

# 1. PRESENT SITUATION AND FUTURE PROBLEMS ON FARM MECHANIZATION IN TAIWAN THE REPUBLIC OF CHINA

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## **Technical problems on farm mechanization**

### **(1) Technical problems concerning introduction of farm machinery**

It is an established fact that climate, land, types of soil, kinds of crops, farm management and economic status of a farmer are the factors to be taken into account in the introduction of farm machinery. However, types of soil affect greatly the design and the durability of tilling machines such as power tillers.

The texture of soils in Taiwan is closely related to the nature of the parent rocks. The slate alluvial soils and the mudstone alluvial soils in the southern part are probably the heaviest alluvial soils in Taiwan, ranging from loamy clay to silty clay loam. The sandstone and slate alluvial soils in northern and central Taiwan are from sandy loam to loam. The soils in the eastern valley vary in their texture, but they are, for most part, loamy soils. Generally speaking, most soils in Taiwan are of loamy texture. Sandy soils are generally confined to a limited area along the sea coast. The heavy soils of slate and mudstone parent materials seldom contain over 40% of clay particles. Therefore, soils in Taiwan, with few local exceptions, pose no or little problem to the utilization of farm machines.

The types of soil in the arable land area of Taiwan are tabulated on page 10.

Although sticky soil comprises less than 20% of the total arable land in Taiwan, yet the machine design has to be strengthened in order to meet the requirement. For instance, more than 30 items of the Japanese power tiller such as rotary shaft, frame for setting engine, bearings, seals, gear casings, etc. have been strengthened when the machine was manufactured locally.

The climate, kinds of crops and farmer's customary practices also have something to do with the adaptability of a machine. For example, the Japanese-type small rice combine has some shortcomings found during trials as the machine does not function quite well, especially its cleaning device which would not perform properly when the moisture content of the grain is too high during early mornings or after a rainfall. However, most of the paddy fields in Taiwan are too soft at the harvesting time to support the heavy machine, and the small, uneven land tracts make the use of the machine less practical and inefficient, in addition to higher grain loss and other drawbacks. To fully utilize this machine will require either a new variety of rice or a change in the field size, as the present rice varieties in Taiwan were originally developed for easy threshing by manual labor.

Speaking of farmers' customary practices, the rice farmers of Taiwan used to leave stubble and part of straw in the field, so the rotary tine of power tiller will not plow deeply enough and consume more power if it is not equipped with a straw-loosing device on the rotary shaft.

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County	Sand and loamy sand		Sandy loam		Loam, silt loam and silt		Clay loam, sandy clay and silty clay loam		Sandy clay, silty clay, and clay	
	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
Taipei	0.75	269.5	19.34	6948.9	43.45	15611.6	36.02	12942.0	0.45	161.7
Taoyuan	2.54	1399.8	18.13	9991.4	26.15	14411.3	52.98	29197.3	0.20	110.2
Hsinchu	0.31	163.8	45.62	24101.0	35.36	18680.7	18.41	9726.0	0.30	158.5
Miaoli	2.17	1139.0	66.29	34795.6	20.33	10671.2	11.15	5852.6	0.06	31.5
Taichung	0.26	120.2	22.04	10189.1	70.28	32490.4	7.42	3430.3	—	—
Changhua	1.76	1178.7	41.03	27477.8	2.96	1982.3	54.35	36398.2	—	—
Yunlin	1.92	1665.6	57.40	49794.5	39.86	34578.6	0.82	711.4	—	—
Nantou	0.06	20.5	11.40	3898.8	48.80	16689.6	39.71	13580.8	—	—
Chiayi	0.30	212.6	38.25	27107.8	56.24	39857.3	5.21	3692.3	—	—
Tainan	—	—	39.36	38072.9	60.64	58657.1	—	—	—	—
Kaohsiung	0.65	343.6	26.35	13928.6	50.81	26858.2	22.17	11719.1	—	—
Pingtung	2.07	1395.2	34.35	23151.9	49.41	33302.3	14.44	9732.6	—	—
Taitung	0.35	99.6	16.56	4711.3	53.28	15158.2	29.80	8478.1	—	—
Hualien	0.19	46.4	33.81	8259.8	43.51	10629.5	21.49	5250.0	—	—
Yilan	0.07	10.6	16.49	2489.0	83.04	12539.0	0.40	60.4	—	—
Total (ha)	8065.1		284919.3		342117.8		150771.1		461.9	
(%)	1.02		36.23		43.51		19.17		0.04	

(2) **Present situation and future aspects of research activities on development, improvement, and utilization of farm machinery**

Up to the present, farm machines used are mainly for land preparation, pest control, water pumping, transportation of farm products, and, on a small scale, grain drying, but machines for other farm operations, such as, seeding/transplanting, fertilizer application, cultivation, harvesting of different crops are still lacking. In order to develop and improve farm machines adaptable to local conditions, many research activities have been conducted by universities, agricultural research institutes and the various district agricultural improvement stations.

