, 1989). However, since 1976 or the fourth National Economic and Social Development Plan (NESDP), the government contemplated that further area expansion would not be possible to increase agricultural production. Thus, the strategies were changed to increase agricultural production by increasing productivity. Modern agricultural technologies were introduced, such as high yield variety (HYV) seed, fertilizer, pesticide, mechanization and other inputs. Thailand agricultural production performance analysis in term of relationship between crop production output and energy input is given in Fig. 1. The contribution and variation of energy inputs in crop production of Thailand during 1950-2005 is shown in Fig. 2. By 2005, the total energy input had increased by about 22 times compared to 1950 while the crop production has increased just about six times only from 7 million tons in 1950 to 55.3 million tons grain equivalent in 2005. Mechanization played a significant role in increasing agricultural production by completing farm operations in time, reducing cost of production, drudgery and increasing crop intensity.

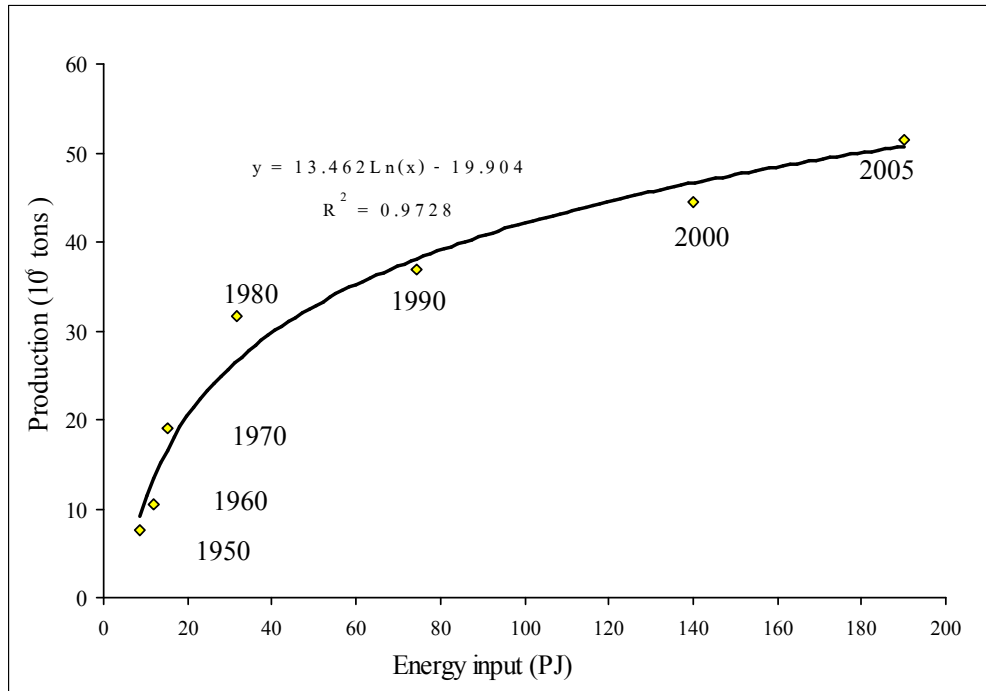


Figure 1: Relationship between energy input and crop production in Thailand during 1950-2005  
Source: Anuchit (2007)