Presently, research workers in Taiwan are focusing their attention to improving rice transplanter, rice combine, etc., which were introduced from Japan. To facilitate mechanized rice transplanting, the experiment on a cooperative nursery shelter with necessary equipment is underway. Besides the research on paddy farming, the development and experiment of a peanut planter to be attached to a power tiller, peanut combine, soybean hand planter, sweet potato digger, cultural machines for tea, flax, jute, etc., has been also conducted.

To accelerate the pace of developing and improving new machinery, more qualified research engineers are required. For training engineers to conduct research work on farm machinery, a farm mechanization research institute is proposed to be established in Taiwan.

To solve the problem of labor shortage in rural areas, highly efficient farm machines, especially wheel tractors, are to be extended to Taiwan farmers for use in a cooperative manner in the near future. The proposed plan of laying out 100 hectares for the establishment of a cooperative mechanized farming unit has been mapped out by government agencies concerned. It is our immediate plan to develop mechanized farming

by making use of small machines, and at the same time adopting big machines for cooperative use for both paddy and upland crops.

### **Evaluation and improvement of farm machinery, especially those made in Japan**

Generally speaking, Japanese-made farm machines are of excellent quality. However, it does not mean that all the machines are adaptable to our farming conditions. Since most of Taiwan farmers are still not mechanically minded and the machines are apt to be overworked during the busy season, the machines have to be strengthened considerably as was mentioned before. Other machines, like rice thresher, rice combine, binder, grain dryer, etc., have either to be modified or improved to suit the local farming conditions.

The change in models and improvement of the designs of farm machines in Japan are relatively fast. Thus it renders the after care of the machines difficult for lack of spare parts. The designs of some newly developed machines are costly and too complicated to be handled by individual farmers. For instance, the most popular power tiller model with 6 forward speeds and two backward speeds for tillage seems too intricate in design for use by the general farm population. If the machine can be so designed that it will be handled easily by farmers of developing countries, it will be within their reach and less problem of after care will be encountered.

Although, most of the Japanese farm machines are well tested for their durability, yet some of them still do not give satisfactory service. For example, the blade of glass cutter can only be continuously used for half an hour each time. It will be less efficient and short-lived, especially when used for reaping rice.

### **Socio-economic problems related to farm mechanization**

- (1) Changes of number of agricultural labor force and number of farm households in the past ten years (1959-68):
- (2) Changes of average farm wage rate per day in the past ten years:

	No. of agricultural labor*	No. of farm households*
1959	1,738,990	780,402
60	1,754,732	785,592
61	1,780,910	800,835
62	1,800,379	809,917
63	1,833,463	824,560
64	1,860,933 (1,820,000)**	834,827
65	1,866,769 (1,704,000)**	847,242
66	1,897,155 (1,586,000)**	854,203
67	1,904,413 (1,705,000)**	868,731
68	1,997,130 (1,652,000)**	877,114

Remaks: \* Statistical data from the Taiwan Demographic Book.

\*\* Data from "Quarterly Report on the Labor Force Survey in Taiwan".

	Average farm wages (NT\$/day)	Equivalent to 1952 value (NT\$/day)
1960	32.80	13.40
61	36.65	14.49
62	38.73	15.68
63	39.14	15.42
64	40.29	15.41
65	41.46	15.83
66	44.57	16.83
67	48.40	17.81
68	56.27	19.71
69	63.31	21.73

The following table is the comparison of farm labor wages between 1964 and 1968:

		Land preparation	Planting	Weeding	Pest control	Harvesting
Rice	1968	120	62	55	68	65
	1964	82	45	30	52	50
		+51%	+38%	+83%	+31%	+40%
Sweet potato	1968	118	50	50	66	60
	1964	80	35	35	52	40
		+48%	+43%	+43%	+27%	+50%
Peanut	1968	115	27*	27*	65	27*
	1964	72	20*	20*	50	19*
		+60%	+35%	+35%	+30%	+42%

\* Female labor.

(3) Changes of numbers of agricultural machinery and implements being used on the farm in the past ten years:

	Power tiller	Power sprayer	Hand sprayer	Hand duster	Rice thresher	Pump
1960	3,708	317	104,150	10,803	177,338	8,378
61	5,313	966	115,699	10,337	181,693	10,114
62	7,504	804	125,899	9,517	184,244	11,678
63	9,079	1,028	139,439	12,764	193,772	19,728
64	10,201	2,949	147,954	15,822	203,329	28,654
65	12,213	4,489	161,506	13,558	205,784	32,107
66	14,272	6,123	166,817	16,788	194,247	35,301
67	17,240	9,734	180,780	21,886	204,337	42,330
68	21,153	12,901	180,477	19,121	201,706	49,310
69	24,640					

## (4) Policies for farm mechanization:

For expediting the farm mechanization program in Taiwan, a four-year plan has been mapped out by the Government of the Republic of China. One of the most important steps to be taken is to lower the price and improve the quality of farm machines manufactured locally. It is proposed that more long-term and low-interest bearing loans be made available to the local farmers to lighten their burden, thus speeding up the process of farm mechanization. The main points of the proposed plan may be briefly described as follows:

1) To lower the price and improve the quality of farm machines: The prices of the locally made farm machines are 30% higher than those of the same types sold in Japan. The price of power tiller has been lowered 10 per cent under the plan.