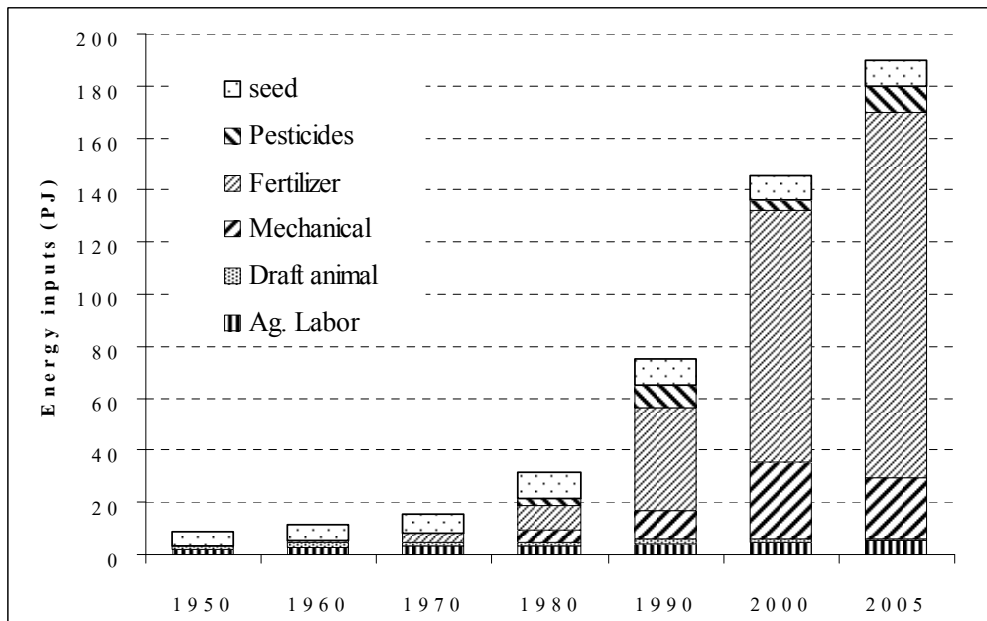


Figure 2: Contribution of different energy inputs in crop production in Thailand during 1950-2005  
Source: Anuchit (2007)

## 2.2 Success stories in agricultural machinery

Traditionally, Thai farmers used simple tools, animal drawn implements and water wheels. Mechanization with power technology began in 1891 when the government imported steam power tractor and rotary hoes that were found to be unsuitable for paddy conditions and also quite expensive (Sukharumana, 1982).

In the early 1920s, agricultural machines were imported for trial operations, the research and development in agricultural mechanization were started but did not progress much due to lack of well trained local personnel and the onset of World War II (Mongkoltanatus, 1993).

In 1947, a single axle tractor with rotary hoes powered by 4.4 kW gasoline engine was imported, but its low chassis was unsuitable for swampy fields (Rijk, 1989).

In the early 1950's, 4-wheeled tractors were imported and promoted as contracting services use by the government but the project was unsuccessful. Five years later, tractors were imported again. The most popular was Japanese designed 2-wheel tractor with number increase significantly and stimulate local workshops to simplify the design of imported tractors to reduce cost and also make them suitable for local conditions.

In 1957, the Agricultural Engineering Division (AED) or Agricultural Engineering Research Institute (AERI) of the Ministry of Agriculture and Co-operative (MOAC) released the design of an axial flow pump, namely "Debaridhi water pump" for local manufacture. This pump was subsequently commercially produced and widely adopted up to present (Mongkoltanatus, 1991; Kaewprakaisaengkul, 1996).

In 1958, the AED released the design of a 4-wheeled tractor powered by a 25 hp engine, named "Iron Buffalo", to two private firms for commercial production (Chakkaphak, 1984). Due to the high cost of this tractor, it could not compete with imported tractors. In the same year, the first prototype of a rice combine harvester was designed. The cutting and threshing units were connected to the tractor (25 hp) and driven by a PTO shaft. This prototype was not commercially produced (Mongkoltanatus, 1991; Kaewprakaisaengkul, 1996).

In 1960 and 1964, two firms, namely Ford and Massey Ferguson, established assembly lines for four wheeled tractors (Singh, 1983).

In 1964-1965, workshops around the Bangkok area began to modify the design of imported 2-wheeled tractors by trial and error method. Only one workshop succeeded in simplifying the gearbox and other parts of the tractor to suite local paddy field conditions. In 1966, a few firms began producing 2-wheeled tractors. The lower price of these tractors relative to the imported tractors and their suitability to local conditions made them popular, and their adoption spread to all parts of the Central plain. The high demand for these tractors resulted in establishment of many farm machinery firms in this region.