2) To subsidize farmers for the purchase of farm machines: Through government assistance, the farmers will be able to use more farm machines, such as power tiller, rice transplanter, small rice combine, grain dryer, power reaper, sprinkler set, etc., for mechanizing farming operations.

3) To set up more township farm mechanization promotion centers and strengthen the existing ones: The existing township farm mechanization promotion centers will be strengthened, and 30 more such centers are to be established according to the 4-year plan by recruiting more qualified technicians and providing more facilities for servicing different kinds of farm machines. Meanwhile, efforts are to be made to fully utilize the existing machines and train more farmer operators.

4) To strengthen research work and train more farm machinery research workers: The research work can only be strengthened through recruitment of more qualified research workers and installation of more research facilities at universities engaging in farm machinery research, agricultural research institutions and district agricultural improvement stations. It is planned that about 80 technicians or research workers are to be sent abroad or to local universities for advanced study or short course training in the immediate future.

5) To initiate a pilot project for promotion of modernized agriculture in selected areas: Through this project the feasibility of large-scale mechanized farming in a co-operative manner can be determined for future agricultural development in Taiwan.

### Discussion

**N. Kawamura, Japan:** What type of machine is suitable for rice harvesting in your country? And how do you promote the mechanization of harvesting rice and other crops?

**Answer;** For the present time, the combination use of power reapers and power threshers may be one of the most economical methods. However, owing to the progress of land consolidation, larger combined harvesters may be adapted for local farmers in future.

**M. Kisu, Japan:** You have referred to the requirement for strengthening the machine design on page 9. Would you mind explaining it in a little more detail?

**Answer:** Heavier soil, severe condition for custom working, different custom practices of farmers, etc. are considered as the factors in the strengthening of the machine design.

**Goh Ah Bah, Malaysia:** 1) I refer to your paper (page 11) from which it appears that there has been a substantial increase in the number of farming households in 10 years from 1959 to 1968. Could you attribute it to any special policy of the Government of Taiwan to encourage this or to other factors? 2) In page 13, you referred to the higher prices of locally made machines. Could you attribute this to the higher

production cost in Taiwan or to other factors?

**Answer:** 1) From the table on page 11, both numbers of agricultural labor and farm households have shown a considerable increase. But I think that the figure from ID card may not exactly mean the real situation. 2) A small number of farm machines and other factors caused the higher production costs and higher prices.

**P. John Zacharia, India:** 1) What is the hp range of power tillers for rice cultivation and how long is the average life of power tillers in working hours? 2) On items 1, 2, and 3 of page 13, Governmental assistance is provided to use more machines. Is the Government maintaining a mass of Ag. machinery to rent to farmers? If so, are commercial rates charged? Do repair centres started by the Government charge the same rates as the workshops of private distributors?

**Answer:** 1) The size of 14 hp power tillers is the most popular and the average life is about 8 years with the annual use of about 850 hours. 2) The Government has subsidized farmers to purchase farm machines, such as power tillers, power sprayers, threshers and other newly introduced machines. Most of the aftercare of farm machines has still been conducted by manufacturers and/or by local agents.

**Z. Kudo, Japan:** I should like to ask you about the relationship between the farm mechanization and cropping system. I learn that there is an inter-related cropping system supported by many family labors on the farms in the southern part of Taiwan. Please explain to me how to improve such a cropping system as promotes the farm mechanization.

**Answer:** The simplification of the cropping system, together with the utilization of highly efficient farm machines, is considered as one of the ways to keep the multi-cropping system in Taiwan.

**Truong, D. H., Vietnam:** Please explain the measures taken by your Government to lower the price and improve the quality of farm machines. Is it by reducing the local types or by subsidies from the Government?

**Answer:** The price of locally made farm machines is lowered through mass production; the Government has subsidized farmers to enhance farm mechanization and management or has endeavored to reduce the benefit of manufacturers and sale agents.

**Soedijanto, Indonesia:** What kind of subsidy is given to farmers so that they can use more farm machines?

**Answer:** The farmers are provided with local currency to buy locally made power farm machines. For instance, the farmers who buy a 14 hp power tiller can get NT\$ 5,000.

**A. U. Khan, IRRI:** What is the reason for almost constant population of threshers in Taiwan for a period of 10 years (see the table on page 12)? Do you think that a market saturation point has been reached by threshers in Taiwan?

**Answer:** I do think that the thresher population has reached to a market saturation point in Taiwan. However, there is much room for power threshers because they will take the place of the pedal operated threshers which are still the most popular nowadays in Taiwan.

**N. Kawamura, Japan:** What is the biggest problem to solve for the mechanization of sugar cane or maize cultivation? Do you have any program to mechanize the harvesting of sugar cane or maize?

**Answer:** Mechanized harvesting for sugar cane and maize is considered one of the most important problems to be solved in Taiwan at present. We have imported several kinds of sugar cane harvesters from Australia and other countries for trial use. And we have developed a kind of maize thresher under a field test.