In 1967-1969, a firm producing 2-wheeled tractors in Ayudhaya province began manufacturing a simple 4-wheeled tractor that was developed from a 2-wheeled tractor gearbox by adding two more wheels and a seat. It was powered by a 15 hp single piston diesel engine (Singh, 1983).

In 1975, the AED constructed the prototype for an axial flow rice thresher, which received its blueprint from the International Rice Research Institute (IRRI), then released it to a selected firms in Chachoengsao province for commercial production. Ten units were immediately sold, but it still was not successful as expected. Later in 1975, a new blueprint was released to three firms for commercial production, and subsequently it was widely used

and developed with very high successfully development. There are many designs both stationary and self propeller also difference in size and length of cylinder. At present, this machine has still be popular used especially in the North and the North East regions while it was not used in the Central plain region because it was replaced by the using of Thai-made rice combine harvester.

In 1977, a blueprint of a portable rice thresher was sent by IRRI and one firm produced it, but it was not widely used due to its low capacity. In the same year, the Japanese combine harvesters (head feed type) were demonstrated to Thai farmers but the farmers were reluctant to accept them.

In 1978, a rice transplanter (12 rows and power operated) was imported from China by a local firm that also produced it, but they could not be sold in significant numbers. At the same time, the AED tested a Japanese reaper. This machine was not popular used in the later time because the immersing of pre-germinated rice broadcasting technology which save in cost and labour requirement. Presently, rice transplanter has became to popular use especially in the Central plain region. This was due to problem on weed and contaminated rice varieties. All rice transplanters were imported. They were used in hiring system.

During 1981 and 1982, approximately 1,000 units of Chinese reapers were imported and sold. The long stem rice varieties were not suitable for reaping and the farmers had to collect and bind harvested rice similar to manual harvesting and it required more labor. Moreover, heavy weight machines were also a major problem during field operations. These reapers were finally abandoned.

In 1985-1987, local firms around Bangkok started to fabricate a Thai-made rice combine harvester (Kalsirisilkp, 1993). Around the early 1990s, these firms successfully developed Thai-made rice combine harvester. It was accepted for use by farmers and popularly used in hiring services, especially in the Central plain and then its use spread in other regions of the country (Krishnasreni and Kiattiwat, 1998). Thai combines have a capacity range from 0.42 to 0.9 hectares per hour (Kalsirisilkp, 1993; Krishnasreni and Kiattiwat, 1998). In 1997, there were about 2,000 units used mainly in the Central rice area of Thailand (Chamsing and Singh, 2000). Although, still much design and development was needed to improve its performance, the Thai rice farming industry was satisfied with the combine performance (Krishnasreni and Thongsawatwong, 2004). Currently, they are being used across the country with high competition in hiring systems especially in the Central region. Hiring rate for harvesting rice in the Central region had decreased while in the other regions it is still high.

At the beginning of the introduction of the combine harvester, rice is combined at relatively high moisture, sometimes as high as 28%, but the average moisture at harvest is about 24%. Farmer does not dry his own paddy but sell it to the miller or the collector right away. The high moisture rice is immediately transported to the rice mill or the local collector. Most millers and collector at that time had no mechanical dryer, drying the high moisture rice depend mostly on sun drying. This change had created large volume of high moisture paddy at a short period, beyond the handling capability of the millers. During 1992 – 93 farm price of paddy at that period was the lowest ever. The government tried to solve the problem by, on one hand subsidizing dryers at cooperatives and farmer's groups in the major rice production areas, on the other hand giving soft loan to millers and owners of central market for paddy to put up dryers. The Ministry of Agriculture and Cooperatives undertook the subsidizing dryers at cooperatives and farmers' group program. The Ministry

of Commerce undertook the soft loans provided for millers and collectors program. The program started in 1995 to 1998 for cooperatives and farmer's group and until the year 2000 for millers. At present almost 90% of the miller and local collector in the major rice production area own mechanical dryers. Drying of wet paddy is done by the miller or by the collector using only dryer or both mechanical dryer and sun drying floor. Types of paddy dryer used in Thailand are cross flow, mixed flow, fluidized bed and rotary dryer. The concurrent flow dryer has not been observed. The dryers that the government subsidized to the Farmers' group and cooperatives were mostly the mixed flow type, very few were the cross flow. Drying capacity of these dryers were about 30 tons per day of paddy at initial moisture of 22% dry to 15%, using diesel fuel burner to generate hot air. The dryer operates as batch re-circulation at about 6 tons per batch for individual farmer to dry his wet paddy. The dryer also, was designed accommodate the harvesting capacity of a combine harvester in one day. There are about 300 units of these dryers in all parts of the country. Survey on the use of these dryers in 1998 found about 10% of them was operated. This may be due to the system of local buying. The pricing of dry paddy in some areas was not much difference from the wet paddy. Also farmers need immediate cash to pay their loan. At present none of those dryers is in operation due to the high price of diesel fuel and no incentive for drying. At cooperatives rice mill level, the government subsidized a larger size of mixed flow dryer having drying capacity of about 60 to over 100 tons per day. Those dryers use rice hull as fuel to generate hot air through heat exchanger and they operate as batch re-circulation. Because of the cheap cost of fuel for drying and the need to dry wet paddy for milling, most of the dryers at cooperative rice mill in the central region are operating. For the case of soft loans provided to rice millers and collectors for securing dryers and the necessary components for operating the dryers, millers mostly hire contractors to build dryers according to their own designed or in consultation with the contractors. This might be that the mill owner sees that construction of a dryer is easy, buying it is too costly, or because there are too fewer dryer manufacturers as compared to the number of the millers. At present there are only five or six manufacturers, which cannot serve over 1,000 of the millers all at once. Many of those built by the contractor, mostly are very large size having holding capacity of 100 tons or more at little moisture extraction rate. Some rice mills install two to three dryers of those sizes to cover the daily input. Operation of those dryers is either as re-circulation batch or continuously drying wet paddy in one passing. Some version of dryer may have four of the mixed flow type drying bins holding about 25 tons each arranged in series instead of a large drying bin. Input paddy continuously flow from one bin to the others and exit at moisture about 15%. Head rice yield obtained from those dryers are higher compared to the sun drying floor method. Source of fuel used for generating hot air for drying is rice hull, and is mostly direct fire from the furnace. The development of cyclonic rice husk burner in Thailand started in 1997 by Agricultural Engineering Research Institute, the Department of Agriculture. Presently, cyclonic rice husk burner has become popular use especially by the rice milling plant.

Development of farm mechanization of the country started with power intensive machines such as irrigation pumps, power tillers and threshers. Most farm machinery used is locally manufactured, except some sophisticated machines which are imported (Mongkoltanatas, 1993; Kaitiwatt, 1996). Since the fourth NESDP, the expansions of other economic sectors of the country (industrial, construction, tourism and services) have greatly increased. These draw out a magnitude of labor force from the agricultural sector and have

created an on-farm labor shortage crisis. Mechanization has therefore become an important input for Thailand's agricultural production system. Mechanization in Thailand is rapidly expanding with both increases in number and size of machinery in use (Mongkoltanatas, 1998). Mechanization initially started from the Central plain and expanded to other regions. Mechanization is not only sprawling but its pattern is also changing. In the Central plain, mechanization has been moving from power intensive to control intensive machines. The population of power tillers, irrigation pumps and power threshers in the Central plain has become almost stable, but the number of rice combine harvesters has been increasing rapidly. In other regions, the number of power tillers is increasing rapidly. Thai-made rice combine harvesters are being adopted to harvest rice in these regions. Mechanical dryers have begun playing an important role to keep and improve rice quality (Chaisattapapong, 1997).

### **3. Development of agricultural machinery testing networks in Thailand**

Thai Industrial Standard Institute (TISI), Ministry of Industry is responsible for standardization of agricultural machinery. TISI was established in 1968. It is the official agency with the responsibility in the development of Thai Industrial Standards (TIS), including agricultural machinery standards.

The preparation of agricultural machinery standards is undertaken by the Technical Committee (TC). The TC, appointed by the TISI, includes representatives from Agricultural Engineering Research Institute (AERI), manufacturers, the Bank of Agriculture and Agricultural Cooperatives (BAAC), universities. Approved standards are published in the government gazette.

Agricultural machinery standards from various countries have been studied and then adapted to be suitable with Thai agricultural machines and their corresponding working conditions. Research is required to get a basic data for developing standards. Safety standard is one part of each agricultural machinery standard.

Anyway, most of agricultural machinery standards are voluntary standards. Only small diesel engine standard is a mandatory one. Only a few number of agricultural machinery manufacturers apply for the TISI standard certification.

The National Agricultural Machinery Center (NAMC) was established in 1979 organized under Research and Development Institute at Kamphaengsaen, Kasetsart University. The main functions of the center was 1) Testing and Standardization 2) Responsibilities to testing of agricultural machines either locally fabricated in Thailand or imported from abroad and collaborating with the Thai Industrial Standards Institute in standardizing agricultural machinery testing.

### **4. Technological challenges and gaps and financial and institution constraints**

- 1) Plot size for crop production is rather small especially for rice production in the North and the Northeast. This decreases field capacity of agricultural machinery and increases energy consumption per unit area especially for big machinery.
- 2) Average family members active in farm for all crop production and regions were rather few about (2.0-2.6 persons/family or only about 45% of total family members). This resulted in labor shortage for farms as some family members were old or women. Therefore, custom service was observed for many or all farm activities.
- 3) Problems pertaining to land holding were size of planted area, land holding status and high rental rate of land.

- 4) Size of planted area for irrigated rice, rainfed rice, cassava and soybean (both wet and dry season soybean) production in the North and the Northeast were smaller compared to that in the Central Thailand. Irrigation availability and socio-economic status of the region influenced farm income, potential to improve crop production efficiency, chance to successfully access loaned money and holding machinery.
- 5) Farm operations of crop production in some regions were still had low competition for custom service of machinery. This resulted in high hiring wage rate and low quality of work done.
- 6) Problems of un-necessary ownership of machinery and finance for machinery acquisition were observed. Some farmers owned un-necessary machines which did not match with their farm works requirement or they did offer for custom service work, therefore low utilization rate of machines resulted in high fixed cost of machine and consequently increased cost of production. These problems were faced especially in rainfed rice production in all regions, and sugarcane production in the Northeast.
- 7) Some parts of agricultural machinery were imported.
- 8) Imported parts were similar to that of other machinery or vehicles. Therefore, import tax was charged at the same rate which was high for agricultural machinery. This results in high price of some agricultural machinery.
- 9) Production technology for agricultural machinery of Thailand is still under development.
- 10) Machinery for some farm operations and crops are still missing.
- 11) Support from the government side in the past was less and was not focused to the requirements of users and producers.
- 12) Governmental support for the development and the promotion for farm mechanization is still inadequate.
- 13) Under-utilization of some agricultural machinery was noted.
- 14) Irrigated area is limited and not equally spreaded through out the country.
- 15) Irrigation system is still in developmental phase that restricts growing more crops per season.
- 16) Inadequate water supply in dry season.
- 17) Lack of drainage system especially for irrigated rice production. Therefore, some planted areas were flooded.
- 18) Landless farmers and small holding farmers cannot reach low interest rate loan money from financial institutes. They still have to seek loan from other sources with high interest rate.

##### **5. Priority area for technical cooperation and assistance for capacity building and recommendation on how to set up and effective mechanism to promote agricultural technology transfer**

Agricultural production policy in Thailand is not only for domestic consumption but also for export to the world market. It draws attention to increase potential for competition in the market. Agricultural mechanization is an important tool and has played crucial role to support agricultural production of the country.

Various sources of data were analyzed. The agricultural mechanization development strategies for Thailand (Chinsuwan, 2005) were considered inclusion. The SWOT analysis was applied. The analysis was then used to provide guidelines for capacity building of



mechanization to support agricultural development policy. The following short-term and long-term plans are recommended:

### 5.1 Short term plan

Recommended activities	Recommendation set up
<b>5.1.1 Capacity building of farmers and operators for efficient use of agricultural machinery</b>	
1) <b>Impart knowledge for using and repair and maintenance of agricultural machinery to farmer:</b> Various agricultural machinery are being used for various crops production. Increase knowledge on using and repair and maintenance will increase usage efficiency of agricultural machine, reduce cost of repair and maintenance, and extend life of machine.	Agricultural Extension Office at district or provincial level organize training course for farmers by the use of resource persons from related institutions. Provincial level training will lead to train farmers from various districts.
2) <b>Extend knowledge and training for operators of big size, high price and high performance agricultural machinery:</b> Trend of using these machines for crops production in Thailand is increasing viz. rice combine harvester, sugarcane harvester etc. High skilled operators are required to maximize utilization efficiency of these machines. This will result in good quality of work done, decreasing repair and maintenance cost and thereby reduce cost for custom service may be possible.	Set up training course and workshops for operators of these agricultural machinery by cooperation of governmental agencies and Agricultural machinery manufactures.
3) <b>Introducing appropriated agricultural machinery to farmers:</b> There are various types and sizes of agricultural machinery in use which are mostly used in the Central plain region. Introducing these machineries to those areas which are currently not using them will boost the mechanization in other regions of Thailand.	1. Setup pilot projects, field trips of farmers for introducing various agricultural machinery. 2. Promote mechanization through various media.
4) <b>Supporting custom service system of agricultural machinery:</b> Agricultural machinery in custom service is popularly used in Thai crop production. The advantages are: increased utilization of machine; reduced fixed cost for holding machine; option to use high performance machine for increasing production efficiency; and relax the problem of labor shortage. This is practiced intensively in the Central, as compared to the North and the Northeast, which have low competition causing high hiring rate and increased cost of production.	1. Introduce the custom service system of small agricultural machinery to the area that still miss this system. For example, hiring of power tiller contractor group for land preparation, so the big machines will not be required where it is not possible to use big agricultural in that area especially in the North and the Northeast. 2. Introduce the custom service of big machines to the area with low

<p>There fore, the promotion of custom service for agricultural machinery should be practiced.</p>	<p>competition of custom service. This will result in reducing of high hiring rate and relax problem on labor shortage, especially for harvesting operation of rice, maize and sugarcane.</p> <ol style="list-style-type: none"> <li>3. Support low interest rate of loan money for those who wants to investment for custom service.</li> <li>4. Support the management activities for custom service.</li> </ol>
<p><b>5.1.2 Research and development on agricultural machinery</b></p>	
<p>1) <b>Study on applicability of existing agricultural knowledge to other regions and crops</b></p>	<ol style="list-style-type: none"> <li>1. Study on applicability of existing agricultural machine from currently using area to another areas. Mostly from the Central to the North and the Northeast.</li> <li>2. Study on applicability of existing machine from currently using crops to other crops that require similar farm operation or cultural practice.</li> </ol>
<p>2) <b>Research and development innovative agricultural machinery for crop production of Thailand</b></p>	<ol style="list-style-type: none"> <li>1. Import, test and evaluate agricultural machinery under various conditions for crop production of Thailand.</li> <li>2. Research and development on the imported machines that show good potential for suitable crop production condition of Thailand.</li> <li>3. Research and development to design new prototype agricultural machinery based on specific requirements.</li> </ol>
<p>3) <b>Research and development to increase efficiency of machinery being currently used.</b></p>	<ol style="list-style-type: none"> <li>1. Study on the current system of using agricultural machinery especially high value crops.</li> <li>2. Identify problems and constraints. Testing and evaluation in the field for more precise assessment.</li> <li>3. Improve the system and disseminate results to the farmers.</li> </ol>

<b>5.1.3 Manufacturing sector support</b>	
<p>1) <b>Revise the standards of agricultural machinery:</b> standards of some agricultural machinery are already defined but few number of Agricultural machinery manufactures requested for the certificate for their products. However, only few numbers of requested cases were awarded the certificates. Therefore, revising standards is required. This will able Agricultural machinery manufactures to increase their potential to compete in the market against imported machines.</p>	<ol style="list-style-type: none"> <li>1. Revise the existing standards and mechanism to achieve those standards.</li> <li>2. Improve regulation to ensure using of the standards.</li> <li>3. Stimulate and promote agricultural machinery production in line with standards. The following incentives may be used: <ul style="list-style-type: none"> <li>- Reduce tax charged from the registered manufactures.</li> <li>- Support low interest rate of loan money for their improvement and for their products that received standard certificate.</li> </ul> </li> </ol>
<p>2) <b>Promote standardization of local agricultural machinery:</b> Good and high standard agricultural machinery will benefit to both farmers and Agricultural machinery manufactures.</p>	<ol style="list-style-type: none"> <li>1. Promote farmers to use agricultural machinery that received certificate of standard.</li> <li>2. Enforce using of the standardization seriously.</li> <li>3. Stimulate and promote agricultural machinery standardization.</li> </ol>
<b>5.1.4 Financial sector support</b>	
<p>1) <b>Support for agricultural machinery investment:</b> Government should promote farmers who have potential for agricultural machinery investment based on the direct requirement of farmers which for using in their owned farm or for custom service. Financial support to those farmers who wish to invest on agricultural machinery for their own use or for custom services.</p>	<ol style="list-style-type: none"> <li>1. Promote investment in agricultural machinery.</li> <li>2. Low interest rate of loan money for investors.</li> </ol>

## 5.2 Long term plan

<b>Recommended activities</b>	<b>Recommendation set up</b>
<p><b>Promote research and development of appropriate agricultural machinery and their utilization:</b> especially for cassava and sugarcane planting; mechanical weed control for all upland crops; maize and sugarcane harvesting. This will overcome labor shortage and high labor cost, timeliness cost and consequently reduce the cost of production.</p>	<ol style="list-style-type: none"> <li>1. Import, test and evaluate agricultural machinery under various conditions for crop production of Thailand.</li> <li>2. Research and development on the imported machine that show good potential for suitable crop production condition of Thailand.</li> </ol>

<p><b>2. Supporting acquisition of big and high price machine:</b> Problems of labor shortage will more serious in future. The big size, high capacity and high price machine are necessary. The BAAC dose not provide direct finance for buying them. So farmers have to seek financial support from neighbors, manufactures, commercial banks and other non-finance institutes with high interest rate and short duration. This problem was also the constraints of mechanization development plan and crop production development as consequent.</p>	<ol style="list-style-type: none"> <li>1. Supporting low interest of loan money for these machines.</li> <li>2. Improve the regulation for using big and high price agricultural machinery.</li> <li>3. Support management activities for strengthening custom service.</li> </ol>
<p><b>3. Promote standardization for agricultural machinery that are not yet defined with the standard:</b> Standardization of agricultural machinery will give benefit to farmers. While Agricultural machinery manufactures will increase potential to compete in the market, especially against the imported machines.</p>	<ol style="list-style-type: none"> <li>1. Improve regulation to the standardization seriously.</li> <li>2. Define the standardization of local agricultural machinery.</li> <li>3. Promote agricultural machinery with standard. The following approaches may be used: <ul style="list-style-type: none"> <li>- Reduced tax charged.</li> <li>- Low interest rate of loan money for their products.</li> </ul> </li> </ol>
<p><b>4. Investment of planted area:</b> Land leveling support irrigation system, especially for rice production. Size of land holding is a constraints for using big agricultural machinery.</p>	<ol style="list-style-type: none"> <li>1. Develop projects of land leveling for high potential crops. This will support irrigation and application of big and high capacity machines.</li> <li>2. Land consolidation for group farming is a possible way to use big and high capacity machine, especially for sugarcane harvester, maize combine harvester and rice combine harvester.</li> </ol>

## **6. Way and mean to address challenges in agricultural machinery development in Thailand and regions**

Establishing a regional network for testing agricultural machinery will be useful among national agricultural machinery testing agencies and institutes of member countries for efficient use of agricultural machinery and promotion of green agricultural technology.

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